"Eyes wide shut " A critical view of aquaculture health management and risk factors in the "real world"

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Few aquatic animal diseases have been modelled sufficiently thoroughly to enable a credible risk assessment to be carried out – and few aquaculture management models can reliably ensure that satisfactory health status is maintained in farmed fish or shellfish stocks. However, a century of experience has told us a story – of diseases on the move, and about the ways they travel.

In spite of all the historical information at our disposal, all our knowledge and all our common sense, we still experience that severe diseases are spread. We suggest that the risk of spreading diseases cannot be completely eliminated, but to a great extent we should be able to choose the level of risk we are willing to accept. We can draw up three rough levels of risk:

Low risk, with no long-distance movements of aquaculture organisms, or highly restricted movements. Autonomous supply of juveniles in each body of water. High level of control and monitoring.

Medium risk. Regional models (based on zoning), with controlled movements. Regular monitoring of the most fatal diseases.

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High risk. Free movements. Low level of control and surveillance. Restrictions based on diagnostics in case of disease outbreaks.

Long-distance movements of aquaculture organisms are still common. Thus, in spite of a long history of aquatic animal diseases - and a high level of knowledge - European aquaculture still accepts a relatively high level of risk. The mismatch between available knowledge, the level of precautions taken and the risk of financial losses due to disease is mainly due to the principle of free trade and the problem of defining an acceptable level of restrictions.

This may partly be explained by the fact that aquaculture is mainly administrated by economists – who often lack knowledge of disease ecology, and thus of the dynamics of disease dispersion. Moving animals, like any other goods, may appear to be acceptable in short-term economic models. There is often a conflict of interest between the short-term financial interest of companies, large or small, and the "eternal", or sustainable perspective on aquaculture management that governmental agencies should take. We suggest that the public debate on aquaculture would benefit by recognising the very existence of this conflict of interest.

Where the movement of animals for farming purposes is concerned, the international and national regulations in Europe are based in principle upon EU Directive 91/67. An understanding of this directive is thus essential for all aquaculture health management and surveillance. The directive is based upon some important principles:

Fish and shellfish diseases are graded and listed according to their severity and distribution. Health management strategy depends on whether or not the diseases concerned are notifiable.

Movements are only allowed between defined geographical zones with a similar zoosanitary status, or from a disease-free zone to an infected zone – of course never from an infected to a disease-free zone.

Action is taken if a notifiable disease is diagnosed. National and international veterinary authorities are notified, and measures are taken to isolate or eradicate the disease.

The legislation is based upon the establishment of national surveillance programmes that are intended to ensure that notifiable diseases are not spread, and – if possible - eradicated.

The differences between the "paper world" and the "real world" remind us that nature is more complex than the directive – and encourage us to put a special focus on some problems related to real risk factors.

The system of notifiable diseases is both important and useful. However, the strategy of notifying the diseases relies on the disease situation of the past and present, and is not well adapted to the future situation. Monitoring and disease control based on this principle do not necessarily capture "new" or emerging diseases satisfactorily. Furthermore, the diagnostic work involved is both expensive and laborious, with the results that monitoring programmes may be limited, in order to save money. We may also lack basic

data from relevant production areas or from wild populations. The conclusion is that mapping of animal diseases is never complete, and the diagnostics are always behind the spread of the pathogen.

According to the World Organisation for Animal Health (OIE), a disease is not present in an area if there are no susceptible species. This seems logical – if we know the life cycles of the pathogenic agents and are familiar with all the susceptible hosts, latent carriers, dispersal routes, vectors, etc. But we do not! Movement of the primary host is not the only dispersal route for pathogenic agents. Anything placed in the sea is bound to come into contact with the surrounding fauna, and diseases may spread by the movement of vectors, latent carriers or contaminated water (e.g. ballast-water). Studies of dispersal routes are important, and we need to acquire information about interactions between wild and cultured animals. The principle is thus acceptable only as long as we are successful in elucidating the numerous aspects of disease ecology.

A positive diagnosis leads to restrictions in or elimination of production, which may result in financial loss to farmers. Several diseases are therefore underdiagnosed, due to the fact that we neither know nor *want to* know. The conflict of interest between short-term financial interests and sustainability adds greatly to this effect. From the point of view of a government body the long-term public interest in surveillance programmes should be prioritised. It is unacceptable in the long term to rely solely on disease prevention actions of companies that operate primarily in the world of short-term interests.

The diagnostic question is very important. In general, diagnostic methods have been designed to detect outbreaks of disease, and sampling is usually done following observations of clinical signs or pathology. In the case of an outbreak, the diagnostic methods in use do not have to be particularly sensitive, as the pathogen will be present in large numbers. A positive diagnosis may result in counter-measures such as eradication of affected stocks and the establishment of a zoosanitary zone. However, there are some serious concerns regarding management and control based on the number of outbreaks of a disease. Movement of latent or asymptomatic carriers is probably one of the most important risk factors in the spread of many diseases - particularly diseases that are transmitted vertically. The transport of fish with unknown carrier status for important pathogens such as infectious salmon anaemia virus (ISAV) (Nylund et al 2003), nodavirus (Munday et al 2002), and possibly also infectious pancreatic necrosis virus (IPNV) and the alphavirus causing pancreas disease has probably contributed to the distribution of these viruses in farmed populations. Here, our lack of knowledge about carrier status, virulence mechanisms and the mechanisms that trigger outbreaks of disease illustrates the limitations of traditional diagnostic surveillance programmes.

The medium-risk ("zoning") model may have two dark sides. One is the danger of introducing pathogenic agents if lack of epizootiological data results in down-classification, resulting in introductions of disease-carrying animals. The other is the principle of defining an entire national coast

as a single zone if it is free from notifiable pathogenic agents. Large zones mean free movements with in large areas – which offer a low level of security if a pathogenic agent is introduced – or if it is present in carriers that are being moved over long distances. If an aquaculture species has no known (or notifiable) pathogens, there will be no zoning at all – meaning free trade (Mortensen 2000).

Some potential "hot spots" in the dispersal pattern of aquatic animal diseases tend to be ignored or are given low priority – increasing the risk of rapid dispersal of emerging diseases. Hatcheries, trade and dispersal centres for fish and shellfish are epizootiological "crossroads" which should be underlaid special surveillance and control. A relevant example is bivalve hatcheries. There are only about ten such hatcheries in Europe. A joint monitoring programme is achievable . . . if we wish to.

Food and aquaculture animals are subject to different legislation (Anon 1991 a & b). The transport of live aquaculture organisms must be more rigidly controlled than food items, but movements of any live or fresh fish and shellfish may bring the risk of introducing their pathogenic agents as well. In this context, relaying of live crustaceans and bivalves produces the highest level of risk.

Given these examples, disease monitoring and surveillance systems based on Directive 91/67 are generally speaking not very proactive. From a "third country" point of view, implementing Directive 91/67 might have represented a retrograde step from a "low risk" to a "high risk" situation. On the other hand, some improvements have been made:

One process is taking place in the industry itself – which has suffered severe losses due to diseases. Local production networks are emerging, based on quality-controlled production chains restricted to geographically defined areas. Self-supply of juveniles is crucial.

Collaboration and networking seem to be improving, linking the industry with management and veterinary services, and ensuring a better flow of information. Expertise becomes better available through professional networks, (such as the Permanent Advisory Network for Diseases in Aquaculture (PANDA), international collaborative research projects and reference laboratory networks.

New projects are being generated with the aim of making more use of scientific data in health management and surveillance, at both national and international level. The EU-financed collaboration network project DIPNET aims at improving our knowledge on the interaction between wild and farmed fish and shellfish.

There is an increasing focus on risk-based monitoring. According to the EU's central veterinary authority, all farms rearing bivalve molluscs and fish susceptible to list I and II-diseases will have to be registered by the competent authority. Disease prevention measures will have to be established, animal health monitoring procedures should be based on a risk assessment and any *suspicion* of listed diseases must be reported by the competent authority to EU.

Quality assurance models are being implemented in diagnostic laboratories, and the reference laboratories are aiming to obtain adequate QA programmes in all networking laboratories, through training of personnel, workshops, etc. However it is important to remember that QAis of limited value if samples are collected at the wrong locations.

The main improvement may be the proposal for the new "Council Directive on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals" (Anon, 2005), with which the Commission aims to shift focus to the prevention of disease rather than dealing with it only when an outbreak has occurred.

Until the new Directive is implemented, we who work on various aspects of fish and shellfish diseases all need to ask ourselves the question "Why should I care?" . . . We must expect all personnel – in all positions – to be competent, and there is thus no excuse for saying "We didn't know" - unless we actually wish to sit down and wait - take the risk - with our eyes wide shut . . .

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