

Aquatic animal health surveillance and disease control system in Bosnia and Herzegovina

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ABSTRACT

The officially permitted export of aquaculture products from Bosnia and Herzegovina (BiH) to the demanding European Union (EU) market is the most important success of Bosnian and Herzegovinian agriculture in the post-war period. However, this breakthrough demands ongoing activities by all Bosnian competent authorities (CAs) and other stakeholders involved in aquaculture aimed toward sustainable export. The key issue for international recognition of the country's aquaculture production is the development and maintenance of an adequate aquatic animal health surveillance and disease control system. The current system, which reflects the complex political structure of Bosnia and Herzegovina, involves multilevel CAs. Additionally, shortcomings in communication, a lack of clearly defined responsibilities among CAs and an absence of use of standardized forms for collection, collation and analysis of disease surveillance and fishfarm registration data are inadequacies of the system. Some concrete and relatively unchallenging activities have been recommended to overcome these obstacles. A primary measure is the establishment and coordination of the Expert Panel for Aquaculture (EPA) by the State Veterinary Office (SVO) of Bosnia and Herzegovina, which should be a leader and coordinator of other recommended activities aimed toward strengthening the national aquatic animal health surveillance and disease control system as a crucial element for improving national aquaculture production.

INTRODUCTION

Bosnia and Herzegovina has a more than century-long tradition of aquaculture of freshwater fish species that dates back to the early Austrian-Hungarian occupation. During the 1992–1995 war, most of the production facilities were destroyed. In the post-war period, the aquaculture sector was renewed, and modern fish processing facilities were established. The most important cultured species are salmonids (e.g. rainbow trout, brown trout and grayling), while the principal cultured cyprinid species is common carp.

The economic and societal potential of the aquaculture sector has been officially recognized in Bosnia and Herzegovina due to its ability to generate cash income and foreign exchange, mitigating poverty, increasing the employment rate and fostering rural development, which results in strong support from the State Veterinary Office of Bosnia and Herzegovina (SVO) to the improvement of the sector.

Bosnia and Herzegovina is currently in the process of signing the Stabilization and Association Agreement (SAA) with the European Union (EU). While a full EU membership represents the only possible way to stabilization and improvement of the Bosnian and Herzegovinian economy and society, it also poses the great challenge of fulfilling the numerous EU requirements in various fields. One of the greatest challenges is to meet EU criteria in the field of agriculture production, particularly in aquaculture. Given that aquaculture is the only sector of agricultural production in Bosnia and Herzegovina that has already obtained an export licence to the EU market, establishment of an effective national aquatic animal health surveillance and disease control system represents an imperative for sustainable and internationally recognizable aquaculture production in the country and maintenance of its current permission to export to the EU market.

CURRENT AQUATIC ANIMAL HEALTH SURVEILLANCE AND DISEASE CONTROL SYSTEM IN BOSNIA AND HERZEGOVINA

Administrative organization of Bosnia and Herzegovina as a basis for an aquatic animal health surveillance and disease control system

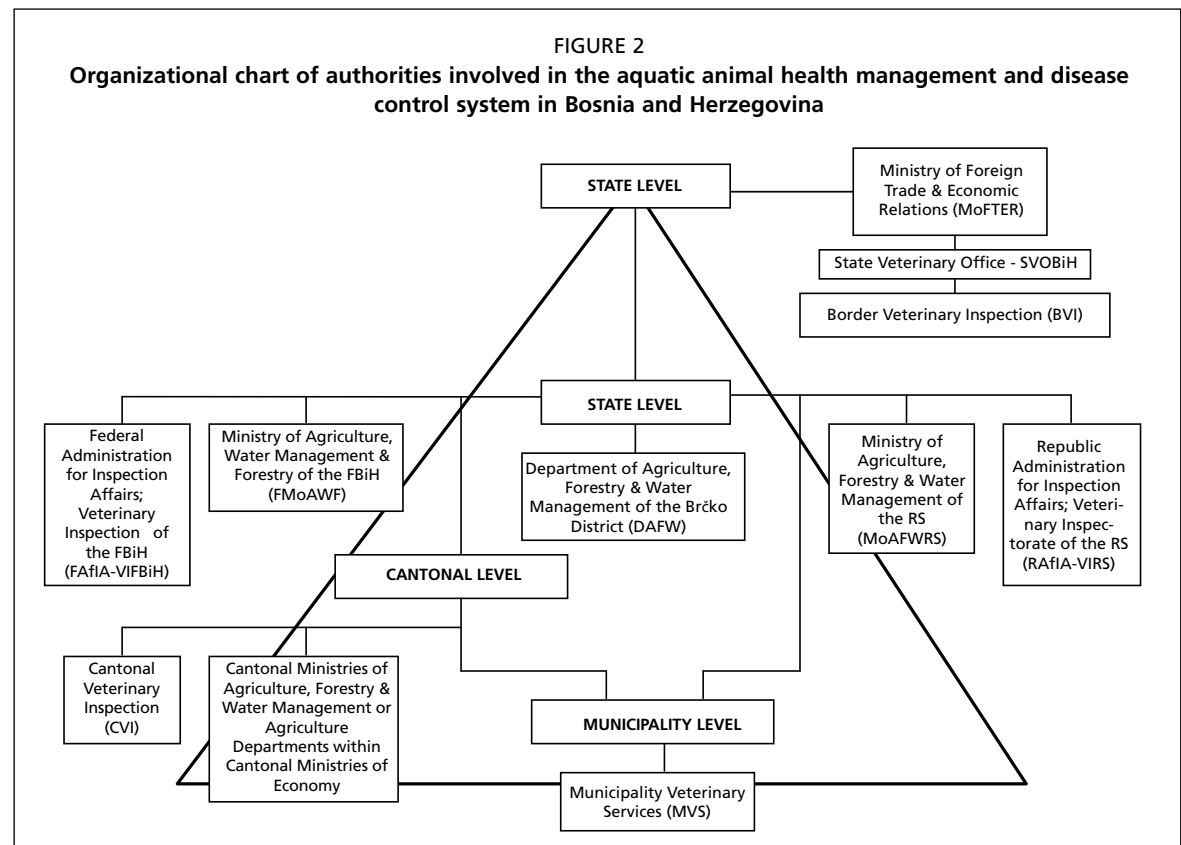
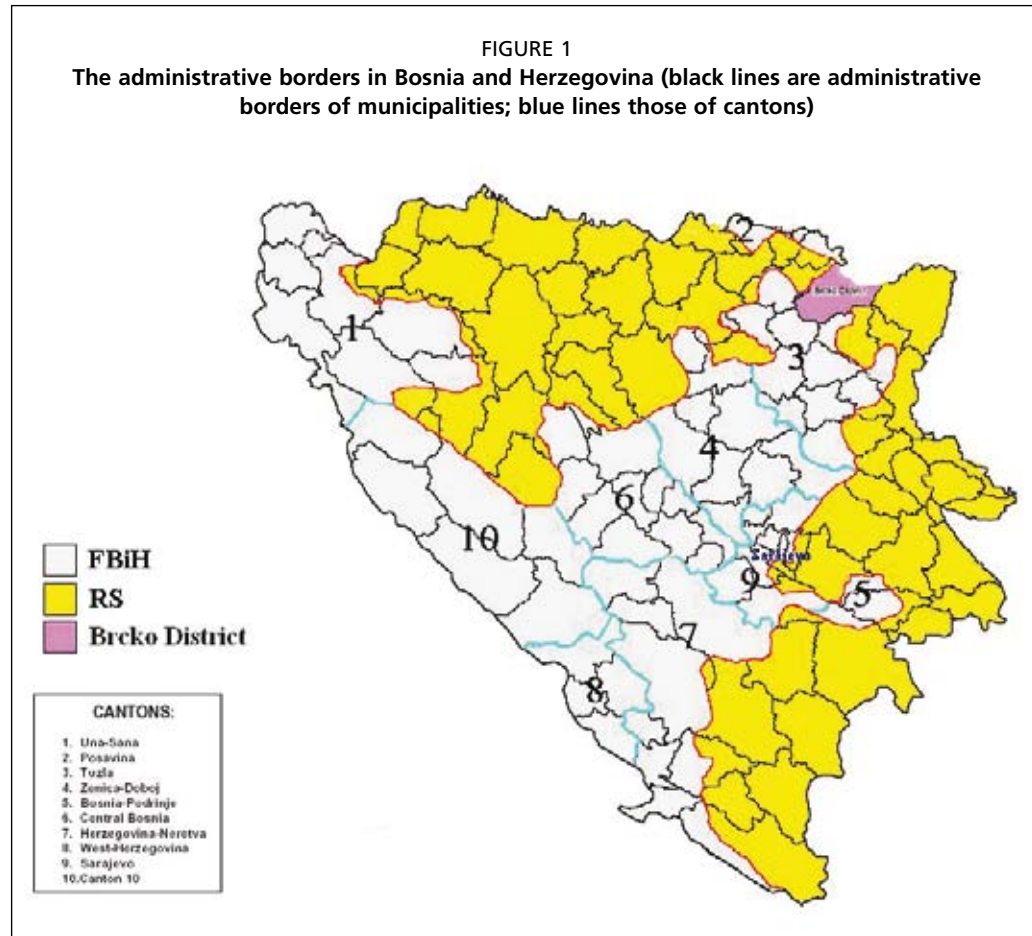
After the disintegration of the former Yugoslavia and the declaration of its independence in 1991, Bosnia and Herzegovina faced a devastating war that was ended by the signing the Dayton Peace Agreement in December 1995. The Agreement defined the current administrative organization of Bosnia and Herzegovina and enforced division of Bosnia and Herzegovina into two entities (administrative units), the Federation of Bosnia and Herzegovina (FBiH) and the Republic of Srpska (RS) and one internationally supervised district, the Brcko District (BD), as an administrative unit under the sovereignty of Bosnia and Herzegovina. The entities retain a large degree of autonomy from the central government, which is dependent upon them for most of its budget. Furthermore, the Federation of Bosnia and Herzegovina is divided into ten cantons as administrative units that also have political and financial autonomy from the central and entity governments to a great extent. Moreover, each of the ten cantons in the Federation of Bosnia and Herzegovina, as well as the whole RS, is divided into municipalities. In addition, the Agreement also established the Office of the High Representative to supervise the implementation of the Agreement. Figure 1 shows the administrative borders in Bosnia and Herzegovina.

Organizational framework of aquatic animal health management and disease control system

The specific political organization of Bosnia and Herzegovina is reflected in a multi-level structure of authorities responsible for planning, realization and supervision of the national aquatic animal health management and disease control system (Figure 2). The following authorities and are engaged in the system:

State level

- *Ministry for Foreign Trade and Economic Relations (MoFTER) of the Council of Ministers of Bosnia and Herzegovina* – With regard to the aquatic animal health management and disease control system, the MoFTER is responsible for the development of basic legislation in the veterinary, phytosanitary, quality control and food safety areas, as well as for establishment of institutions that are directly responsible for its implementation. Due to the adoption of the Inspection Laws



(*Law on Inspections in the Federation of Bosnia and Herzegovina* [OJ of FBiH, 69/05]; *RS Law on Inspections* [OJ of RS, 113/05]) at the entities level, most of the inspection services performed by the ministries responsible for the above named areas now seem to be eliminated from the scope of their activities.

- *State Veterinary Office of Bosnia and Herzegovina (SVO)*: Under the MoFTER jurisdiction, the SVO acts as the Central Competent Authority (CCA) at the state level. Its major competencies, duties and authorities are defined by the State Veterinary Law (*Veterinary Law of Bosnia and Herzegovina* (OJ of BiH, 34/02). From the aspect of the aquatic animal health management and disease control system in Bosnia and Herzegovina, the SVO, alone or in cooperation with the entity and the DB competent authorities (CAs), is charged with the following duties:
 - Drafting proposals of veterinary legislation, which then go to the MoFTER and the Council of Ministries of Bosnia and Herzegovina and to parliamentary procedure.
 - Issuance of veterinary health certificates (licences) and import licenses.
 - Border Veterinary Inspection (BVI) – the Veterinary Inspection Department is an integral part of the SVO. It is also in charge of animal identification and movement controls through the Agency for Animal Identification and Movement Control located in Banja Luka (RS).
 - Drafting the disease surveillance programmes.
 - Monitoring of animal infectious diseases within the national territory and abroad and informing all interested parties in Bosnia and Herzegovina and abroad (in cooperation with the entity and the DB CAs).
 - Coordinating and supervising the zoning process in Bosnia and Herzegovina aquaculture.
 - Cooperating with the relevant EU authorities and other international organizations.
 - Cooperating with and informing state veterinary offices of other states.
 - Adopting working programmes and implementing control and prevention measures for animal infectious diseases and epidemics.
 - Monitoring and analysis of Bosnia and Herzegovina’s veterinary epidemiological situation in accordance with criteria of the World Organisation for Animal Health (OIE) and the EU, and with Bosnia and Herzegovina’s animal health protection programme.
 - Managing legally imposed databases and publishing monthly reports on the occurrence of infectious diseases in Bosnia and Herzegovina.
 - Reporting to the OIE and to all interested parties in Bosnia and Herzegovina and abroad on the current epidemiological situation with regard to animal infectious diseases and related disease management activities and measures.
 - Assuring the linkage of veterinary databases in a unique Bosnia and Herzegovina veterinary information system and its connection to international veterinary information systems.
 - Operating reference veterinary diagnostic laboratories.
 - All other issues related to international trade of live animals and products of animal origin, and the veterinary health conditions in the establishments.

Entity level – Federation of Bosnia and Herzegovina

The Federal Ministry of Agriculture, Water Management and Forestry (FMoAWF), with its Veterinary Sector – Section for Animal Health Protection, is responsible for the implementation of state-level legislation. In addition, they have a right to enforce vertical legislation to regulate issues that are not addressed or précised by the state legislation. In the field of animal health protection, this CA has the following main duties and responsibilities (*Veterinary Law of FBiH* [OJ of FBiH, 46/00]):

- Animal health protection and human protection from zoonoses.
- Epidemiological investigations of infectious and parasitic disease outbreaks.
- Collecting and analyzing epidemiological data on the occurrence of infectious and parasitic diseases in the Federation of Bosnia and Herzegovina and collaboration with CCA and other CAs.
- Designing emergency response plans in cases of occurrence of especially dangerous infectious diseases.
- Proposing and organising teams for the implementation of measures for control and eradication of diseases.
- Establishing and maintaining the animal disease and health status database.
- Designing annual plans for disease monitoring and control.
- Planning and financing the implementation of control measures for infectious and parasitic diseases.
- Developing programmes for the detection, control, eradication and prevention of infectious and parasitic diseases and zoonoses in accordance with the current epidemiological situation.
- Defining veterinary, health and hygienic conditions for animal keeping and production.
- Auditing and registering establishments for animal production and maintaining the register of approved establishments.

The Veterinary Inspectorate of the Federation of Bosnia and Herzegovina (VIFBiH) is under the jurisdiction of the Federal Administration for Inspection Affairs in the Federation of Bosnia and Herzegovina (FAfIA) and both supervises and cooperates closely with the cantonal inspection authorities. Authorities for the overall inspection supervision on the entity level were established as independent administrative organizations for inspection affairs in 2006 under the *Law on Inspections in the Federation of Bosnia and Herzegovina* (OJ of FBiH, 69/05) and the *Law on Inspections in the RS* (OJ of RS, 113/05). Supervision of the operation of these inspections is performed by the entity governments. Consequently, the entity ministries of agriculture may not perform a direct supervision of their operations. Entity Veterinary Inspection (EVI) is responsible for the implementation of fish inspection with regard to enforcement of health monitoring and surveillance, food safety, facility standards and movement of aquatic animals and products thereof. Post-border veterinary inspection supervision is the responsibility of the above inspectors, except in the case of veterinary inspection organized at the state level. In addition, they follow-up registered establishments for animal production, perform on-site inspections, do daily updates if disease outbreaks occur, etc.

Entity level – Republic of Srpska

The Ministry of Agriculture, Forestry and Water Management of Republic of Srpska (MoAFWRS) and its Veterinary Department has similar authorities and duties as the FMOAWF as outlined in the *Law on Animal Health Protection and Veterinary Duties in RS* (OJ of RS, 11/95). The Veterinary Inspectorate of Republic of Srpska (VIRS) is a division of the Republic Administration for Inspection Affairs in RS (RAfIA). Its authorities and duties are similar to those of the FAfIA – VIFBiH. For veterinary purposes, RS is divided into six regions, each of which having been assigned a veterinary inspector.

Entity level – Brcko District

The Brcko District (BD), as an autonomous and internationally supervised part of Bosnia and Herzegovina territory, has its own government with different departments. Agriculture policy of BD is governed by the Department of Agriculture, Forestry and Water Management (DAFW), where the Veterinary Section is responsible for all

veterinary issues. Its duties and authorities are similar to those of entity ministries of agriculture. Veterinary Inspection in BD is under the jurisdiction of the Department of Public Security and has responsibilities and duties similar to VIFBiH and VIRS. Based on information given by SVO officials, there are no registered establishments for aquaculture in BD.

Cantonal level

From an organizational aspect, the development and implementation of agriculture policy is not identically addressed in all ten cantons of the Federation of Bosnia and Herzegovina. In six cantons, Cantonal Ministries for Agriculture, Forestry and Water Management exist within cantonal governments, while in the other four cantons there are only Agriculture Departments within the Cantonal Ministries of Economy. Their corresponding responsibilities and duties are similar to those of entity-level authorities. Their activity is supervised by the cantonal government and by the FMoAWF. They are obliged to monitor the epidemiological situation on their territory and to submit timely reports thereof to the FMoAWF (*Veterinary Law of F BiH* [OJ of FBiH, 46/00]).

Cantonal Veterinary Inspections (CVI) have duties and authorities within their respective territories similar to those of VIFBiH, and they are supervised in parallel by cantonal governments and the VIFBiH. It is important to emphasize that the cantonal veterinary inspectors are officials that bear full responsibility for the performance of official health control and the epidemiological situation in all registered fish farms, since they are personally designated by the entity CAs (following geographical and political criteria of jurisdiction) to one or more fish farms as the responsible veterinary inspector for the specific farm/zone. In some instances in FBiH, this responsibility is assigned to the federal veterinary inspectors, who are employees of the FAfIA – VIFBiH.

Municipality level

Municipality Veterinary Services (MVS) are responsible for the primary animal health protection, as well as for implementation of measures for prevention of infectious diseases, collection and distribution of specimens to authorized diagnostic laboratories in cases of suspicion on occurrence of infectious diseases and the mandatory notification of occurrence of infectious diseases. All MVS in RS are privatized, while those in the Federation of Bosnia and Herzegovina are either public or in the process of privatization. Some municipalities in the RS do not have an official inspector, and the task has been contracted by tender to a private-sector veterinarian who acts as “official veterinarian”.

CHARACTERISTICS AND PERFORMANCE OF THE AQUATIC ANIMAL HEALTH SURVEILLANCE AND DISEASE CONTROL SYSTEM IN BOSNIA AND HERZEGOVINA

Many different definitions of passive, active and targeted types of surveillance may be found in the literature. For the purpose of this paper, the definitions stated in the relevant EU regulation are used (*Reg. 2006/88/EC on animal health requirements for aquaculture animals and products thereof, and on prevention and control of certain diseases in aquatic animals* [OJ L 328]:

- **Passive surveillance** shall include mandatory immediate notification of the occurrence or suspicion of specified diseases or of any increased mortalities. In such cases epidemiological investigations shall be required (described in other sections of the regulation).
- **Active surveillance** shall include:
 - a) routine inspection by the CA or by other qualified health services on behalf of the CAs;
 - b) examination of the aquaculture animal population on the farm for clinical disease;

- c) diagnostic samples to be collected on suspicion of a listed disease or observed increased mortality during inspection;
- d) mandatory immediate notification of occurrence of specified diseases or of any increased mortalities.
- **Targeted surveillance** shall include:
 - a) routine inspection by the CA or by other qualified health services on behalf of the CAs;
 - b) prescribed samples of aquaculture animals to be taken and tested for specific pathogen(s) by specified methods;
 - c) mandatory immediate notification of occurrence of specified diseases or of any increased mortalities.

The Bosnia and Herzegovina aquatic animal health surveillance programme includes all these types of surveillance.

Passive and active aquatic animal health surveillance

According to the provisions of the *Veterinary Law of Bosnia and Herzegovina* (OJ of BiH, 34/02) and the provisions of the *Decision on the Infectious Diseases of Animals* (OJ of BiH, 44/03), as well as of the provisions of the *Decision on Veterinary-health Conditions which have to be Fulfilled in Premises for Farming, Production and Trading of Fish and Products Thereof, and of Crustaceans and Products Thereof* (OJ of BiH, 5/04), mandatory notification of any unusual change in animal health status and/or of any increased mortality to the CAs is required. Thus a sufficient general legal framework for passive surveillance of aquaculture animal health is in place.

The current national list of the aquaculture animal diseases that require mandatory notification and implementation of general and special preventive, control and eradication measures is based on previous OIE criteria for listing animal diseases (the A, B and C list approach). This list is defined through provisions of the *Decision on the Infectious Diseases of Animals* (OJ of BiH, 44/03) and it is presented in Table 1.

In addition, Decision OJ of BiH, 44/03 also prescribes the notification procedure in the case of suspicion of the occurrence of a listed disease. The notification procedure in the case of viral haemorrhagic septicaemia (VHS), spring viraemia of carp (SVC) and infectious haematopoietic necrosis (IHN) is the following:

- The Decision requires that the owners, farmers and all the other stakeholders operating with live fish are obligated to notify the nearest Municipality Veterinary Service (MVS) upon suspicion of the occurrence of any disease, which logically includes notification of the occurrence of any increased mortality.
- MVS alerts the responsible veterinary inspector and undertakes all necessary measures to prevent spread of the disease until arrival of the inspector.

TABLE 1

Aquaculture animal diseases that require mandatory notification and contingency planning for implementation of general and special preventive, control and eradication measures in Bosnia and Herzegovina

Fish diseases	Molluscan and crustacean diseases
Viral haemorrhagic septicaemia (VHS) ¹	Bonamiosis
Spring viraemia of carp (SVC) ¹	Haplosporidiosis (<i>Haplosporidium nelsoni</i> or <i>H. costale</i>)
Infectious haematopoietic necrosis (IHN) ^{1, 2}	Perkinsosis
Epizootic haematopoietic necrosis (EHN)	Marteiliosis
<i>Oncorhynchus masou</i> virus disease (OMVD)	Iridovirosis
	Mikrocytosis (<i>Mikrocytos mackini</i>)
	Taura syndrome
	White spot disease
	Yellowhead disease

¹ Disease for which immediate notification is mandatory.

² Disease for which immediate international notification is mandatory.

- The inspector collects the specimens, undertakes all the legal measures to prevent spread of the disease and sends the samples to an authorized diagnostic laboratory.
- The laboratory notifies the inspector of the diagnostic results by telephone, fax and/or e-mail, and the inspector further informs the respective entity CAs (ministries of agriculture, forestry and water management).
- In the case of occurrence of a primary outbreak of the above diseases, it is obligatory for the laboratory to notify both the respective entity CA and CCA (SVO) by telephone, fax and/or e-mail.

In the case of an occurrence of any of the other diseases listed in Table 1, the notification procedure requires MVS to notify the responsible veterinary inspector as soon as the disease has been confirmed by the required diagnostic methods.

Besides the emergency notification procedure mentioned above, the Decision also defines the timing and hierarchy of regular reporting on disease occurrence as the basis for both passive and active surveillance:

- The authorized laboratories are required to submit regular monthly comprehensive reports to the respective CA and CCA on the results of all diagnostic examinations undertaken during the past month until the 15th day of the current month. The means of reporting are by printed report or e-mail. In addition, the laboratories are required to send the results of diagnostic testing to the responsible veterinary inspector, as well as to the sender of the specimen.
- The entity CAs are obligated to submit regular monthly reports on the past-month occurrence of the diseases listed in Table 1 to the CCA until the 10th day of the current month.
- Mandatory immediate international notification is enforced only for IHN; it is the responsibility of the CCA (SVO) to report to the OIE, the European Community (EC) and the SVOs of neighbouring countries.

Permanent official inspection supervision of the aquaculture establishments, as the other requirement for an acceptable active surveillance programme, is also met in the Bosnia and Herzegovina aquaculture sector. Based on the provisions of the *Veterinary Law of Bosnia and Herzegovina* (OJ of BiH, 34/02), all registered fish farms, as well as those in the process of initial registration or revision of registration, are under the constant inspection control of appointed official veterinary inspectors, who are employed by municipal (RS) or cantonal CAs (FBiH) or by the entity veterinary inspection services (VIFBiH and VIRS). Appointment of the inspectors was done based on the geographical distribution of the fish farms and the geographically based jurisdiction of each CA. According to the provisions of the *Veterinary Law of Bosnia and Herzegovina*, one of the main responsibilities of each veterinary inspector is to send comprehensive monthly reports to the supreme-level authority. Also, according to the legal provisions, supervision of municipality (RS) and cantonal (FBiH) veterinary inspectors by the entity-level veterinary inspection (VIFBiH and VIRS) is also enforced. Besides the regular health surveillance of the farms by the appointed veterinary inspectors, inspection of all aquaculture establishments registered for export by SVO officials is also required by the *Decision on Veterinary-health Conditions which have to be Fulfilled in Premises for Farming, Production and Trading of Fish and Products Thereof, and of Crustaceans and Products Thereof* (OJ of BiH, 5/04) and the *Decision on Conditions which have to be Fulfilled by the Establishments Intended for Slaughter of the Animals, Processing, Refining and Storing of the Products of Animal Origin* [OJ of BiH, 27/05]). Finally, according to the provisions of the *Veterinary Law of Bosnia and Herzegovina*, during any kind of official inspection, every inspector (municipal, cantonal, entity or CCA officials) is allowed and encouraged to collect as many samples as necessary if any suspicion of any disease or animal health disorder exists.

The requirement for an adequate active surveillance programme for aquatic animal health also includes on-farm examination of cultured animal populations for evidence of clinical disease, which also implies compulsory regular self-checking of aquatic animal health status on farms. This requirement is legally defined in the provisions of the above mentioned legislation, as well as in the *Decision on Implementation of the Compulsory Measures in Approved Establishments with Regard to the Reduction of Microbiological and Other Contaminations of the Meat, Meat Products and Other Products of Animal Origin Intended for Human Consumption* (OJ of BiH, 8/05, last amended 33/07), where is specified that, concerning the obligation of the owners to maintain good animal health and in order to ensure production of food safe for human consumption, it is mandatory for all establishments registered for aquaculture production to perform regular self-check controls of aquatic animal health status on farms. Such controls are realized through contracting the laboratories authorized for animal health diagnostics (six laboratories are specified by the *Decision on Conditions which must be Fulfilled by the Authorized Veterinary Laboratories* (OJ of BiH, 25/04, last amended 16/05). The personnel of these laboratories perform sampling of the respective animal population, on-site clinical examination of the fish population, clinical laboratory-based examination of samples and, if necessary, further diagnostic examinations to identify pathogens. On the other hand, oversight of these self-check results by the appointed veterinary inspectors is mandatory during their regular inspections. Results of such self-check samplings and laboratory analyses constitute valuable data needed for active aquatic animal health surveillance in Bosnia and Herzegovina.

According to information provided by the SVO, the officials of entity CAs, the designated veterinary inspectors responsible for health inspection of fish farms, and by Dr Adnan Jazic, Dr Jasmin Omeragić and other personnel of the DAVFS, no case of mass, increased or unusual mortality in Bosnia and Herzegovina fish populations has ever been observed or reported by either passive or active (including targeted) surveillance in the post-war period. This situation argues in favor of a good quality of fish and fish products, as well as of an epidemiologically acceptable health situation in the fish populations in Bosnia and Herzegovina.

Contingency planning and emergency response

The *Decision on the Infectious Diseases of Animals* (OJ of BiH, 44/03) specifies the list of animal infectious diseases for which emergency preparedness plans should be prepared. None of the diseases listed in Table 1 is included in the list of diseases that require the advance planning of emergency preparedness measures. However, the same Decision also indicates that for all the other infectious diseases (including the diseases listed in Table 1) the design and implementation of emergency preparedness measures depend on the epidemiological situation, which implies that contingency planning and emergency preparedness measures will be designed and implemented upon the identification of occurrence of certain diseases by the surveillance system.

The minimal elements that should be included in any disease contingency plan are as follows:

1. The means for establishing the Crisis Headquarters for disease surveillance, which leads and coordinates implementation of all the disease control measures at the state level.
2. The list of local crisis centers for disease surveillance that are properly equipped for coordination of measures for disease control at the local level.
3. A detailed list of personnel involved in implementation of disease control measures, including their educational level, expertise and responsibilities.
4. The fastest means for the local centers to contact persons and organizations that are directly or indirectly linked to the disease outbreak.

5. The availability of the equipment and other material necessary for a complete and correct implementation of the disease control measures.
6. Detailed instructions on measures and actions that must be carried out in the case of suspicion and confirmation of a disease, including the means for destruction of carcasses.
7. Organization of educational programmes concerning permanent improvement of expertise for implementation of field and management actions, which must be performed on a regular basis.
8. For diagnostic laboratories (as applicable), the space and equipment for post mortem examinations, including serological, histological and other necessary examinations, the capacity for rapid diagnostic procedures and the assurance of fast specimen delivery.
9. Information relating to the quantity of vaccines necessary in the case of implementation of emergency preventive vaccination.
10. A plan for implementation of the measures.

Mandatory epidemiological investigation of disease outbreaks

Mandatory epidemiological investigation of disease outbreaks, as an essential mechanism of the emergency response and the overall surveillance system, is generally enforced by the provisions of the *Veterinary Law of Bosnia and Herzegovina* (OJ of BiH, 34/02) on duties and responsibilities of the veterinary CAs and veterinary inspectors. In addition, this legislation ensures sufficient legal power for the SVO to issue mandatory instructions on implementation of emergency measures to the overall Bosnia and Herzegovina veterinary service in the case of any animal health emergency situation.

An example of the employment of contingency planning, emergency preparedness and response actions happened in 2004, when the presence of infectious pancreatic necrosis (IPN) virus was detected and confirmed in salmonid fish populations sampled from two river basins during the initial screening of the health status of the fish. Although the virus was not listed in the national pathogen list and no clinical cases of disease were observed, the emergency response mechanism was activated and the SVO issued the *Instruction on Implementation of Measures to Prevent the Spread of Infectious Diseases of Fish in Bosnia and Herzegovina* (SVOBiH Document No. 01-1-02-607-1/04 from July 20, 2004). This document was fully harmonized with the relevant EU legislation (*Reg. 2001/183/EC Laying Down the Sampling Plans and Diagnostic Methods for the detection of and confirmation of certain fish diseases and repealing Decision 92/532/EEC [OJ L 67]*) from the point of sampling framework and diagnostic procedures for related diseases, which served as the basis for sampling and later diagnostic aspects, as well as current targeted surveillance on viral fish diseases. During this crisis situation, the following main measures were realized:

- A Crisis Unit under the supervision and control of the SVO was established.
- Epidemiological investigation of the occurrence of the disease agent was conducted.
- A laboratory (DAVFS) responsible for developing a plan for sampling and diagnostic testing based on provisions of the relevant EU legislation was designated.
- Further testing for the presence of VHS, IPN and IHN viruses in salmonids and SVC in cyprinids was undertaken.
- Sampling was done by DAVFS personnel and responsible veterinary inspectors.
- Entity CAs established the lists of all fish farms under veterinary control with names of responsible veterinary inspectors, along with a centralized database.
- Entity chief veterinary inspectors delivered the information and data on epidemiological investigations carried out in 2004.
- DAVFS proposed control and eradication measures for the diseases based on the test results, including depopulation of infected farms and cleaning and disinfection of premises under the supervision of the responsible veterinary inspectors.

- Movement of live fish was regulated according to the health status of the fish farms of origin, based on the results of clinical and laboratory examinations.
- Timely feed-back information to responsible veterinary inspectors on the current health status of the farms and to the aquaculture stakeholders was provided by the SVO.
- Education of the veterinary inspectors was accomplished by the entity CAs.

The epidemiological investigation mentioned above included all activities needed to provide information on:

- the possible source of infection on the farm;
- the time period in which the disease was present on the farm prior to the suspicion of disease;
- a list of farms from which eggs, fry and/or live fish were introduced to the farm in question;
- in the case of imported eggs, fry and/or live fish, the country and farm of origin, place of quarantine and the type of diagnostic examination undertaken;
- all movements of live fish, eggs and/or fry from the farm;
- all movements of live fish, eggs, and/or fry to the farm;
- all movements of vehicles, equipment, raw materials and persons that could act as possible vectors of the virus in or out of the farm; and
- the possibility of transfer of the disease via other carriers of the virus.

The above information indicates that the legal and organizational capabilities of the aquaculture CAs are adequate to timely and effectively implement contingency planning and an emergency response mechanism in the case of an outbreak of aquatic animal disease.

Targeted surveillance of viral fish diseases

Implementation of targeted surveillance for fish viral diseases is legally based on provisions of the annually enforced *Decisions on Measures of Control of Infectious and Parasite Diseases of Animals and their Implementation and Financing*, and it is specified for all fish farms and for wild fish populations living in open waters.

Decisions regarding the inclusion of certain diseases in the surveillance programme are based on the results obtained from the overall surveillance programme, the current epidemiological situation for aquatic animal health and the provisions of the *Decision on Veterinary Health Conditions that must be Fulfilled when Putting into Trade Live Fish, Mollusks, and Crustaceans and Products Thereof* (OJ of BiH, 62/05), which is harmonized with the EU legislation (*Reg. 91/67/EEC Concerning the Animal Health Conditions Governing the Placing on the Market of Aquaculture Animals and Products Thereof* (OJ L 46), last amended 806/2003/EZ [OJ L 122]) and the OIE *Aquatic Animal Health Code* that were in effect at the time of its enactment. The list of aquatic animal diseases/pathogens and susceptible species that are considered for monitoring for the purpose of the zoning and approval of an area or a farm is presented in Table 2.

Inspection and sampling scheme for all salmonid fish farms

The inspection and sampling scheme for salmonid fish farms is harmonized with the provisions of the relevant EU regulation (*Reg. 2001/183/EC Laying Down the Sampling Plans and Diagnostic Methods for the Detection of and Confirmation of Certain Fish Diseases and Repealing Decision 92/532/EEC* [OJ L 67]) regulating this issue for VHS and IHN, and the same provisions are applied for IPN, as well as for other salmonid fish diseases of concern.

All samples are taken in triplicate. One set is delivered to the national reference laboratory (DAVFS), the second set is sent to one of the EU-recognized laboratories (the Community Reference Laboratory for Fish Diseases, Aarhus, Denmark, and the National Veterinary Institute, Ljubljana, Slovenia), while the third set is held in reserve by the veterinary inspector for the purpose of super-analysis.

TABLE 2

List of aquatic animal diseases/pathogens and susceptible species that are considered for monitoring purposes with regard to the zoning and approval of an area/farm in Bosnia and Herzegovina

Disease/pathogen	Susceptible species
Infectious salmon anaemia (ISA) ¹	Atlantic salmon (<i>Salmo salar</i>)
Viral haemorrhagic septicaemia (VHS) ²	Salmonid species
	Grayling (<i>Thymallus thymallus</i>)
	Whitefish (<i>Coregonus</i> spp.)
	Pike (<i>Esox lucius</i>)
Infectious haematopoietic necrosis (IHN) ²	Turbot (<i>Scophthalmus maximus</i>)
	Salmonid species
Bonamiosis (<i>Bonamia ostreae</i>) ²	Flat oyster (<i>Ostrea edulis</i>)
Marteiliosis (<i>Marteilla refringens</i>) ²	
Infectious pancreatic necrosis (IPN) ³	To be specified in monitoring programmes designed and performed by entity CAs – not mandatory for the zoning purposes
Spring viraemia of carp (SVC) ³	
Bacterial kidney disease (BKD) (<i>Renibacterium salmoninarum</i>) ³	
Furunculosis (<i>Aeromonas salmonicida</i>) ³	
Enteric redmouth disease (ERD) (<i>Yersinia ruckeri</i>) ³	
Gyrodactylosis (<i>Gyrodactylus salaris</i>) ³	
Crayfish plague (<i>Aphanomyces astaci</i>) ³	

¹ List I Diseases.

² List II Diseases.

³ List III Diseases.

Each sampling procedure must be followed by the official inspection record. Besides the usual data, each inspection record should include data on water temperature on the date of sampling, as well as species and categories sampled (official labels: broodstock [M]; one-year fry [0+]; fry more than one year old [1+]). One copy of the official inspection record shall be available on the sampled farm.

Sampling of farms for which continuous two-year surveillance with two samplings per year has not been completed shall be done according to the sampling scheme presented in Table 3, while sampling of farms for which the two-year surveillance programme has been completed shall be done in line with the sampling scheme presented in Table 4 (decreased number of samples).

Clinical inspections must be realized during the period October to June or whenever the water temperature is below 14 °C. When farms are to be clinically inspected twice per year, the interval between inspections must be at least four months. All production units (ponds, tanks, net-cages, etc.) must be inspected for the presence of dead, weak or abnormally behaving fish. Particular attention must be paid to the water outlet area where weak fish tend to accumulate because of the water current.

The criteria for the selection of fish to be sampled are as follows:

- If rainbow trout are present, only that fish species shall be sampled. If rainbow trout are not present, the sample must be obtained from all other fish species present that are susceptible to VHS and IHN viruses (the list of pathogens and the susceptible species are specified in the relevant Bosnia and Herzegovina legislation (*Decision on Veterinary Health Conditions that must be Fulfilled when Putting into Trade Live Fish, Mollusks, and Crustaceans and Products Thereof* [OJ of BiH, 62/05]), which is harmonized with the equivalent EU regulation (*Reg. 91/67/EEC Concerning the Animal Health Conditions Governing the Placing on the Market of Aquaculture Animals and Products Thereof* [OJ L 46], last amended by *Reg. 806/2003/EZ* [OJ L 122]). The species must be proportionally represented in the sample.
- If more than one water source is utilized for fish production, fish representing all water sources must be included in the sample.

TABLE 3

Inspection and sampling scheme for salmonid fish farms under increased two-year targeted surveillance programme mandatory to achieve status of approved zone or approved farm in unapproved zone. (To be applied in the case of farms which have not finished the compulsory 2-year targeted surveillance)

	No. of clinical inspections per year	No. of laboratory examinations per year	Laboratory examination for presence of virus	
			Number of growing fish (organ material)	Number of broodstock fish (ovarian fluid)
Continental zones and farms				
(a) Farms with broodstock	2	2	120 (first inspection) ¹ 150 (second inspection)	30 (first inspection) ² 0 (second inspection)
(b) Farms with broodstock only	2	1	0	150 (first or second inspection) ³
(c) Farms without broodstock	2	2	150 (first and second inspection)	0
Coastal zones and farms				
(a) Farms with broodstock	2	2	120 (first inspection) 150 (second inspection)	30 (first inspection) ³ 0 (second inspection)
(b) Salmonid farms without broodstock	2	2	30 (first and second inspection) ³	0
(c) Non-salmonid farms without broodstock	2	2	150 (first or second inspection)	0

Maximum 10 fish per one pooled sample; ¹ Clinical inspection; ² In exceptional circumstances, if it is impossible to obtain ovarian fluid, organs may be sampled instead; ³ The samples have to be collected no sooner than three weeks after transfer of fish from fresh to saltwater.

TABLE 4

Inspection and sampling scheme for salmonid fish farms under decreased targeted surveillance programme mandatory to achieve status of approved zone or farm in unapproved zone. (To be applied in the case of farms that have finished the compulsory 2-year targeted surveillance)

	No. of clinical inspections per year	No. of laboratory examinations per year	Laboratory examination for presence of virus	
			Number of growing fish (organ material)	Number of broodstock fish (ovarian fluid)
Continental zones and farms				
(a) Farms with broodstock	2	2	0 (first inspection) ¹ 30 (second inspection)	30 (first inspection) ² 0 (second inspection)
(b) Farms with broodstock only	2	1	0	30 (first or second inspection) ³
(c) Farms without broodstock	2	2	30 (first and second inspection)	0
Coastal zones and farms				
(a) Farms with broodstock	2	2	0 (first inspection) 30 (second inspection)	30 (first inspection) ³ 0 (second inspection)
(b) Salmonid farms without broodstock	2	2	30 (first and second inspection) ³	0
(c) Non-salmonid farms without broodstock	2	2	30 (first or second inspection)	0

Maximum 10 fish per one pooled sample; ¹ Clinical inspection; ² In exceptional circumstances, if it is impossible to obtain ovarian fluid, organs may be sampled instead; ³ The samples have to be collected no sooner than three weeks after transfer of fish from fresh to saltwater.

- If weak, abnormally behaving or freshly dead (but not decomposed) fish are present, such fish should be primarily sampled. If such fish are not present, the sample must include normally appearing, healthy fish in such a way that all parts of the farm, as well as all year classes, are proportionally represented in the sample.

Inspection and sampling scheme for cyprinid fish farms

Examination for the presence of SVC virus in cyprinid broodstock has to be carried out during the spawning time. For the purpose of examination, a sample of ovarian

fluid has to be taken at the end of squeezing (one pooled sample includes specimens of ovarian fluid from five broodstock in one tube).

Clinical examination of cyprinid fry (0+ and 1+ age categories) must be carried out in the spring (when the water temperature is below 20 °C) and in autumn (when the water temperature is below 18 °C). At the same time, samples that include 150 fish shall be delivered for testing for the presence of SVC virus.

Collection, distribution and laboratory examination of samples

Precise information on the collection of samples and their distribution to authorized laboratories is also given in the annually enforced *Decisions on Measures of Control of Infectious and Parasite Diseases of Animals and their Implementation and Financing*, which is based on provisions of the relevant EU legislation (*Reg. 2001/183/EC Laying Down the Sampling Plans and Diagnostic Methods for the Detection of and Confirmation of Certain Fish Diseases and Repealing Decision 92/532/EEC [OJ No. L 67]*). The tissues to be examined are the spleen, anterior kidney, and either the heart or the brain. In some instances, when examining broodstock, ovarian fluid is to be collected. In addition to live fish, whole dead fish may also be sampled.

The same legislation also regulates diagnostic methods for virological examination of samples and the confirmation of viral diseases (VHS and IHN) in suspected outbreaks. In the case of suspected outbreaks, at least 10 fish showing typical signs of VHS or IHN must be selected for examination. To diagnose the diseases, one or more of the following diagnostic procedures shall be applied:

- a) conventional viral isolation (inoculation on to cell cultures and observation of cytopathic effect by microscopy) with subsequent serological viral identification (virus neutralization technique, immunofluorescence technique (IF) and/or enzyme linked immunosorbent assay (ELISA) technique)
- b) isolation of virus with simultaneous serological virus identification
- c) rapid serological virus identification (ELISA and/or indirect fluorescent antibody test (IFAT)), which must be followed by the above "a" or "b" diagnostic procedure within 48 hours after the sampling, if a negative result is obtained, or if a positive result is obtained with material representing the first case of VHS or IHN in an approved zone.

Other alternative diagnostic methods may be applied such as reverse transcriptase-polymerase chain reaction (RT-PCR) or immunohistochemistry (if frozen sections), but they must always be accompanied by cell culture inoculation with diagnostic material.

In addition to the above provisions, the Decision on the Infectious Diseases of Animals (OJ of BiH, 44/03) specifies laboratory tests and methods for examination and confirmation of the infectious diseases listed in this Decision, as well as the specimens that need to be taken and their delivery to laboratories. For infectious diseases for which the required methods, equipment or space do not exist in Bosnia and Herzegovina, it is specified that diagnostics is to be performed in the OIE reference laboratory or other international reference laboratories with which the SVO has a signed contract for provision of diagnostic services. Finally, it is also specified that the SVO is responsible for coordination of sampling and the distribution of samples to reference laboratories. The lists of prescribed and alternative diagnostic methods, required specimens and specimen delivery methods for all aquatic animal diseases listed in Table 1 are given in Annex 4 of the Decision. In addition, the Annex also provides the same information for other significant diseases from the OIE list: viral encephalopathy and retinopathy (VER), IPN, infectious salmon anaemia (ISA), bacterial kidney disease (BKD) and crayfish plague. A list of laboratory tests and methods for sampling and specimen delivery to laboratories for some fish diseases in Bosnia and Herzegovina is presented in Table 5.

TABLE 5

List of laboratory tests and sampling methods for some fish diseases in Bosnia and Herzegovina

Disease ¹	Diagnostic method ²		Sampling and delivery of samples	
	Compulsory	Other	Specimens	Delivery
EHN	Virus isolation and serological identification	IF, ELISA, molecular methods	Whole fry if smaller than 4 cm; intestine with kidney from fry 4-6 cm in size; from bigger fish, kidney, spleen and liver from clinically diseased fish; in the case of unapparent infections, the same as above; statistically representative number of fish or parental ovarian and seed fluid	Live diseased fish, fresh dead fish or slaughtered fish on ice. Organs or ovarian and seed fluid in transport fluid 1:10 at 4 °C
IHN	Virus isolation, identification with SN, IFAT, ELISA, molecular methods			
VHS	Virus isolation, identification with SN, IF, ELISA			
SVC	Virus isolation, identification with IF, ELISA	IF, ELISA	Whole fry if smaller than 4 cm; intestine with kidney and brain from bigger fish; in the case of unapparent infections, kidney, spleen, gills and brain of a statistically representative sample	
OMVD			The same as for EHN, IHN, and VHS with addition of brain and ulcerative skin lesions in clinically diseased fish, and brain in unapparent infections.	

¹ EHN = epizootic haematopoietic necrosis, IHN = infectious haematopoietic necrosis, VHS = viral haemorrhagic septicaemia, SVC = spring viraemia of carp, OMVD = *Oncorhynchus masou* virus disease.

ELISA = enzyme linked immunosorbent assay, IF = immunofluorescence, IFAT = indirect fluorescent antibody test, SN = semi-nested.

Source: Decision on Infectious Diseases of Animals (OJ of BiH, 44/03)

Laboratories involved in aquatic animal health surveillance

In Bosnia and Herzegovina, the designation of laboratories for performance of examinations with regard to animal health is regulated by the *Decision on Conditions which must be Fulfilled by the Authorized Veterinary Laboratories* (OJ of Bosnia and Herzegovina, 25/04, last amended 16/05) and the *Decision on Designation of Referent Laboratories in Bosnia and Herzegovina* (OJ of Bosnia and Herzegovina, 68/05, last amended 90/05). According to this legislation, the DAVFS is designated as the National Reference Laboratory for Viral Fish Diseases (NRL). The other laboratories that are authorized to perform diagnostics for aquatic animal diseases are the Veterinary Institute "Dr Vaso Butozan" in Banja Luka, RS, and the Veterinary Institute in Mostar, FBiH. The above mentioned legislation specifies that the authorized laboratories and the NRL must have all the necessary equipment and materials to carry out the diagnostic analyses in accordance with the OIE *Manual of Diagnostic Tests for Aquatic Animals*, 4th Edition, 2003. As for their diagnostic performance, all laboratories are currently performing only ELISA testing for fish diseases. However, confirmatory laboratory technique (virus isolation) is ensured by employment of the EU Reference Laboratory for Fish Diseases in Aarhus, Denmark (CRL), which has been officially contracted by the SVO for this purpose since 2005. In this way, the shortcoming in full implementation of appropriate screening and confirmatory diagnostics of fish diseases has been successfully addressed. In addition, one of the major activities of the FAO-funded project is the provision of equipment and training of laboratory staff of the NRL in order to achieve an internationally recognized level of diagnostic performance for fish diseases. According to NRL and SVO officials, a fully equipped and capable laboratory is expected to be in place not later than the middle of 2008.

Another important requirement for an authorized or reference laboratory is that, in order to retain its authorization, it must organize its operative diagnostic work according to the provisions of the national BAS EN ISO/IEC 17025:2005 standard, which is fully harmonized with the international standard ISO/IEC 17025:2005¹. The accreditation

¹ ISO/IEC International Standard 17025 (2005). *General requirements for the competence of testing and calibration laboratories*. International Organisation for Standardisation (ISO), ISO Central Secretariat, 1 rue de Varembe, Case Postale 56, CH - 1211, Geneva 20, Switzerland.

is performed by a national accreditation body (the Institute for Accreditation of Bosnia and Herzegovina), which is not officially a part of an EU accreditation body. Neither the NRL nor the other two laboratories are presently accredited, which is a very important obstacle to international recognition of their diagnostic results. Nevertheless, personnel of the NRL and of the Veterinary Institute in Banja Luka have expressed optimism concerning this problem, since extensive activities have been undertaken to prepare their laboratories and personnel for accreditation, which should be obtained during the current year.

Concerning evaluation of the effectiveness of the surveillance programme and the dissemination feed-back information, the Decision clearly indicates that the CCA is responsible to ensure implementation, coordination and analysis of the implemented measures through the Expert Group for Epidemiology, which is responsible for further improvement of the surveillance programme based on scientific findings and analysis. The Expert Group is responsible for preparing an annual report on the scope and effectiveness of the surveillance programme at the end of the current year, in which necessary improvements should be proposed for the coming year. In addition, the NRL is obliged to establish cooperation with the OIE reference laboratories and/or the CRL and to participate in ring testing trials. The dissemination of feed-back information is a responsibility of the CCA and the entity CAs, who are in charge of organizing training and providing information to veterinarians, fish farmers, inspectors and other aquaculture stakeholders by the means of symposia, scientific events, bulletins, manuals, etc. According to officials of the SVO and the FMoAWF, besides the regular preparation and distribution of the *Monthly Bulletin on Occurrence of Infectious Diseases*, many seminars, conferences, trainings and expert consultations have been organized. However, according to the officials of the CCA and the CAs, the Expert Group for Epidemiology has never been officially established, which is surely a very important shortcoming that needs to be appropriately addressed.

Results of the Bosnia and Herzegovina targeted surveillance on fish diseases

Results of the Bosnia and Herzegovina targeted surveillance programme for viral fish diseases implemented during the period 2004-2007, based on available data provided by SVO officials, are presented in Table 6. Targeted surveillance of fish diseases started in 2004 as an initial screening of health status of salmonid fish farms in two river basins for the presence of the viral diseases VHS, IHN and IPN.

TABLE 6
Results of targeted surveillance for the presence of certain viral agents of fish disease implemented in Bosnia and Herzegovina fish farms during 2004-2007

Year	Salmonid species ¹				Cyprinid species ²
	VHS virus ³ a / b ⁴	IHN virus a / b	IPN virus a / b	ISA virus a / b	SVC virus a / b
2004	0 / 32	0 / 32	17 / 32	NA ⁵	NA
2005	0 / 30	0 / 30	26 / 30	0 / 30	0 / 7
2006	0 / 34	0 / 34	6 / 34	NA	0 / 5
2007	0 / 28	0 / 28	0 / 28	NA	0 / 6

¹ Rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta m. fario*), brook trout (*Salvelinus fontinalis*), grayling (*Thymallus thymallus*), and Adriatic salmon (*Salmothymus obtusirostris*). In 2007 one farm producing arctic char (*Salvelinus alpinus*) was also included in the surveillance programme.

² Common carp (*Cyprinus carpio*).

³ IHN = infectious haematopoietic necrosis, ISA = infectious salmon anaemia, SVC = spring viraemia of carp, VHS = viral haemorrhagic septicaemia.

⁴ a – Number of farms having fish populations in which the presence of the virus is confirmed in the respective year. No increased or unusual mortality or any specific clinical sign of the respective diseases were observed during implementation of the surveillance programme. b – Total number of fish farms included in the surveillance programme per year. All officially registered farms and those in the process of registration were included in the programme in the respective year.

⁵ NA – Not applicable. The agent was not under official targeted surveillance.

In 2005, based on recommendations of the relevant EU CA², besides these three viral diseases, the targeted surveillance was modified to include preventive examinations for ISA virus. Surveillance for ISA virus was not continued in the following years because of confirmation of all negative results for monitoring done in 2005, the absence of Atlantic salmon (the species susceptible to ISA) in Bosnia and Herzegovina aquaculture, the desirable overall epidemiological situation in Bosnia and Herzegovina aquaculture (absence of any increased mortality) and the high expenditures for confirmatory testing in the CRL. Also, from 2005 systematic targeted surveillance for the presence of SVC virus in common carp was initiated.

In 2006, besides surveillance for the viruses causing IHN, VHS, IPN and SVC, the relevant annual Decision requiring surveillance for BKD and gyrodactylosis was also implemented. However, in spite of the legal provisions, surveillance for these two non-viral diseases was not realized due to a lack of implementing budget. It is important to emphasize that Bosnia and Herzegovina is one of only a few countries that pays all the expenses associated with targeted surveillance without any participation of the fish farmers, although it is primarily their interest to gain access to the international markets, which may be only reached by international recognition of the surveillance system as the backbone of aquaculture animal health management.

The laboratory examination of the samples included use of ELISA screening methods for fish viral diseases performed at the NRL, followed by ELISA and viral isolation, a simultaneous diagnostic system for confirmation performed by the CRL in Aarhus, Denmark. This approach was used during 2004-2005, while in 2006 and 2007 samples were not sent to the CRL due to the extremely high costs of their service. This approach may be provisionally accepted due to the absolute absence of any increased or mass mortality in Bosnia and Herzegovina aquaculture, which argues in favor of a historical freedom of disease. However, efforts to ensure sustainable and cost-effective access to diagnostics services for important fish diseases must be available. The solution to this problem is provided by implementation of the FAO-funded project, whose major outputs include strengthening the capability of the NRL such that it can provide reliable, internationally recognized diagnostic services.

Bearing in mind the absence of any increased mortality in aquaculture during the post-war period and longer, the detection of IPN virus in salmonid fish without any clinical manifestation of disease may be taken as a positive characteristic of the overall performance of surveillance in Bosnia and Herzegovina aquaculture. The facts that this virus is recognized as free-living microorganism in freshwater, and that the disease is not currently among the diseases listed by the OIE or the EU, as well as the fact that the agent was not detected in 2007, may be taken as arguments in favor of deleting the disease from the Bosnia and Herzegovina national list of diseases in aquacultured animals.

Finally, from the results of targeted surveillance and the historical freedom of Bosnia and Herzegovina's aquaculture from diseases, it may be concluded that Bosnia and Herzegovina salmonid and cyprinid fish production is based on a desirable epidemiological status with regard to the diseases that have been under surveillance. Also the listing of Bosnia and Herzegovina among the third countries for which the imports of fishery products in any form for human consumption to the EU market are officially permitted without any restriction³ argues in favour of such an opinion. However, since the current EU regulation on this matter enforces changed criteria for aquatic animal disease listing, and having in mind a sustainable export of Bosnia and

² FVO Inspection Mission to Bosnia and Herzegovina; Ref.No.DG(SANCO)/7720/2005.

³ Reg. 2008/156/EC amending Decision 2006/766/EC as Regards the List of Third Countries and Territories from which Imports of Fishery Products in any Form for Human Consumption are Permitted (OJ L 50)

Herzegovina aquaculture products as a long-term national objective, an update and improvement of the surveillance system in BiH aquaculture becomes necessary.

DEFICIENCIES, INCONSISTENCIES AND RECOMMENDATIONS FOR THEIR IMPROVEMENT

The issues identified with regard to aquatic animal health surveillance in Bosnia and Herzegovina can be divided into:

- organizational and structural issues;
- legislative issues; and
- issues related to the management of domestic movement of aquatic animals.

Organizational and structural issues

Problems and inconsistencies

The organizational structure of all the CAs responsible for aquatic animal health management and disease control in Bosnia and Herzegovina (Figure 2) is pyramidal and hierarchical in terms of their relevant competencies and duties. This structure, in addition to a sufficient legal framework, provides an essential foundation for their mutual cooperation in establishing and implementing an effective system. However, to accomplish the numerous duties and competencies in a well-coordinated and productive manner, problems related to the issues identified below need to be addressed:

The need for clear designation of institutional and personal responsibilities for aquaculture issues within the CAs and associated shortcomings in effective communication and coordination

One of the basic requirements for a productive aquatic animal health management and disease control system is to clearly assign personal duties and responsibilities in all CAs (FAO, 2004). In addition, the existence of an appropriate system of communication and coordination is one of the major requirements for the effective functioning of animal health surveillance systems in general (Zepeda and Salman, 2003). However, the problems of miscommunication and lack of enthusiasm may be identified as common obstacles to efficacious functioning in all complex and multilevel systems, particularly in those systems that involve many bureaucratic components, even in countries that are more developed and have a less structured administrative organization than Bosnia and Herzegovina (Anon., 2002).

The organizational structure of the CCA and the entity-level CA, besides their other sections and departments, also includes those responsible for animal health management and control issues in general. Nevertheless, from discussion with representatives of the CCA and entity-level CAs, it is clear that there are no personally assigned responsibilities and duties related to aquaculture animal health issues in these sections and departments. This is rather contradictory to the recognition by Bosnia and Herzegovina officials of aquaculture as one of the leading and most-promising agricultural sectors and certainly deserves appropriate attention to improve Bosnia and Herzegovina aquaculture. Also, despite the fact that a sufficient legal basis for communication has been established, the effective and constructive exchange of data and information among CAs at all levels was not observed during the mission. From visits to institutions, insights into the existing databases in the SVO, and discussions with representatives of all CAs and other stakeholders, it is clear that one of the main problems facing aquatic animal health management and disease control in Bosnia and Herzegovina is the lack of effect communication among all the CAs.

This organizational problem may be partially explained by a current shortage of adequate personnel in the responsible institutions. For instance, the human resources of the SVO in Sarajevo on 1 September 2007 comprised only 10 veterinarians in total,

including all the decision-makers, operative personnel and three apprentices. Given the numerous duties and responsibilities of the CCA, this obvious shortcoming in human resources results in unclear personal responsibilities of the personnel for performing specific duties. Similar situations and problems may be identified within the entity and cantonal CAs responsible for aquatic animal health management and disease control. Without clear assignment of personal responsibilities for managing aquaculture animal health issues within the CAs, a lack of effective communication among them arises as another institutional and organizational problem.

The need for timely collection, uniformity, transparency and analysis of epidemiological data and dissemination of feedback information

BiH and the EU legislation (*Veterinary Law of BiH* (OJ of BiH, No. 34/02) and *Reg. 2006/88/EC on Animal Health Requirements for Aquaculture Animals and Products Thereof, and on Prevention and Control of Certain Diseases in Aquatic Animals* [OJ No. L 328]) requires that all decisions on aquatic animal health management and disease control should be based on appropriate epidemiological analysis and risk assessment procedures, ensuring that reliable and scientifically based decisions are made and that resulting measures and activities will be disseminated to all stakeholders and elements involved in the MOSS. However, formal epidemiological units within the CCA or the entity CAs have not been created, mainly due to the fact that personal responsibilities for the aquaculture sector have not been designated. In order to be able to provide appropriate epidemiological analysis, make scientifically based decisions, enforce measures and disseminate feed-back information to stakeholders, it is essential for any epidemiological unit to have reliable and timely data on hand.

In spite of the above legal provisions, and from discussion with contacts within the CAs at all levels, it is clear that one of the major constraints of the system is a lack of timely collation of data and reports. This is considered a reflection of other identified problems (e.g. lack of clearly designated personal responsibilities for aquaculture issues in CAs and human resource shortcomings), but it is also a consequence of a lack of willingness to cooperate and of failure to recognize the importance of timely reporting. However, this is acknowledged as a general problem in the implementation of animal disease surveillance systems (Thacker, Parrish and Throwbridge, 1988; Håstein *et al.*, 2001; Zepeda and Salman, 2003), and it is the responsibility of the CA of each country to find the most appropriate means to address it. Consequently, timely updated databases on issues related to the aquaculture sector could not be found. For instance, the results of the laboratory examinations done within the monitoring programme on viral fish diseases are centralized in an electronic format only for 2004 and 2005, while the data obtained during 2006 and 2007 are still contained in the paper-based reports of the NRL and the inspectors. In addition, the established electronic database is not structured in a useful way that could provide a fruitful analysis of the data. A similar situation exists for the database on registered fish farms, which, although organized in a better and simpler way, is not updated in a timely manner.

Recommendations

The importance of the aquaculture sector in the overall development of national agriculture and the fact that it is the only segment of Bosnia and Herzegovina agriculture that is officially permitted to export products to the EU market speaks to the essential importance of the following actions:

- *Assign clear personal responsibilities for managing aquaculture issues in the SVO and in the entity CAs.* Such assignments should improve effectiveness of communication between the CCA and the CAs, which may lead to increased managerial capability within the state and entity-level CAs.

- *Officially establish the Expert Panel for Aquaculture (EPA).* Besides the Deputy Director of the SVO as the coordinator of the panel, the EPA may include people personally responsible for aquaculture in the SVO, both entity ministries for agriculture (FMoAWF and MoAFWRS), the Chief Veterinary Inspectors from VIFBiH and VIRS, and a representative from the Bosnia and Herzegovina Association of Aquaculture Producers. The EPA should be under the supervision of the SVO, and its members should be adequately compensated for their activities from the SVO budget. This group should hold their meetings at least on a quarterly basis. The primary role of the EPA should be to coordinate all activities related to Bosnia and Herzegovina aquaculture among the CCA and the entity CAs. In addition, the EPA should provide expert opinion on the current status and requirements for improving Bosnia and Herzegovina aquaculture, as well as suggestions and recommendations for drafting new legislation related to aquaculture.
- *Design and implement internal Standard Operating Procedures (SOPs) for the timely collection of data and establishment of updated and operational databases in all CAs involved in aquatic animal health surveillance.* This may be a suitable approach to appropriately address the problem of lack of timely collection of data by CAs.
- *Design and implement uniform report sheets for collection and submission of monthly data on disease occurrence, laboratory testing results, registration of aquaculture establishments and all the other areas relevant to the surveillance system.* This should be legally required and addressed through the SOPs in all CAs. Report sheets should be designed to ensure the generation of a centralized electronic database at the SVO that contains data of uniform format that can be used to generate variables of interest for reliable statistical analyses (e.g. data on the number, profile and age categories of susceptible species for each farm; date, number and type of samples taken for laboratory analysis; geographical location of each farm; codes for each farm and the responsible veterinary inspectors, etc.). The establishment of such a uniform electronic database within the CCA and its presentation on the Internet should ensure transparency of the data and an easy access to the official status of each registered aquaculture establishment.
- *Establish an epidemiological and risk analysis unit within the SVO.* This should include well-trained epidemiologists and risk analysts able to form and manage uniform and centralized databases related to Bosnia and Herzegovina aquaculture; perform statistical analyses of the surveillance and registration data; and undertake appropriate risk analyses that should permit risk analysis-based decision-making to support the designation of health status and zoning of farms and zones, the level and scope of an aquatic animal health surveillance programme, and a sound policy for movements of aquatic animals. In addition, the activities of this unit and the EPA are prerequisites for ensuring the dissemination of scientific-based feed-back information.

The need to address problems with self-checked data

Despite the fact that all authorized laboratories are required to submit monthly reports on all of their diagnostic activities, which would include information on all of diagnostic tests performed regardless of who paid for them, none of the self-check results are submitted to the CCA. In addition, these data should be accessible to the responsible veterinary inspectors designated for each farm.

Recommendations

- *CAs and the CCA should more completely enforce submission of the official reports from their subordinates (i.e. veterinary inspectors personally assigned to each fish farm) with regard of their content and timing, as well as to standardize the*

procedures for data collection and collation. Recommendations for improvement of the system of data collection and collation are provided above (through SOPs and uniform data sheets). Since a more thorough enforcement of the self-checked data is suggested, this recommendation refers both to the organizational and legislation-related shortcomings of the Bosnia and Herzegovina aquatic animal health surveillance programme.

Legislative issues

Problems and inconsistencies

Compared to the other animal production sectors in Bosnia and Herzegovina, the national legislation that regulates the management and control of diseases and the other aspects of aquaculture is more advanced and up-to-date with EU legislation. This confirms the general recognition of aquaculture as one of the most-promising animal production sectors in Bosnia and Herzegovina and highlights the efforts of the SVO and others to ensure the necessary legal basis for promotion and international recognition of national aquaculture.

Considering the existing legal framework for aquatic animal health management in Bosnia and Herzegovina, it is clear that there exists a sufficient legal basis for establishing and maintaining a comprehensive disease surveillance programme, including both passive and active components. However, some problems related to the legal basis may be identified.

The need for timely harmonization and updating of relevant legislation and improving unclearly defined institutional jurisdictions and responsibilities

Further improvement and strengthening of the capacities of the aquaculture sector is needed to ensure the sustainable export of aquaculture products to the European Union and regional markets. To reach the goal, timely harmonization of Bosnia and Herzegovina legislation with the corresponding EU legal acts is essential. This will be the one of permanent major challenges facing the Bosnia and Herzegovina legislative system. An example of such a challenge is the enforcement of a risk assessment-based approach in the EU regulation concerning the general health requirements for aquaculture animals and the prevention and control of their diseases through the zoning process (*Reg. 2006/88/EC on Animal Health Requirements for Aquaculture Animals and Products Thereof, and on Prevention and Control of Certain Diseases in Aquatic Animals [OJ L 328]*), which is not mentioned in the corresponding Bosnia and Herzegovina legislation (*Decision on Veterinary Health Conditions that must be Fulfilled when Putting into Trade Live Fish, Mollusks, and Crustaceans and Products Thereof [OJ of Bosnia and Herzegovina, 62/05]*). Furthermore, one of the consequences of the multi-level decentralized political and operational competencies in Bosnia and Herzegovina is a corresponding reflection of this structure in the legislation, which may lead to a lack of harmonization and overlapping of the legal acts that regulate the same issues at different levels of jurisdiction. For instance, in addition to the *Veterinary Law of Bosnia and Herzegovina*, two entity-level laws are in force, the *Veterinary Law of the Federation of Bosnia and Herzegovina*, (OJ of FBiH, 46/00) and the *Law on Animal Health Protection and Veterinary Duties in RS* (OJ of RS, 11/95). Although the national law is obsolete (e.g. with regard to the current OIE and EU listings of aquatic animal diseases), the entity-level laws are still not harmonized with the already outdated state-level law. This lack of harmonization results in insufficiently clear jurisdictions and competencies and confusion in the implementation of the relevant legislation.

One of key requirements for establishing a productive and dynamic animal health surveillance system is a clear legal definition of jurisdictions and responsibilities for each of its components, particularly in countries like Bosnia and Herzegovina where

a multilevel jurisdiction and competence is in place. As previously mentioned, until 2006 the entity veterinary inspection services (VIFBiH and VIRS) were under the jurisdiction of their respective ministries for agriculture (FMoAWF and MoAFRS), an arrangement that provided more practical capability and a mechanism for the ministries to implement relevant legislation and to have clearly defined responsibilities. Since 2006 VIFBiH and VIRS have been placed under the jurisdiction of the entity inspection administrations (FAfIA and RAfIA), an operational structure in which FMoAWF and MoAFRS do not have any direct jurisdiction. This situation complicates implementation of many duties and responsibilities of the entity CAs and requires necessary updates of relevant legislation. Other examples of indistinctly defined legal responsibilities of the CCA and the entity CAs may also be identified in the *Veterinary Law of BiH* with regard of collection and analysis of epidemiological data and dissemination of feed-back information.

Recommendations

- *Assign the EPA a lead role in harmonizing and updating national legislation.* As stated above, one of the duties of the proposed EPA is to provide suggestions for drafting new legislation. The EPA should be assigned a lead role in harmonizing national legislation with the relevant EU legislation, and of the entity legislation to the national legislation.
- *Clearly define the competencies and duties of the SVO and the entity veterinary services.* This should be accomplished during the next revision of the *Veterinary Law of Bosnia and Herzegovina*.
- *Harmonize Bosnia and Herzegovina legislation with Directive 2006/88/EC.* This should be considered as one of the crucial actions for improvement of the legal basis for aquatic animal health surveillance, since this Directive provides summary legislation regulating most aspects of aquatic animal health surveillance and trading requirements. In addition, it is important to emphasize that the SVO has already taken necessary steps for the harmonization of Bosnia and Herzegovina legislation with EU Directive 2006/88/EC (translation of the EU regulation has already been done).

The need for legal flexibility in defining the national list of animal diseases, mandatorily notifiable diseases and other necessary elements of a surveillance programme

Animal diseases of national concern are those diseases that require the design and implementation of general and specific measures for their prevention, control and eradication depending on the current epidemiological situation. The Bosnia and Herzegovina disease list is imposed in the *Veterinary Law of Bosnia and Herzegovina* (OJ of BiH, 34/02), which is the horizontal Bosnian and Herzegovinan veterinary legislation and, as such, is inflexible and difficult to amend or repeal, particularly given the complicated and extremely slow parliamentary procedure existing in Bosnia and Herzegovina. On the other hand, changes in epidemiological characteristics such as the occurrence and spread of a disease are often very dynamic and thus require timely changes in the legal basis for surveillance and management. Thus, to allow needed flexibility, the supreme legal definition of such a dynamic and essential component of the national surveillance system should be established via vertical sub-law legislation.

Recommendations

- *Specify the national list of diseases and susceptible species for aquaculture animals in the Decision on Measures of Control of Infectious and Parasite Diseases of Animals and their Implementation and Financing.* This mechanism will allow annual

updating and redefinition of diseases and susceptible species, legal prerequisites needed to ensure improved flexibility and overall performance and efficiency of the surveillance system.

- *Require mandatory notification to domestic and international CAs for all diseases and susceptible species included in the national list of aquaculture animal diseases.* In this way, the EU requirements for a sufficient passive surveillance would be met. It is also recommended to enforce these legal provisions in the above mentioned annual Decisions, which would again ensure enough legal flexibility and the ability to make necessary changes in a timely manner.
- *Legally define the definitions of contingency planning, minimal elements of epidemiological investigation of disease outbreaks, and minimal control and eradication measures for diseases.* These should be legally defined in similar way to ensure sufficient legal flexibility and updating.

The need to improve legally imprecise responsibility for health surveillance of wild fish populations

An appropriate approach to include health monitoring of wild fish populations within the overall disease control system is one of basic requirements needed to establish an adequate and internationally recognizable aquatic animal health surveillance programme. This issue is not adequately addressed in the annual plan for targeted surveillance, since it does not define a clear responsibility for the practical implementation of the health monitoring of wild fish populations.

Recommendations

- *Legally enforce clear responsibilities of veterinary inspection and related CA activities for surveillance of health status of wild fish populations based on the geographical jurisdiction of assigned veterinary inspectors and the geographical location of recreational fishing and catchment areas for each river basin.* To implement this recommendation, close collaboration between veterinary and agricultural inspection and recreational fishing associations may be required. The fact that entity inspection services are organized as independent administrations (FAfIA and RafIA) and include all types of inspection services provides a sound basis for the close cooperation of different inspection services whose jurisdictions may overlap with regard to inspection of open-water sources.
- *Assign the responsibility to undertake a pilot project to investigate the health status of wild fish populations to the SVO and the entity CAs.* This will initiate activities aimed at obtaining species profiles for wild fish populations, particularly their health status with regard to fish diseases of national concern. This pilot-project should include all the river basins in Bosnia and Herzegovina where registered fish farms exist. Project design and diagnostic examinations may be the responsibility of the NRL, while sampling of wild fish populations would require close cooperation with recreational fishing associations and the veterinary inspectors responsible for health supervision of farms. A proxy sampling approach (sampling without the probability sampling frame where the sampling frame is defined by spatial locations) should be used. The output of such a pilot-project would be more precise information on the susceptible species present in each drainage basin and their health status with regard to the proposed list of fish diseases, which may serve as a basis for more precise legal definition of surveillance of health status of wild fish populations in Bosnia and Herzegovina.

The need to address inconsistencies in official registration of aquaculture production establishments and problems related to consistency and timing in data collection.

Registration of fish farms and other aquaculture production establishments is regulated by the *Decision on Measures of Control of Infectious and Parasite Diseases of Animals and their Implementation and Financing in the Year 2007* (OJ of BiH, 35/07). According to this legislation, food business enterprises intending to export their products must be registered by the FMoAWF, while establishments whose products are intended for the domestic market are registered by the cantonal CAs. There is a sufficient legal basis for a uniform procedure for registration of the enterprises and for establishment of a uniform and centralized database on registered farms and processing as a basis for issuing the official control veterinary numbers (codes) for registered establishments. Farms and processing plants whose products are intended for export are subject to the regular controls of the SVO Inspection Department.

However, examination of documents provided by the SVO concerning farms registered on the cantonal and entity levels shows that the registration data for the two groups do not have the same level of precision. The registration documents for farms intending to export includes information on the species that are intended for farming and trade, farming capacity, etc., while such information is not included in the registration license for farms registered at the cantonal level for domestic trade only. SVO activities to improve the registration process have included a request to the entity CAs to carry out the process of revision of registration of the farms, followed by the uniform checklist for the processing plants in accordance with the above legislation as a basis for issuing the official control veterinary numbers (codes) for registered establishments. Nevertheless, this effort seems to be insufficient to ensure a consistent and timely updated database on registered enterprises.

Recommendations

- *Design and implement the use of uniform report sheets for collecting and submitting registration data on the number, profile and age categories of susceptible species for each farm, regardless of its status in domestic and international movement of animals.* This activity will ensure collection of better quality data on registered fish farms, including more reliable and timely data on species profiles and the farming capacities of all registered farms. Such data is essential for epidemiological analyses and a consistent aquatic animal health surveillance programme. These data sheets should be completed and dispatched to the SVO by responsible veterinary inspectors on monthly basis. This would ensure establishment of a centralized and timely updated database on registered farms and their production profiles and would serve as a prerequisite to collect necessary input data for risk assessment of health status for each farm by the proposed epidemiological and risk analysis unit at the SVO. It would also provide timely and sufficient information on the health status of registered aquaculture establishments for use by responsible veterinary inspectors and other stakeholders.

Issues related to the management of movement of aquatic animals

Problems and inconsistencies

Aquaculture zoning is internationally accepted as a useful tool for effective risk assessment-based decision making and an essential requirement for consistent management of aquaculture animal health and domestic and international movement of aquaculture animals and their products (FAO, 2004). This requirement has been legally enacted in BiH since 2005 via the *Decision on Veterinary Health Conditions that Must be Fulfilled when Putting into Trade Live Fish, Mollusks, and Crustaceans and*

Products Thereof (OJ of BiH, 62/05). This Decision clearly states that the movement of live aquatic animals can be done only between zones/farms with the same health status (approved [disease-free] zone, approved [disease free] farm, unapproved zone, unapproved farm, approved [disease free] farm in the unapproved zone disease free, buffer zone). However, a zoning programme has never been implemented.

Lack of enthusiasm and political cooperation to initiate aquaculture zoning

By the provisions of the above mentioned Decision, the system of approved aquaculture establishments and zones has been foreseen. The entity CAs (FMoAWF and MoAFRS) are designated as the authorities responsible for implementation of the zoning process, while the SVO has a coordinating and supervisory role; thus initiative for the zoning has to come from entity CAs. However, officials of the FMoAWF underline that the initial steps must be done by the fishfarm owners. Another related problem highlighted by the officials of SVO and entity CAs is that all river basins in BiH are shared between the two entities, a fact which complicates the field situation. Therefore, there appears to be insufficient enthusiasm and political cooperation to initiate the zoning process in Bosnia and Herzegovina aquaculture. Nevertheless, according to the provisions of the relevant EU legislation (*Reg. 2006/88/EC on Animal Health Requirements for Aquaculture Animals and Products Thereof, and on Prevention and Control of Certain Diseases in Aquatic Animals (OJ L 328)*), the sustainable export of aquaculture products from Bosnia and Herzegovina to the EU market may be achieved only if the decision-making and disease management system is based on an appropriate zoning of aquaculture as a prerequisite for reliable risk analysis and communication procedures.

Recommendations

- *Initiate signing of an Agreement of Mutual Understanding and Political Cooperation.* An agreement addressing aquaculture issues is needed between the governments of the Federation of Bosnia and Herzegovina and RS or between their respective ministries (FMoAWF and MoAFWRS). Such an agreement is a common initial step when issues of sharing inter- or intranational hydrographic areas among countries or regions occur (FAO, 2004), and it should provide sufficient formal and political grounds to initiate cooperation between the BiH entities with regard to the zoning process.
- *Start with a precise geographical delineation of all river basins and the differentiation of zones within.* This activity should be coordinated by the EPA and SVO and would require the involvement of other services such as agricultural and water management, which are already under jurisdiction of entity CAs.
- Differentiate fish farms within established zones according to their health status as demonstrated through results of targeted surveillance programmes carried out to date.

The need for transparency of animal movement data

Despite the fact that the official process for the international and domestic movement of aquaculture animals generates a significant amount of animal health data (date and location of all international and domestic movements, quarantine, aquaculture species, samples taken, laboratory test results, etc.), these data are not collected and analysed in a way that ensures their consistent utilization. Consequently, there are no transparent, well-timed and easily accessible databases that would serve as a reliable basis for analysis and decision making to aid in the proper management of the animal movement process. As a result, the veterinary inspectors responsible for control of the health status of the farm of origin are not able to have on-time and accurate information on the health

status of the farm of destination of the shipment. In general, the sole responsibility for international and domestic movements of live aquatic animals lies with the officially designated veterinary inspectors for each zone/farm. Appropriate realization of the zoning process, backed up by a consistent, transparent and easily accessible database on the health status of all registered establishments is essential to improve national policy concerning domestic and international movement of aquatic animals.

Recommendations

- *Design and enforce implementation of uniform report sheets for collecting and submission of registration data.* Use of uniform report sheets for collection data on the number, profile and age categories of susceptible species for each farm, regardless of its status in domestic and international movement of animals, should be considered. This was also included among the recommendations for improvement of the organizational and legislative framework for aquatic animal health surveillance.

CONCLUSIONS

Following the 1992–1995 war and the consequent enormous human losses and devastation of infrastructure, aquaculture production in Bosnia and Herzegovina was successfully renewed and has now reached a level of development that has resulted in an officially permitted export of aquaculture products to the demanding EU market. This achievement should be considered a significant breakthrough for Bosnian and Herzegovinian agriculture and as an initial benchmark for other agricultural sectors in the long and challenging way to EU market access.

On the other hand, permission to export to the EU market also represents an ongoing challenge for all Bosnian and Herzegovinan CAs and other stakeholders and requires continuous improvement of all aspects of national aquaculture production. Establishment and maintenance of an adequate aquatic animal health surveillance and disease control system is surely one of the key elements of a successful and internationally recognized aquaculture production.

The current complexity of the Bosnia and Herzegovina aquatic animal health surveillance and disease control system is an unavoidable outcome of the country's complex political structure, which involves multilevel CAs. Consequently, a lack of effective communication and clearly defined responsibilities among the CAs and deficiencies in the use of standardized forms for collection, collation and analysis of disease surveillance and fishfarm registration data have been highlighted as the major inconsistencies of the system. To address these limitations, some practical and relatively undemanding actions have been recommended, primarily to establish the Expert Panel for Agriculture (EPA), which should be coordinated by the SVO and take a lead role in coordinating and implementing the other recommended activities.

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