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Expert consultation on risk factors for introduction of infectious pathogens into fish farms

Birgit C. Oidtmann[a,*], Edmund J. Peeler[a], Mark A. Thrush[a], Angus R. Cameron[b], R. Allan Reese[a], Fiona M. Pearce[a,c], Peter Dunn[a], Trude M. Lyngstad[d], Saraya Tavornpanich[d], Edgar Brun[d], Katharina D.C. Stärk[e]

[a] Centre for Environment, Fisheries and Aquaculture Science (Cefas), Barrack Road, Weymouth, Dorset DT4 8UB, United Kingdom
[b] AusVet Animal Health Services, 140 Falls Road, Wentworth Falls 2782, NSW, Australia
[c] Ministry for Primary Industries, Pastoral House, 25 The Terrace, Wellington 6011, New Zealand
[d] Norwegian Veterinary Institute, Pb 750 Sentrum, 0106 Oslo, Norway
[e] Department of Production and Population Health, Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield AL9 7TA, United Kingdom

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ABSTRACT

An expert consultation was conducted to provide quantitative parameters required to inform risk-based surveillance of aquaculture holdings for selected infectious hazards. The hazards were four fish diseases endemic in some or several European countries: infectious salmon anaemia (ISA), viral haemorrhagic septicaemia (VHS), infectious haematopoietic necrosis (IHN), and koi herpes virus disease (KHD). Experts were asked to provide estimates for the relative importance of 5 risk themes for the hazard to be introduced into and infect susceptible fish at the destination. The 5 risk themes were: (1) live fish and egg movements; (2) exposure via water; (3) on-site processing; (4) short distance mechanical transmission and (5) distance independent mechanical transmission. The experts also provided parameter estimates for hazard transmission pathways within the themes. The expert consultation was undertaken in a 2 step approach: an online survey followed by an expert consultation meeting. The expert opinion indicated that live fish movements and exposure via water were the major relevant risk themes. Experts were recruited from several European countries and thus covered a range of farming systems. Therefore, the outputs from the expert consultation have relevance for the European context.

1. Introduction

Animal health surveillance is conducted for several objectives, including the early detection of exotic, new and emerging diseases, demonstration of freedom from infection and monitoring disease prevalence (Doherr and Audigé, 2001; Stärk et al., 2006; Oidtmann et al., 2011b; Cameron, 2012). Limited resources increase the need to improve the efficiency and effectiveness of surveillance activities. Risk-based surveillance (RBS) has the potential to increase the efficiency of resource allocation (Stärk et al., 2006).

Whereas RBS approaches have been presented for a number of terrestrial animal diseases (trichinella, brucellosis, enzootic bovine leucosis, and avian influenza (Hadorn et al., 2002; Snow et al., 2007; Alban et al., 2008)), there are fewer examples for aquatic animal diseases. However, the application of these approaches to aquatic animal health

* Corresponding author. Tel.: +44 1305 206661; fax: +44 1305 206601.
E-mail address: Birgit.Oidtmann@cefas.co.uk (B.C. Oidtmann).

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is needed to improve the efficiency of surveillance (e.g. Gustafson et al., 2010; VHSV Expert Panel and Working Group, 2010; Oidtmann et al., 2011a, 2013).

In Europe, aquaculture production businesses (APBs) producing fish to be marketed (from here on called fish farms or farms) are subject to European Council Directive 2006/88/EC on animal health requirements for aquaculture animals and their products, and on the prevention and control of certain diseases in aquatic animals (Anon., 2006, subsequently referred to as the 'Directive'). Five fish diseases are currently notifiable under the Directive: infectious salmon anaemia (ISA), viral haemorrhagic septicaemia (VHS), infectious haematopoietic necrosis (IHN), koi herpes virus disease (KHD), and epizootic haematopoietic necrosis (EHN).

The Directive requires regular farm inspections (to detect notifiable diseases, abnormal mortality and compliance with conditions of authorisation), the frequency of which should be determined by the disease status of the farm and the likelihood of pathogen introduction into and spread from the farm. Five disease categories (not to be confused with risk categories) for countries, zones or compartments are defined by the Directive: Category I – approved pathogen-free status; Category II – not declared disease-free, but subject to a surveillance programme to achieve disease-free status; Category III – infection status is unknown; Category IV – subject to an eradication programme, and Category V – where some farms (but not necessarily all) are known to be infected. Since there are multiple notifiable fish diseases, a single farm may be in multiple disease categories, depending on the pathogen (e.g. in Category I for VHS, and Category IV for IHN).

The Directive requires that a risk-based approach is used for both disease surveillance (article 10 of the Directive) and compliance inspections (article 7). While a risk-based approach has been described in some countries for controls on food businesses (Maudoux et al., 2006; Lee et al., 2009; FAO, 2008), this approach is new in EU legislation for compliance controls of live animal holdings.

The work presented here builds on earlier work for risk ranking of fish farms: Oidtmann et al. (2011a) developed a model for risk ranking fish farms that combined information on five main risk themes to obtain an integrated risk score for individual farms. The model development included expert consultation processes. However, the authors suggested using more rigorous elicitation methods to improve estimates to parameterise the model.

Prior to the work presented here, we assessed the published literature, which showed that very little specific information was available to provide the quantitative parameters required by the risk model. We concluded that expert elicitation of parameters was required (Oidtmann et al., 2013) and conducted an expert consultation to support the parameterisation of a model for risk ranking fish farms in the EU. The parameter estimates were intended to be applicable across EU member states, to help set priorities for field visits by official inspectors for control purposes. The expert elicitation included the pathogens causing four fish diseases listed by the Directive as 'non-exotic' to Europe IHN virus (IHNV), VHS virus (VHSV), Koi Herpes Virus (KHV) and ISA virus (ISAV).

2. Material and methods

The questionnaires were designed to provide parameter estimates that would be suitable to inform risk-based surveillance for selected pathogens based on risk of pathogen introduction to fish farms. In this paper the term risk is used as defined in epidemiology to indicate probability and not as used in risk analysis where it is defined to include both probability combined with consequences.

A generic *questionnaire* was developed, covering the themes in Table 1, and adapted for the individual pathogens (see supplementary material) to take into account different exposure routes for marine or freshwater environments. Questionnaires for VHSV, IHNV, and KHV asked for estimates of pathogen transmission in the freshwater environment only and were identical except for the fish species the experts were asked to consider. The questionnaire for ISAV asked for estimates for pathogen transmission into farms in the marine environment.

The *first round of consultation* was achieved by an online survey. The questionnaire was piloted with three experts whose first language was not English and minor modifications were made to make the questions clearer. Participants who were experts for more than one pathogen were invited to complete more than one questionnaire (e.g. most experts for VHS were also experts for IHN). Before completing the online survey, experts had been briefed on the context of the questionnaire to clarify the approach and ensure a common understanding of the questions. This was done by explaining in an email the purpose of the expert consultation and the concept of the hypothetical country (see below); a pdf copy of the questionnaire was provided. This was followed by a pre-arranged phone call to explain again the purpose of the expert consultation and the concept of the hypothetical country and to clarify any questions the experts may have had after going through the questionnaire. The link to the online questionnaire was sent to them following the phone call.

The VHS questionnaire is shown in Appendix 1. Experts were asked to imagine a hypothetical country in Europe with 2000 farm sites,[1] where the specified pathogen was present at a stated between-farm site level prevalence. Maps of the four scenarios were presented to the experts. The scenarios were: (1) 2% prevalence across the whole country; (2) 5% prevalence across the whole country; (3) and (4) assumed approved disease-free (i.e. Category I) zones within the country, but outside these zones farm site-level prevalence of 2 or 5%, respectively. The two different prevalence levels (2 or 5%) were used to explore whether prevalence influenced experts' responses.

The questionnaire was structured in 2 parts: part 1 aimed to allocate relative weights to the 5 risk themes for each scenario. This was achieved indirectly by asking the experts to imagine that 100 farm sites would become infected with the particular pathogen and to indicate how many of these sites had been infected via pathways in five risk themes over a 12-month period. They were asked to

[1] In the questionnaire, the term farm site (rather than farm) was used (farms can consist of multiple farm sites).

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