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Preparedness and response to aquatic animal health emergencies in Asia: guidelines

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Aquatic animal diseases. Courtesy of Richard Callinan, Kishio Hatai, Brian Jones, Stuart Millar, Mongkhon Primpon, Melba Reantaso.

Preparedness and response to aquatic animal health emergencies in Asia: guidelines

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Preparation of this document

The need for technical guidance for developing countries on emergency preparedness and response for serious outbreaks of aquatic animal disease was recognized at the Regional Workshop on Preparedness and Response to Aquatic Animal Health Emergencies, held in Jakarta, Indonesia from 21–23 September 2004.

The workshop was jointly organized by the Food and Agriculture Organization of the United Nations (FAO) Inland Water Resources and Aquaculture Service, the Network of Aquaculture Centres in Asia-Pacific (NACA) and the WorldFish Center, and was hosted by the Government of Indonesia, Ministry of Marine Affairs and Fisheries (MMAF). The preparation, publishing and distribution of the document were undertaken by FAO.

The workshop was made possible with financial assistance through FAO/TCP/INS/2905 – Health Management in Freshwater Aquaculture and the FishCode Programme of the FAO Fisheries Department.

Abstract

This document provides guidance to assist developing countries in improving national emergency preparedness in order to maximize the efficiency of response to serious outbreaks of aquatic animal diseases. It is a product of the Food and Agriculture Organization of the United Nations (FAO)/Network of Aquaculture Centres in Asia-Pacific (NACA)/WorldFish Center (WFC) Regional Workshop on Preparedness and Response to Aquatic Animal Health Emergencies, held in Jakarta, Indonesia from 21–23 September 2004. The workshop, which was hosted by the Government of Indonesia, Ministry of Marine Affairs and Fisheries (MMAF), was attended by 51 participants, including national policy-makers and scientists from the Asian Region, and international experts and resource persons from both the region and elsewhere.

The primary objective of biosecurity arrangements is to prevent the incursion of exotic pathogens and pests. Knowing, however, that the risk of such incursions can never be reduced to zero, such arrangements must also include plans to ensure a rapid, well organized and appropriate response to an emergency disease incident. Infectious disease emergencies may arise within a country through incursions of known exotic diseases (transboundary aquatic animal diseases, TAADs), by a sudden change in the behaviour or distribution of endemic diseases, or via the appearance of previously unrecognized diseases. Effective emergency preparedness through contingency planning, early detection and a rapid response is critical to the successful management of such disease outbreaks. A strong national approach to contingency planning is essential to ensure that the necessary operational capability is in place so that early detection and effective responses are achieved. Recovery from an emergency disease response must be followed by measures to ensure that freedom from the particular disease is again maintained.

Having the capability to deal with emergency diseases involves systematic planning, training, and simulation exercises (field trials or "dummy runs"), as well as having access to an appropriate level of resources, including trained personnel, essential equipment and the necessary financial and legal mechanisms. Although a comprehensive capability in many countries will take a long time to achieve, it is hoped that this manual will assist developing countries in laying foundations within the framework of whatever resources presently exist.

Arthur, J.R.; Baldock, F.C.; Subasinghe, R.P.; McGladdery, S.E.
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Foreword

The epizootic spread of aquatic animal diseases is becoming more common in many parts of the world, and many countries in the Asia-Pacific Region have, to various degrees, suffered the consequences of serious disease outbreaks. Examples include the devastating impacts of epizootic ulcerative syndrome (EUS) in freshwater fish during the 1980s and the 1990s, viral encephalopathy and retinopathy (VER) in marine fish since the 1990s, white spot syndrome virus (WSSV) in penaeid shrimp from the early 1990s, and the emerging Taura syndrome virus (TSV) in *Penaeus vannamei*. Since 2002, Indonesia has faced a serious epizootic of koi herpesvirus (KHV) that is causing large-scale mortalities with significant economic losses among cultured common and koi carp (*Cyprinus carpio*) populations. More recently, during the last quarter of 2003, an outbreak of KHV also occurred in common and koi carp in Japan. New transboundary aquatic animal diseases (TAADs) continue to appear, causing losses in aquaculture and capture fisheries – whitetail disease in giant river prawn the People's Republic of China and India, Akoya oyster disease in pearl oysters in Japan and abalone mortalities in China are examples.

The above examples demonstrate the vulnerability of aquaculture and wild resource production to wide-scale infectious disease emergencies and the significant impacts that new diseases can have on local economies. Unless appropriate health management and biosecurity measures are effectively implemented and continuously maintained, the risk of major disease incursions and newly emerging diseases will continue to threaten sustainable productivity in the aquaculture sector. Past experiences in dealing with disease epizootics provide useful lessons towards better preparedness for and improved responses to similar events when they occur in the future.

Effective prevention and control measures complemented by improved extension services, educational programmes and capacity building for farmers and other seafood producers are essential to reduce the risk of transboundary epizootics. A strong national approach along with a well-planned regional strategy is required to ensure that the operational capability is in place and prepared to respond effectively to disease emergencies. Equally important is a clear understanding by both government and the private sector of the benefits to be gained from investing and participating in emergency response systems for aquatic animal diseases commensurate with those in place for terrestrial animal and human disease emergencies.

The capacity for early detection and effective response to disease emergencies is inadequate in many countries. This is due to several factors, such as limited diagnostic capacities, lack of information, insufficient human resources and infrastructure, and lack of financial resources. Limited understanding of the gravity of the problem often results in failure to provide priority action at the national

and regional levels. This urgently needs rectifying to avoid further introduction of exotic pathogens and the spread of emerging diseases. In Asia, KHV is a prime example, requiring immediate attention from relevant international research and development agencies, as well as the private sector. Concerted action is essential for controlling this serious epizootic and to regain both consumer and producer confidence.

In order to review and evaluate the national and regional status of emergency preparedness and response to infectious diseases in aquatic animals, and to find avenues for providing guidance and assistance for national and regional improvements, the Food and Agriculture Organization of the United Nations (FAO), in partnership with the Government of Indonesia, the Network of Aquaculture Centres in Asia-Pacific (NACA) and the WorldFish Center (WFC) organized a workshop entitled "Emergency Preparedness and Response to Aquatic Animal Diseases". The purpose of the workshop was to review the regional experiences in responding to disease emergencies, including the work accomplished through an FAO Technical Cooperation Programme project in Indonesia providing technical assistance to improve national capacity to effectively respond to the ongoing carp disease losses (see FAO, 2005). The workshop was aimed at assisting Indonesia and other countries of the Asian Region in identifying actions to reduce the impacts of KHV on aquaculture and small-scale fisheries and strengthening preparedness in order to improve response to other serious aquatic animal disease emergencies, should they arise in the future. During the workshop, the participants identified the need for more extensive technical guidance for developing countries on emergency preparedness and response for serious outbreaks of aquatic animal diseases, leading to the preparation of this manual.

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1. Scope and purpose

The epizootic spread and devastating impacts of white spot syndrome virus (WSSV) in cultured shrimp in Asia clearly demonstrates the vulnerability of internationally dependent and connected aquaculture systems to wide-scale infectious disease emergencies (see de la Peña 2004). More recently, mass mortalities of koi and common carp (*Cyprinus carpio*) in Indonesia and Japan have re-emphasized this vulnerability with significant impacts on local economies (see Sunarto *et al*., 2004; Sano *et al.,* 2004; Sunarto and Cameron, 2005; Iida *et al.,* 2005). These and other outbreaks of transboundary aquatic animal diseases (TAADs) have shown that national aquatic animal health systems in Asian countries are generally ill-prepared to deal rapidly and effectively with epizootics caused by highly pathogenic, easily transmissible pathogens. There is therefore, an urgent need for national governments to improve their ability to prevent the entry of exotic pathogens, and to detect, contain, and if possible, eradicate serious pathogens if they appear in vulnerable species within a national territory or across a shared waterbody.

The important role of contingency planning[1] within a National Aquatic Animal Health Strategy is stressed in the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy* (FAO/NACA, 2000) and preliminary guidance to developing countries on the development of contingency plans is provided in the *Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* (FAO/NACA, 2001). This manual, *Preparedness and response to aquatic animal health emergencies in Asia: guidelines,* provides more detailed technical advice to assist Competent Authorities and other responsible individuals in planning for national aquatic animal disease emergencies through better planning and response and the preparation of national or bi-, multilateral contingency plans, as appropriate.

The approach outlined in these technical guidelines is based on Baldock (2005), and consistent with the World Organisation for Animal Health (OIE)[2]

[1] Contingency planning can be defined as the preparation of documented work plans designed to ensure that all needed actions, requirements and resources are provided in order to eradicate or control outbreaks of serious diseases of aquatic animals (see OIE, 2004). In these guidelines, we have used the term "emergency preparedness and response" to encompass the entire range of activities that national governments must undertake in preparing for, and dealing effectively with, outbreaks of transboundary aquatic animal diseases. This, of course, includes contingency planning as a major component.

[2] World Organisation for Animal Health was formally known as Office international des épizooties (OIE) – http://www.oie.net

Aquatic Animal Health Code (OIE, 2005) and the FAO Good Emergency Management Practices (GEMP) programme (www.fao.org/ag/AGA/AGAH/EMPRES/GEMP.htm).

Having the capability to deal with emergency diseases involves a great deal of planning and training, as well as an appropriate level of resources in the form of sufficient skilled personnel, equipment and financial and legislative mechanisms. Although such an infrastructure may take a long time to achieve for many countries, strong foundations can be laid within the framework of whatever resources presently exist. The need for capacity development and training for emergency preparedness and response to aquatic animal disease outbreaks in developing countries in Asia has been discussed by Mohan and Phillips (2005). These authors note that so far, the 21 participating countries in the Asia-Pacific Region have made little progress in the areas of contingency planning, import risk analysis and disease zoning – all key areas for rapid emergency response to disease outbreaks (see Table 1). Technical guidance for disease zoning has recently been provided by FAO (2004), while a manual on risk analysis to assist developing countries has been published (see Arthur *et al.*, 2004). It is hoped that this manual will assist developing countries in Asia and elsewhere to improve preparedness arrangements for early detection of, and rapid response to, serious outbreaks of aquatic animal diseases.

TABLE 1

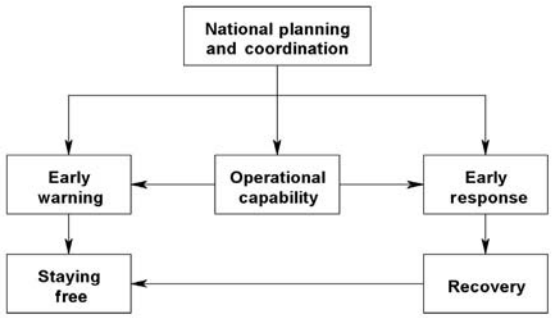
Assessment of progress made by 21 participating countries in the Asia-Pacific Region towards implementation of the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* (FAO/NACA, 2000) (from Mohan and Phillips, 2005).

Elements in the Technical Guidelines	Progress made (Number of countries)		
	Good	Moderate	Low
Disease diagnosis	8	8	5
Health certification and quarantine measures	10	5	6
Disease zoning	3	3	15
Disease surveillance and reporting	6	9	6
Contingency planning	3	6	12
Import risk analysis	2	5	14
National strategies and policy frameworks	11	4	6

2. Background

Infectious disease emergencies may arise within a country in a number of ways, for example, via incursions of known exotic diseases, through sudden changes in the behaviour of existing endemic diseases or by the appearance of previously unrecognized diseases. Early detection and rapid response are critical to the effective management of such disease emergencies. These depend on an aquatic animal disease prevention programme aimed at surveillance of vulnerable resources for disease outbreaks with a strong diagnostic capability to distinguish diseases of concern from recurrent endemic, husbandry or environmentally induced disease losses. A strong national approach is required to ensure that the necessary operational capability is in place so that early detection and effective responses are achieved. Assessment of the success of an emergency disease response requires measures to ensure that freedom from the particular disease has been achieved. Figure 1 shows the linkages among the different components of a comprehensive emergency preparedness and response plan. Each is explained in more detail in the following sections.

FIGURE 1
Framework for emergency disease preparedness and response (Baldock, 2005)



3. National planning and coordination

In order to have contingency planning recognized as an important core function of government services and to have adequate funding and other resources allocated to these activities, the Responsible Authority should ensure the support of, and participation by, all stakeholders. These include the relevant minister and senior ministry officials, other government departments and agencies (including national economic development planning authorities), farming and fishing communities and organizations, seafood marketing authorities, processors, traders and exporters (see Box 1). The importance of including private-sector stakeholders in planning for disease emergencies is stressed by Fegan (2005) – farm observations and rapid reporting are essential for early detection, which optimizes the probability of a successful response. A diagram showing the typical direct private-sector stakeholders in aquaculture is presented in Figure 2.

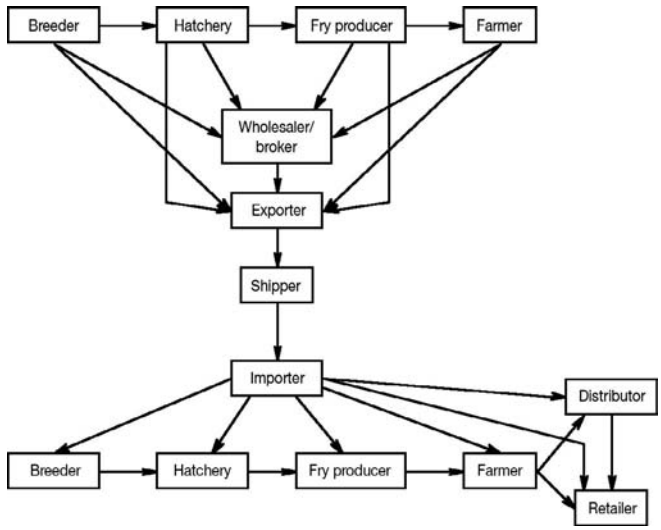
The key stakeholders are the government representing the wider community and the farming and fishing communities who are directly affected by emergency diseases. In presenting a strong case for support for emergency preparedness planning, the identified disease risks should be described together with the potential socio-economic consequences of an incursion of the disease. Additionally, the benefits that will result from more rapid containment and eradication of an emergency disease outbreak through preparedness should be forcefully presented.

BOX 1

Examples of key stakeholders who should participate in national preparedness for a disease emergency

- National & state fisheries agencies
- National & state veterinary agencies
- National disaster planning agencies
- National & state environmental agencies
- National & state wildlife agencies
- National, state & local enforcement agencies
- National economic development & planning agencies
- Key municipal/local governments of farming & fishing communities likely to be most impacted
- Key university & private-sector experts
- Aquaculture organizations
- Fisherman's organizations
- Fish marketing organizations
- Fish processing organizations
- Major exporters and traders

FIGURE 2
Typical network of direct stakeholders in aquaculture (Fegan, 2005)



The case should preferably be strengthened by a formal socio-economic cost-benefit analysis.

4. Operational capability

4.1 Responsibility for aquatic animal disease emergencies

"Countries must establish specified crises centre(s) (disease control centre[s]) that shall have the responsibility for the co-ordination of all control measures to be carried out. Such centres could either be located centrally or locally, depending on the infrastructure in a given country. A list of the crises centre(s) that have the necessary facilities to carry out disease control measures should be made widely available.

The contingency plan(s) should also state that the crises centre(s) have the authority to act rapidly to bring a given disease situation under control by contacting the personnel, organisations, aquaculture establishments, etc., that are involved directly or indirectly in managing an outbreak of a disease." (OIE, 2005)

The Responsible Officer recognized by the World Organisation for Animal Health (OIE) for the particular country should have overall technical responsibility with regard to preparedness for and management of aquatic animal health emergencies. This may be the office of the Chief Veterinary Officer (CVO) or equivalent Competent Authority, such as the Director of Fisheries, for a country. The government minister responsible for the regulatory authority for aquatic animal health protection would be ultimately responsible for the country.

4.1.1 National Emergency Disease Planning Committee

A National Emergency Disease Planning Committee (NEDPC) should be appointed to facilitate and coordinate contingency planning. This committee should be directly accountable to the relevant minister, and should be charged with the responsibility for developing and maintaining a high state of preparedness for animal disease emergencies. It should preferably be chaired by a clearly identified Responsible Officer who should conduct regular meetings to carry out the following functions:

- commissioning of risk analyses on high-priority disease threats and identification of those diseases that constitute a national emergency;
- appointing of appropriate expertise to prepare, monitor and approve contingency plans and supporting documents;
- assuring liaison with, and involvement of, relevant persons and organizations outside the government aquatic animal health services who are required to ensure a cohesive chain of response for aquatic animal disease contingency planning. These may include industry groups, the national disaster management authority, and the departments of economic planning and finance, environment and wildlife;
- enhancing the capabilities of emergency field and laboratory services, especially for specific high-priority disease emergencies that, by definition, fall outside the scope of day to day operational experience (i.e. the diseases are exotic, hence, unfamiliar);

- developing active disease surveillance and epidemiological analysis capabilities and emergency reporting systems;
- training staff responsible for delivery of the national aquatic animal health prevention and preparedness programme and developing fisherman/farmer awareness programmes;
- assessing the resource needs and planning for their provision during disease emergencies;
- drafting of legislation and development of financial plans;
- implementing simulation exercises to test and modify disease emergency plans and preparedness; and
- overall monitoring and maintenance of the preparedness programme (personnel, equipment and communications plans) for real-time response to suspect, as well as confirmed, disease emergencies.

The NEDPC should comprise the Responsible Officer as chairman, a National Emergency Disease Planning Officer (see below) as secretary, a director of field services/director of disease control (or equivalent), a director of the national laboratory system, the director of aquatic animal quarantine (border controls) and/or aquatic epidemiology unit (where present) and the directors of relevant state or provincial agencies.

In addition to these senior officials, representatives of other ministries that may have responsibilities related to responding to aquatic animal disease emergencies, such as environment, wildlife services, and economic planning and finance, should either be full members of the committee or designated, as required. It is recommended that members drawn from the private sector, such as representatives of major fishing, farmer, processing and trading organizations, as well as national industry representatives be included in the planning process. Directly affected stakeholders should be included in contingency plan implementation to ensure collaboration and effective containment of diseases that might otherwise be spread by "panic response" activities. Proactive inclusion of stakeholders of vulnerable resources in test runs of contingency plans is a recommended procedure for identification of any gaps or problems in implementation plans, as well as easing industry concerns over "fear of the unknown".

4.1.2 National Emergency Disease Planning Officer

A National Emergency Disease Planning Officer (NEDPO) should be appointed. This officer should be a senior officer in the relevant government department with training in epidemiology and/or extensive field experience in the management of aquatic animal disease control programmes. Depending on resource vulnerability and diversity, a small unit of specialized professionals can be appointed to support the NEDPO (e.g. communications officer), however, a single overall leader, with clearly identified responsibilities, is essential.

The planning officer would be both the adviser to, and the executive officer of the National Emergency Disease Planning Committee, and would be actively involved in all NEDPC functions listed in Section 4.1.1 above.

4.2 Aquatic animal disease contingency planning as a component of a National Disaster Plan

Most countries have well-developed national disaster plans applicable to major fires, floods, hurricanes, earthquakes, volcanic eruptions, and terrestrial animal and human infectious disease outbreaks. These allow essential government and non-government services and resources to be rapidly mobilized in response to these disasters. Such plans may also allow essential services agencies to be given special powers to act unimpeded by normal bureaucracy under such emergencies.

A strong case can be made for the official recognition of aquatic animal disease emergencies as a defined disaster situation that can be readily incorporated into existing national disaster plans. An epizootic of an emergency aquatic animal disease, for example, has the same characteristics as other natural disasters: it is often a sudden and unexpected event, has the potential to cause major socio-economic consequences, including jeopardy of national food security, and requires a rapid nationally coordinated response.

4.3 Legislation and enforcement

"Countries must establish the necessary legal provisions that are needed for the implementation of contingency plan(s). Such legal powers must include provisions for establishing a list of diseases for which action is needed, definitions of how such diseases should be managed if detected, provisions for access to infected/suspected sites, and other legal provisions, as needed" (OIE, 2004).

National governments must have in place the necessary legislation to allow them to implement contingency plans. This may involve stringent measures, such as restrictions on domestic movement (zoning) and the sale of potentially infected stock, entry of aquaculture premises and processing facilities for purposes of testing and inspection, confiscation of stock, the mandatory treatment or destruction of aquatic animals, and penalties for violations. As part of national aquatic animal disease contingency planning, the Responsible Authority should undertake a review of the pertinent existing national and state legislation to ensure that necessary legal powers are in place. If existing legislation is lacking or inadequate, the national legislation should be revised or new legislation prepared. Developing countries that lack sufficient expertise to assess their legislative needs can request assistance from international agencies such as the Food and Agriculture Organization of the United Nations (FAO). Regulatory frameworks for national emergency preparedness and response to aquatic animal disease outbreaks have recently been reviewed by Van Houtte and Dogra (2005).

5. Early warning

Early warning at the national level could be described as having advance knowledge of high-risk diseases likely to threaten national biosecurity before the pathogens actually enter national territory. Effective early warning depends strongly on the responsible authority having excellent awareness of the current disease situation of the country's primary trading partners and on emerging aquatic animal diseases on a world-wide basis. Early warning thus involves such activities as:

- developing good communication linkages and working relationships with the Responsible Authorities of primary trading partners;
- contributing to, and frequent checking of, regional and international disease reporting systems and databases; and
- communicating with key aquatic animal health researchers in primary trading partner countries and on a world-wide basis through such avenues as aquatic animal health newsletters and e-mail discussion groups and attendance at regional and international meetings and workshops where "breaking news" on new disease occurrences is reported.

As an example, Indonesia and Japan could have had early warning of the potential threat posed by koi herpesvirus if their Responsible Authorities had been carefully monitoring and analyzing reports of scientific meetings and recent articles appearing in scientific journals. In turn, because Japan and Indonesia provided trading partners with fairly rapid notification, via reporting to the OIE and through presentations given at scientific meetings, that a serious disease outbreak was occurring in their koi and common carp, their trading partners have had a good opportunity for early warning and the chance to take appropriate biosecurity measures to protect their carp and koi culture industries.

6. Early detection

"An early detection system is an efficient system for ensuring the rapid recognition of signs that are suspicious of a listed disease, or an emerging disease situation, or unexplained mortality, in aquatic animals in an aquaculture establishment or in the wild, and the rapid communication of the event to the Competent Authority, with the aim of activating diagnostic investigation with minimal delay." (modified from OIE, 2004)

Early detection is the detection of an emerging disease situation within a country's national territory within the shortest time frame possible. The aim of an early detection system is to ensure detection of the introduction of, or sudden increase in the incidence of, any disease of aquatic animals that has the potential of developing to epizootic proportions and/or causing serious socio-economic consequences. It embraces all initiatives that lead to improved awareness and knowledge of the distribution and behavior of disease outbreaks (and of infection) and that allow forecasting of the source and evolution of the disease outbreaks and the monitoring of the effectiveness of disease control campaigns. The key components of a national early detection system are given in Box 2.

BOX 2

Key components of a national early detection system (modified from OIE, 2004)

- Broad awareness, e.g. among the personnel employed at aquaculture establishments or involved in processing, of the characteristic signs of listed diseases and characteristics of other diseases that could be cause for concern ("emerging diseases").
- Experienced veterinarians or other aquatic animal health professionals trained in recognizing and reporting suspicious disease occurrence.
- Ability of the Competent Authority to undertake rapid and effective disease investigation.
- Access by the Competent Authority to laboratories with the expertise and facilities required to diagnose and differentiate listed and emerging diseases from endemic or benign infections.

7. Risk analysis

Risk analysis is something that we all do intuitively in our everyday life as well as in our professional work. Only recently has it developed into a more formal discipline, and its is now used in an increasingly diverse range of fields, including aquatic animal health management. In aquatic animal health, it is widely applied to evaluate risks associated with international trade imports. Risk analyses are used in reaching decisions on appropriate disease lists for federal control programmes, health certification, and disease control measures/conditions applied to imports into a particular country in order to reduce the risk of such diseases impacting on vulnerable resources within the country to the country's acceptable level of risk (i.e. to below the appropriate level of protection).

Risk analysis is a tool that can also be used to good advantage for animal disease emergency preparedness. International standards for import risk analysis are contained in the *Aquatic Animal Health Code* (OIE, 2004). A *Manual on Risk Analysis for the Safe Movement of Aquatic Animals* (Arthur *et al.*, 2004) provides a simplified overview of the risk analysis process to assist responsible individuals to formulate national policies and develop approaches for conducting risk analyses for pathogens.

In the context of contingency planning, risk analysis works at two levels:

- determining which aquatic resources are at a particular level of risk from aquatic animal imports for aquaculture, processing or live/fresh marketing and thus merit protection via investment in a prevention programme and contingency plan measures; and
- determining which control options present the greatest chance for success versus risk of failure, should the disease of concern appear in naïve (vulnerable) resources. This entails an analysis of the cost of each proposed control option, weighed against the consequences of failure to contain or eradicate the pathogen.

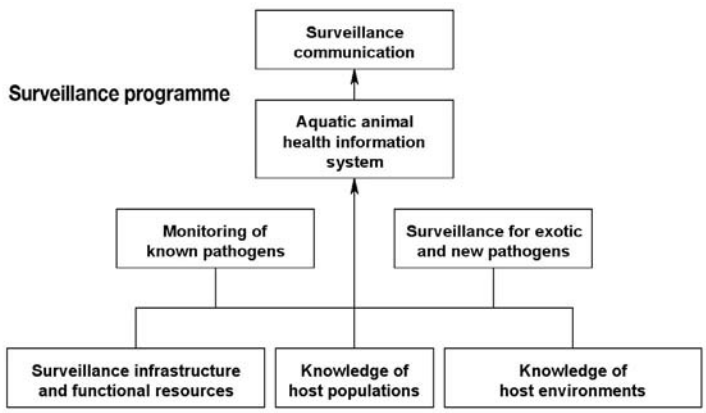
8. Disease surveillance

"*The primary purpose of aquatic animal disease surveillance is to provide cost-effective information for assessing and managing risks associated with trade (intra- and international) in aquatic animals and products, animal production efficiency and public health.*" (FAO, 2004)

Disease surveillance is an underpinning necessity for any effective government aquatic animal health protection programme. This maximizes the chances of early detection of diseases of concern and provides the data required for science-based certification of export health status, international reporting and verification of freedom from diseases. A comprehensive disease surveillance system provides a reliable picture of the health status of aquatic animal populations on an ongoing basis. It also provides the tracking/traceability information for rapid and effective response to the emergence of an aquatic animal disease emergency.

Figure 3 provides a conceptual summary of the relationships among the broad components of a national aquatic animal disease surveillance programme. This figure incorporates the concepts of the OIE *Aquatic Animal Health Code* of providing an effective surveillance infrastructure, as well as including a description of host population and environmental characteristics. Detailed guidance to Responsible Authorities for establishing a national system for surveillance and zoning for aquatic animal diseases can be found in *Surveillance and Zoning for Aquatic Animal Diseases* (FAO, 2004). An important concept for contingency planning in relation to surveillance and zoning is planning for a disease emergency in

FIGURE 3
Relationships among different components of a surveillance programme incorporating OIE Code concepts (Baldock, 2005)



vulnerable resources than span national borders (shared waters). Collaborative surveillance and zoning, as well as contingency planning, is essential to prevent one country's efforts, or lack thereof, affecting their neighbour's efforts.

Information on aquatic animal diseases important to the Asia-Pacific Region can be found in the *OIE Aquatic Animal Health Code* and *Manual of Diagnostic Tests for Aquatic Animals* (OIE, 2003, 2004), the *Asia Diagnostic Guide to Aquatic Animal Diseases* (FAO/NACA, 2001), the Network of Aquaculture Centres in Asia-Pacific (NACA)/Food and Agriculture Organization of the United Nations (FAO)/OIE Quarterly Aquatic Animal Disease Reporting System (http://www.enaca.org/Health/QAAD) and the OIE International Database on Aquatic Animal Diseases (http://www.collabcen.net). The current status of serious diseases of aquatic animals in the Asia-Pacific Region has recently been reviewed by Arthur (2005).

9. Early response

Early response can be defined as all actions that would be targeted at rapid and effective containment of, and then possibly elimination of, an emergency disease outbreak, with the objective of preventing it from spreading and becoming an uncontrollable epizootic. There are three broad control options for responding to emergency disease detection; the option chosen for any particular disease will depend on many different factors associated with the detection scenario. Some cases may require testing a combination of these options:

- ***Eradication.*** Initial eradication of disease with eventual total elimination of the pathogen from the country or affected population, including sub-clinical infections if they occur. This is the highest level of response but may not always be possible, especially where the disease was well-established prior to the initial detection (i.e. where early detection has essentially failed), intermediate or carrier hosts are unknown, or the source of the infection is unknown (or related to an uncontrollable, ongoing, unrelated human activity such as recreational water use or commercial shipping).
- ***Containment.*** Containment of the disease and pathogen within specified zones with controls in place around infected zones to prevent spread to uninfected populations within the country or straddling neighbouring borders.
- ***Mitigation.*** Reduction of the impacts of the pathogen by implementing control measures at the farm, or affected population, level that reduce the occurrence and severity of disease. These measures focus on stocks within the infected zone, and concentrate on long-term circumvention of disease losses, either through development of treatments (vaccines, antibiotics as appropriate) or husbandry techniques (selection of resistant broodstock, variation of stocking/harvest times). These measures are based on failed eradication attempts or epidemiological risk assessments indicating that eradication efforts are unfeasible or impractical.

10. Contingency plans

"A number of diseases are regarded as posing a potential threat to aquaculture as well as to wild stocks of aquatic animals world-wide. The introduction of such diseases into countries recognised to be free from these diseases or into countries with an established control system and eradication programme for such diseases, may result in significant losses. In order to diminish such losses, the Veterinary Administration or other Competent Authority responsible for aquatic animal health may need to act quickly and should develop contingency plan(s) before such events occur." (OIE, 2004).

An aquatic animal disease contingency plan is a documented work plan designed to ensure that all needed actions, requirements and resources are provided in order to eradicate or bring under control outbreaks of infectious diseases of significance to aquatic animal productivity and/or market access. Efforts should concentrate on specific, high-priority emergency diseases, with a series of generic plans focused on activities or programmes shared by the various specific disease contingency plans (e.g. national and local disease control centers). Effective contingency plans need stable resources and financial support, along with legislative backing for all control actions (access to sites, animals, fishery closure enforcement, etc.). The contingency plans need to be reviewed and agreed upon in advance by all major stakeholders, including the political and bureaucratic arms of government and the private sector, particularly representative farmer, fishery and community organizations that have a stake in the resources falling under contingency plan protection. This must include consideration of "collateral damage" to sympatric species (species sharing the same waters as known naïve resources), as these are increasingly subject to inclusion as "potential susceptible species" (i.e. carriers) under international standards (OIE, 2004).

Contingency plans should be refined on a regular basis through simulation exercises and personnel should be trained in their individual roles and responsibilities. The frequency of such revisions should be determined by the rate of development of vulnerable resources or any changes in human activities that change vulnerability (e.g. changes to species grown on leases), regulatory responsibility or environmental changes).

The components of a contingency plan are shown in Box 3.

Examples of developed country experiences in contingency planning and response to serious disease outbreaks are given by Håstein and Gudding (2005) for Norway, and by McGladdery and Stephenson (2005) for Canada. The Canadian experience in developing a model contingency plan and then modifying it into an actual working contingency plan in the face of a sudden outbreak of a serious exotic disease (MSX (*Haplosporidium nelsoni*) in eastern oysters (*Crassostrea virginica*)) is discussed by the latter authors. Fegan (2005) presents two case studies of attempts by national governments and the private sector in developing

BOX 3

Components of a contingency plan (Baldock, 2005)

- **Summary document**
- **Technical plans**
  - Disease strategy manuals (one for each high priority disease)
  - General procedures manuals
  - Enterprise manuals
  - Job descriptions
- **Support plans**
  - Financial
  - Resource
  - Legislation
  - Other agencies
- **Operational capability**
  - Management manuals
  - Diagnostic resources
  - Field personnel
  - Training resources
  - Awareness and education
  - Response exercises

countries to deal with serious outbreaks of disease in penaeid shrimp – yellowhead disease (YHD) and white spot disease (WSD) in Thailand and loose shell syndrome (LSS) in India. However, in both of these cases, as with the recent outbreaks of koi herpesvirus (KHV) in Indonesia, national governments were unprepared to deal with the disease outbreaks, as no contingency plans had been made prior to the epizootic appearance of the pathogen.

The relationships among the different components of a model contingency plan are shown in Figure 4 and each of the various components are discussed below.

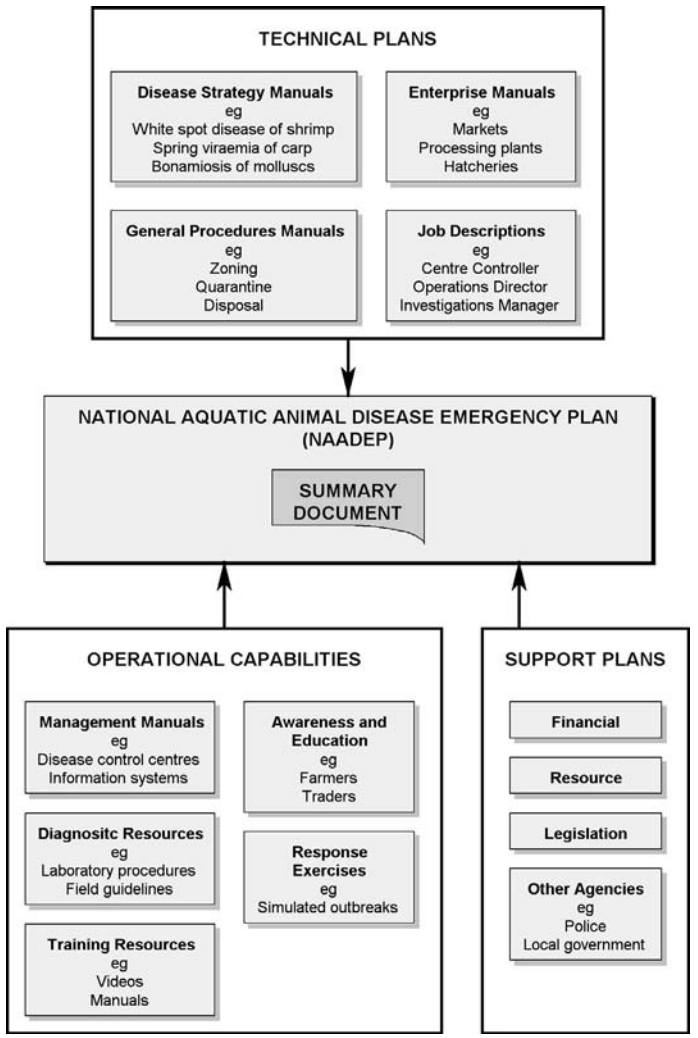
10.1 Summary document

The responsible authority should prepare a summary document presenting an overview of the national approach for contingency planning for serious aquatic animal diseases. The information should be concisely and clearly presented, such that it can be easily understood by all stakeholders, many of whom will have little or no understanding of the technical aspects of aquatic animal health. Information on emergency preparedness and response, including contingency planning, can be incorporated into a broader document presenting the country's National Aquatic Animal Health Strategy. An example of this is AQUAPLAN, which presents to the public Australia's strategic plan for aquatic animal health (AFFA, 1999).

10.2 Technical plans

Technical plans, presented as sets of instructions or manuals, are required to support the various components of national contingency plans. Some manuals can

FIGURE 4
Relationships among different components of a National Aquatic Animal Disease Contingency Plan (Baldock, 2005)



be "generic" for components that apply to all/most disease emergencies; whereas others will need to be disease specific, taking into account the need for specialized expertise, partnerships or international coordination. The exact number of manuals or instructions needed for a given contingency plan may vary, depending on the nature of the pathogen, the disease under consideration and the nature of the aquatic resources they are designed to protect. The technical plans developed for use by government must incorporate private-sector contacts as required and be available to those personnel for cohesive coordination of effort. Any updates must, likewise, be shared with all contacts that remain listed or are added to the technical implementation plan.

An example of a national emergency preparedness and response programme is the Australian Aquatic Animal Diseases Veterinary Emergency Plan (AQUAVETPLAN. See AFFA, 2002). The AQUAVETPLAN consists of a series of management, operational procedures, enterprise (facility) and disease strategy manuals outlining Australian emergency preparedness, response and control strategies. The manuals provide guidance, based on experienced analysis, linking policy, strategies, implementation, coordination and emergency management plans. This plan is also aimed at maximizing access to terrestrial animal emergency response expertise by paralleling the terrestrial AUSVETPLAN as closely as possible. At present, the AQUAVETPLAN manuals include:

10.2.1 Control Centers Management Manual

The Control Centers Management Manual is a management manual that outlines the organizational response during the investigation, alert, operational and stand-down phases of an aquatic animal disease emergency. The manual:

- addresses the associated legislative, management and resource issues;
- lists the immediate duties of field officers, senior managers, the chief veterinary officer and other staff in each phase;
- covers the establishment and operations of the State/Provincial disease control headquarters and of local disease control centers, with special reference to their roles, location, equipment, staffing, layout and specialist elements;
- addresses issues related to information management during and after an emergency; and
- provides checklists, sample forms, draft meeting agendas and notes on movement permits and cost-recovery arrangements.

10.2.2 Enterprise manual

Enterprise manuals can be used provide detailed disease emergency response guidelines for a number of different types of "enterprise", such as aquaculture facilities, hatcheries, diagnostic laboratories, processing plants, live markets, etc. As an example, the AUQAVETPLAN Enterprise Manual describes the emergency response options available for control and eradication of aquatic animal diseases for four general types of production systems:

- open (catchment, estuarine and marine systems);
- semi-open (cage culture and shellfish culture systems);
- semi-closed (introduced and native freshwater fish, hatcheries and raceways); and
- closed systems (aquaria).

It also provides a framework for deciding which strategy to use, taking into account such additional factors as the type of pathogen, the management practices used and the effectiveness of available treatments. The manual is divided into three sections and the appendices:

- a section providing general information on emergency response;
- a section providing information on industry practices relevant to disease control;

- a section providing information on response options; and
- the appendices, which provide supporting information on such topics as national and state legislation, zoonoses, diseases of concern, currently cultured animal species, use of chemicals and drugs in aquaculture and a list of contact numbers.

10.2.3 Destruction manual

The Destruction manual is an operational procedures manual to be used in instances where preventing the spread of a serious disease necessitates the efficient and humane killing of stock. The manual:

- guides the decision to destroy the stock, and the choice and application of appropriate techniques based on several considerations (e.g. type of animal, disease and production system; the number and size of the animals and their end use; and the possibility of the disease infecting human beings);
- assesses the chemicals available for use with finfish, crustaceans and molluscs, with a note on environmental considerations;
- recommends methods for closed, semi-closed, semi-open and open (marine and riverine) systems; and
- provides standard chemical safety datasheets, and a detailed note on the use of rotenone.

10.2.4 Disposal manual

The Disposal manual is an operational procedures manual that provides guidance on best practice for safe transport and disposal of carcasses, animal products and wastes. The manual includes guidance on:

- selection of disposal sites, both on and off the site;
- transportation of material and the protection of navigation;
- for burial or incineration, site selection, appropriate earth moving equipment, correct pit or pyre construction, and the use of incinerators;
- less frequently used methods, including rendering, composting, on-site processing and freezing; and
- items requiring special consideration, such as blood water and liquid waste, effluent, semen and ova, and laboratory waste.

10.2.5 Disease strategy manuals

Disease strategy manuals are a series of manuals that provide specific information needed for the recognition and control of individual diseases. At present AQUAVETPLAN includes strategy manuals for two diseases of finfish – viral encephalopathy and retinopathy (VER) and furunculosis (*Aeromonas salmonicida salmonicida*). Each disease strategy manual covers the following topics, with disease-specific variation in the subtopics that are included:

- nature of the disease
  - etiology
  - susceptible species
  - world distribution and occurrence in Australia

    - diagnostic criteria (e.g. clinical signs, pathology/histopathology, laboratory tests, differential diagnosis, treatment of infected animals)
    - resistance and immunity (innate, active and passive immunity, vaccination)
    - epidemiology (e.g. sources, reservoirs, predisposing factors, persistence of agent, modes of transmission)
- principles of control and eradication
    - methods to prevent the spread of pathogens and to eliminate them (e.g. quarantine and movement controls, tracing, surveillance, treatment of fish, destruction of fish, treatment of fish products and by-products, disposal of animal products and by-products, decontamination, environmental considerations, vaccination, vector control, sentinel and restocking measures, public awareness)
    - feasibility of specific options for control in Australia (eradication, and containment, control and zoning; trade and industry considerations)
- policy and rationale
    - discussion of overall policy
    - problem definition (rapid confirmation of infection, epidemiological investigation and definition of the nature and extent of the problem, interim measures to minimize further spread, determination of appropriate response)
    - overview of response options (eradication, and containment, control, zoning)
    - strategies for control and eradication (epidemiological investigation, quarantine and movement controls, zoning, destruction of clinically diseased fish, destruction of unexposed fish, destruction of exposed or potentially exposed but clinical normal fish, treatment of infected fish, treatment of fish products and by-products, vaccination, combined control measures, disposal, decontamination, surveillance, sentinel and restocking measures, tracing)
    - social and economic effects
    - criteria for proof of freedom
    - funding and compensation

10.2.6 Job descriptions

A rapid and effective response to a disease emergency requires that all key personnel involved in implementing the contingency plan clearly know and follow their roles and responsibilities. Designated alternates should be alerted and ready when a contingency plan is put into effect, whether for training or for a real-time exercise, in case key personnel cannot participate for reasons beyond their control. Key staff should be identified (by name, title or position), along with their major responsibilities and current contact information. Where agreed upon by the contact person, personal contact information can be included in case that detection of an emergency disease occurs outside regular working hours. Alternatively, dedicated phone numbers or 24-hour security numbers can be provided. Contingency plan

responsibilities should be incorporated into the normal job description of key individuals; however, it is also essential to have this information included in any operational procedures manual, so everyone involved in an emergency response knows their duties, the chain of command and can access the requisite contact information.

10.3 "Surge" support

Implementation of a contingency plan in the face of a major disease outbreak requires substantial financial, equipment and human resources over and above those required for non-emergency (routine) operations. This means that contingency planning must take into account routine operating budgets and maintain sufficient equipment and personnel time to permit a minimal state of response readiness should a suspect or emergency diagnosis be made. Resource plans and access to personnel from other projects or operational offices/laboratories should be agreed upon, in advance, by senior managers to avoid wasting time seeking approvals or negotiating conditions when an emergency is underway. A major outbreak of a rapidly spreading, highly pathogenic disease may require the involvement of many governmental departments and agencies, key private-sector organizations, and regional or international assistance and expertise. Recent agreements, such as those signed by Australia, New Zealand, Canada and the United States for serious terrestrial animal diseases, could be used as models for regional or multinational cooperation. This would be especially useful for countries that share waterbodies and/or have comparable or complimentary expertise in the aquatic resources deemed vulnerable.

10.4 Operational capability

"*The contingency plan(s) should provide information on the staff required to undertake the control measures, their responsibilities, and instructions on the chain of command.*" (OIE, 2004).

Developing and maintaining an operational capability to effectively and efficiently deal with emergency disease events is a major and continuing challenge. It is not possible to be prepared for all possible emergencies, but countries can aim towards having the resources prepared for more likely outbreak scenarios. This can be accomplished by ensuring that key personnel are well trained and that key stakeholders are aware of the significance of emergency diseases and the need for rapid, coordinated and pre-agreed action plans. It should be noted and reinforced among key governmental and private-sector personnel that the primary objective is to avoid the need to put the contingency plan into action (i.e. to prevent the emergence of emergency diseases). Contingency plans can only remain effective if they are regularly tested. Complacency in testing a plan over an extended period of time (due to no disease emergencies) can render the best contingency plan ineffective. The vulnerable resource, personnel and environment inevitably change over time; thus the longer the time between testing, the greater the chances of gaps and inefficiencies occurring. Thus, the response capacity of all components of the contingency plan should be subject to regular testing and review.

10.4.1 Response management manuals

Manuals that outline the management structure and communication/information flow for an emergency disease should coordinate both national and local levels. This can include information on national and local disease control (or operation) centers, providing information on the chain of command, tahe functions of different sections of the Responsible Authority and role descriptions. Management manuals can also be prepared for:

- organization and operation of the national disease control center;
- organization and operation of local disease control centers; and
- emergency disease reporting and information systems, including public and media information, and mapping of emergency surveillance results for assessing control options and for informing key stakeholders and the public.

A comprehensive list of sets of instructions or procedures that may be needed for contingency plans is given in Box 4. Note that several sets of procedures or instructions may be incorporated into a single operational procedures, disease strategy, management or enterprise manual, especially where expertise or resources overlap.

10.4.2 Diagnostic resources

"Countries establishing contingency plan(s) should establish national reference laboratories having the necessary facilities for diagnostic work on aquatic animal diseases that can be carried out rapidly. The national laboratory(ies) must also have established a set of instructions as regards rapid transportation of samples, and established protocols for quality assurance and diagnostic procedures to be used." (OIE, 2004).

Once a particular disease has been recognized as an emergency, the capability to make a presumptive field diagnosis as well as subsequent confirmation in the laboratory must be available. For disease threats that are a high priority, this capability must be in place in advance of disease outbreaks. The initial diagnosis should be confirmed in a laboratory with specialized expertise with the disease in question, especially if this is a first diagnosis. Where the disease in question is an OIE-listed disease, OIE reference laboratories exist with the mandate of assisting with confirmatory diagnosis where such capacity does not exist within the country. Note, however, that these laboratories are also responsible for reporting a positive confirmation if the country submitting the sample does not do so within the recommended reporting period set by the Aquatic Animal Health Standards Commission (AAC) of the OIE (OIE, 2004). Abnormal findings during a disease outbreak should also be confirmed, as benign similar pathogens may be encountered during intense surveillance to map the exact distribution of the serious infection.

To respond effectively to an emergency disease, the authority to supervise activities and control access to known affected stocks as well as "unknown status" neighbouring stocks is critical. In addition, pre-prepared communication and information packages are essential to control "over-reaction" by non-disease experts. One of the first projects should be investigation of the possible avenues

BOX 4

Sets of instructions needed for emergency response management (modified from OIE, 2004)

- Standard Operating Procedures for diagnostic analyses at national reference laboratories.
- Provisions for raising public awareness of aquatic animal diseases considered to pose a risk to local resources – supplement to on-farm surveillance.
- Reporting procedures – for suspicion and for confirmatory diagnostics.
- Confirmation of diagnosis, if necessary, at an OIE Reference Laboratory (recommended for OIE-listed disease agent detection for the first time in a country, or for a suspect detection in an "abnormal" aquatic host species.
- Standing instructions to aquatic animal health personnel in the field with respect to security measures for collecting, packaging and transporting samples to designated laboratories.
- Instructions for handling/disposal of dead aquatic animals at aquaculture establishments, from harvest/aboriginal fisheries, from live-holding brokers and from processing plants; as well as for sanitary culling of infected stock, as required.
- Instructions for local disease control measures to prevent spread via community activities that may, or may not be directly related to the affected aquatic resource.
- Instructions for the establishment areas designated as closed pending emergency surveillance to map the extent of the emergency disease outbreak.
- Provisions for controlling movements of aquatic animals from areas designated as under emergency disease control.
- Disinfection procedures, where appropriate for collection materials; holding, aquaculture and processing facilities; and for other water users in affected areas (e.g. recreational boats).
- Fallowing procedures.
- Surveillance methods for assessing success/failure of control efforts aimed at eradication.
- Restocking procedures.
- Compensation criteria and application procedures, where applicable for proprietary animals.

for introduction of the pathogen. If related to human activities that can be stopped, this must be pursued as quickly as possible.

Perhaps the most important link in the chain from the site of the disease outbreak to the diagnostic laboratory is the necessity for adequately trained and motivated field personnel. Fisheries extension officers, aquaculture technicians or other local staff will be the first to know that a disease outbreak is occurring. To play an effective role in early disease detection, they must:

- have sufficient knowledge and awareness to recognize when a serious disease outbreak is occurring; and

- know the appropriate persons/agency to contact to report the disease occurrence so that a diagnostics team can be quickly dispatched.

Additionally, it is useful if field staff:

- have sufficient training so that they can provide an accurate description of the gross clinical signs (training in Level 1 diagnostics);
- know how to provide a preliminary assessment of the outbreak (correctly identify the species affected and estimate the extent and pattern of mortalities); and
- know how to properly collect, preserve, label and ship samples of diseased aquatic animals and/or their tissues to the laboratory for necropsy and/or histopathological examination.

10.4.3 Training resources

"Countries establishing contingency plan(s) must establish necessary training programmes to ensure that skills in field, administrative and diagnostic procedures are maintained." (OIE, 2004).

All staff should be thoroughly trained in their roles and responsibilities in a disease emergency. More intense training will be needed for those who are in key coordination and decision-making positions, as well as for designated spokespeople responsible for responding to media enquiries.[3] Training must also include designated back-up staff for all roles within the contingency plan. Training of aquatic animal health staff in early recognition of emergency diseases and collection and dispatch of diagnostic specimens is a key component for the effectiveness of any contingency plan.

Training for early recognition and diagnosis of exotic diseases of concern should, ideally, be undertaken in areas where the disease is endemic and laboratory personnel are familiar with the disease agent and its various manifestations. If such training cannot be conducted in areas endemic for the disease, tight biosecurity conditions at the training facility are required to ensure no disease agents escape… eliciting the contingency plan prematurely!

An outline of human resource requirements and expertise for establishing effective contingency plans in the Asia-Pacific Region is given in Tables 2 and 3.

10.4.4 Awareness and education

This is one of the most critical, but sometimes neglected, aspects of contingency planning for emergency diseases, and for fostering "ownership" and support for emergency disease control/eradication campaigns from farmers and other key stakeholders. This should focus on a "bottom up" approach, since the front line for early messages and media attention is usually the affected farmers or fishery industry representatives, as well as local government authorities.

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[3] Due to their knowledge of the disease or outbreak situation, key scientific personnel are often delegated responsibility for communicating with the media. However, this can reduce their availability for actual disease investigation, especially where there is intense media interest and thus, it is preferable that managers who have received preparatory briefing assume the role of media spokespeople.

TABLE 2
The responsibilities involved at different levels and the capacity building required for contingency planning (modified from Mohan and Phillips 2005)

People	Responsibilities	Capacity Required
• National committees/ responsible authorities (e.g. Ministry of Fisheries, Department of Fisheries, Department of Livestock, fisheries research centers, fisheries teaching institutions, extension departments, private sector) with a single, clearly identified, lead person.	• developing national aquatic animal health strategies • identifying diseases of national concern • commissioning risk analyses on high-priority disease threats • developing technical plans for emergency preparedness (disease response manuals, general procedure manuals, enterprise/facility manuals, job descriptions) • developing support plans for emergency preparedness (e.g. financial, human & equipment resources, legislation) • developing active disease surveillance & epidemiological analysis capabilities & emergency reporting systems • conducting training & awareness programmes	• qualified human resources with specialization in aquatic animal health (e.g. diagnostics, disease management and treatment, epidemiology, risk analysis, surveillance, zoning, biosecurity) • qualified human resources with knowledge on environmental assessment, socio-economic infrastructure (knowledge of established or changing human activities for each area encompassing vulnerable populations) • necessary laboratory infrastructure • access to information • financial resources • full-time dedicated field equipment
	• Ensuring operational capacity for early warning & emergency response (e.g. management manuals, diagnostic resources, capacity & awareness building)	• trained human resource for diagnostics (levels I, II & III diagnostic capabilities), risk analyses, surveillance, epidemiology. • adequate infrastructure, equipment, authority (policy & regulations), communication and transport access. • training resources • emergency field & laboratory services • adequate financial resources

The preparation of proactive communication plans, shared, where possible, with industry stakeholders responsible for vulnerable resources, can avoid unnecessary deflection of valuable expertise to address "blame" questions at the height of the disease emergency. Proactive communication can take the form of pamphlets or flyers that are available both before and during a disease emergency. These can be kept on the farm, in local field offices, and in government and laboratory facilities. Most contingency plans focus on reactive communication responses, but the value of pre-prepared information cannot be over-estimated, especially as a critical time-saving exercise for disease experts.

The communication strategies should aim to make stakeholders aware of the nature and potential consequences of important diseases, and of the benefits to be derived from participating in their prevention and eradication. Furthermore, communications should emphasise the need to rally the whole community to the common cause of fighting the disease. Another critical component of all public communication is the need to lead with a key message related to food safety. This is the general public's first concern, and thus the consumer needs to be immediately

TABLE 3
The responsibilities involved at the different levels of technical complexity and the capacity building required for effective early disease detection and emergency response implementation (modified from Mohan and Phillips (2005)

People	Responsibilities	Capacity required to support skill development
Pond/Farm Level (e.g. farmers, farmer associations, fisheries extension officers, officers of the local disease control center)	• recognize a disease emergency • report to the concerned authority • initiate early response controls • facilitate the implementation of response options suggested by the local/national disease control centers through providing access to affected sites, on-site boats & other equipment, & assisting with communication of information as it becomes available with anyone with direct links to the affected animals. • Provide local/national authorities with any information that can help trace the source of infection, as well as any movements of live animals off the site prior to the disease outbreak	• Level I diagnostics (presumptive diagnosis based on history and gross clinical signs) • methods of disease reporting, collection of data & samples • basic biosecurity principles to help prevent spread of disease pending, as well as following diagnostic confirmation of infection • disinfection procedures • methods for safe destruction & disposal of suspected infected animals
Village/District level (e.g. extension staff, department officers, farmer leaders, research staff, officers of the local disease control center; fisheries organizations, aboriginal resource users, processors, live-holding brokers)	• recognize a disease emergency • report to the concerned higher authority • coordinate early response controls between affected farmers, fishery interests, related stakeholders, local authorities and the State/ Province level • implement the recommended control options to prevent disease spread, both prior to and following diagnostic confirmation	• Level I diagnostics (presumptive diagnosis based on history and gross clinical signs) • procedures for collection of healthy & moribund samples, optimal preservation techniques • transportation biosecurity measures to prevent spread of disease via collection of samples for laboratory analysis, including disinfection methods • methods for safe destruction and disposal of suspected infected animals
State/Province level (e.g. research personnel, officers of departmental authorities, officers of state and provincial authorities and disease control centers)	• identify a disease emergency • identify risks associated with the suspected outbreak of the exotic pathogen • assist with confirmation of suspect diagnosis using direct expertise or via a national/OIE reference laboratory • report confirmation to the national authority • ensure implementation of suggested control options, both pending & following diagnostic confirmation of infection	• advanced training in aquatic animal health at graduate/ post-graduate levels • level II and III diagnostics • principles of risk analysis • epidemiology • organizing general and targeted surveillance programmes
National level • personnel from national research laboratories, main authority departments, national disease control centers	• organize and coordinate surveillance systems for early warning • organize and coordinate disease reporting mechanisms • confirm the disease diagnosis with the reference laboratory • conduct risk analysis and analyse risks associated with the reported outbreak scenario • develop national contingency plans for dealing with aquatic animal disease emergencies • provide field exercises and regular reviews of contingency plans to ensure effective & well-coordinated implementation • define disease zones based on data from reporting laboratories • organize training & rapid communication plans for accurate information dissemination	• advanced training and specialization in aquatic animal health at degree/ postgraduate levels • Level III diagnostics for listed diseases of concern to the country • Designing & conducting risk analyses • Designing & conducting surveillance programmes

and strongly informed that (in most cases) the aquatic animal disease has no human health significance. If this concern is not addressed as soon as possible, economic losses can increase significantly beyond those directly due to mortalities, due to an inability to market animals that should be removed from the water.

Professional communicators and extension experts should be enlisted to help design and carry out awareness and publicity campaigns. Meetings with farming and fishing communities, processors and traders are recommended, in addition to communication with media outlets, such as newspapers, radio and television that can reach a broader target audience. Radio and television news programmes have proven to be a very effective method for spreading the message. These should be broadcast at times of the day when most farmers could be expected to be listening to the radio – this may be early in the morning or at night.

10.4.5 Simulated response exercises

"Announced and unannounced field exercises for administrators and aquatic animal health personnel should be carried out to maintain the state of readiness." (OIE, 2004).

Practice runs of contingency plans are extremely useful for testing and refining the plans in advance of a real disease emergency. They are also a valuable means of building teams for emergency disease responses and for training staff.

Disease outbreak scenarios that are as realistic as possible should be devised for the exercises, using real data where possible (e.g. for vulnerable farm locations, populations and trading/transfer activities). The scenario used may cover one or more time phases during the outbreak with a range of possible outcomes. However, neither the scenario nor the exercise should be overly complicated or long. It is best to test just one part of the contingency plan at a time, e.g. operation of a local disease control center. Practice exercises can be carried out as a purely paper exercise or through trial-run activities, or as a combination of both. On completion of each practice run, there should be a review to identify areas where the plan needs to be modified and/or further training is needed.

A full-scale contingency plan simulation exercise can be attempted after the individual components of the plan have been tested have met minimum response criteria. Attempting a full-scale practice run before testing the component parts can complicate accurate identification of any "weak" spots and is not recommended.

11. Recovery from an emergency disease

The process of recovery, following a successful eradication of an emergency disease, involves verification and international acceptance of proof of national disease freedom. Rehabilitation of affected farming and fishing communities is also required to help rebuild socio-economic losses and re-establish lost markets.

11.1 Verification and international acceptance of disease freedom

The important objective with respect to regaining freedom from an exotic disease is to ensure that the causative agent, not just the clinical evidence of the disease, has been eradicated. There are many examples where intense eradication efforts have been stopped when the disease seems to have disappeared; however, small pockets of infectious agents remain that multiply to disease levels as soon as the host populations begin to build up again in numbers. Failure to completely remove the pathogen from the environment or production system, therefore, undermines the investment in expensive eradication programmes.

Disease control measures should diminish once the active disease outbreak has come under control and either stabilized or the pathogen is thought to have been eradicated. Emphasis shifts from mapping the disease spread towards targeted surveillance to detect any residual infection. If vaccination has been used, this should be stopped so that there is no masking of infection. If the disease and/or agent have not been eradicated, surveillance efforts shift from the infected zone to a defined buffer zone around the affected area. This should be subject to stringent controls and targeted surveillance to ensure that the disease remains contained within the delineated positive zone.

When it is believed that infection has truly been eradicated (a situation that is likely to occur only within confined growing conditions such as farm facilities), a series of verification programmes should be carried out. These are aimed at providing objective proof to areas with unaffected susceptible populations (trade partners or other areas within the country) that the affected population(s) has/have regained freedom from the disease agent. This will provide the foundation for export of the animals and/or their products to be restored to areas that are unaffected and have populations at risk from the disease. This may involve:

- demonstration that the country has a capable aquatic animal health service and relevant disease surveillance programmes;
- targeted surveillance using scientifically proven laboratory tests for both clinical and subclinical infections; and
- provision of surveillance data as evidence of an effective surveillance programme and diagnostic testing.

Reference should be made to the FAO publication on *Surveillance and Zonation for Aquatic Animal Diseases* (FAO, 2004) and the OIE's *Aquatic Animal Health Code* (OIE, 2004) for more guidance on acceptable methods and principles for declaring freedom from specific infectious diseases.

11.2 Rehabilitation of farming and fishing communities

If a disease agent has been successfully eradicated from an area, there will be a need to repopulate with disease-free animals. There is little economic benefit in repopulating any area in which a disease has become established with naïve (disease-free) animals. In this case, rehabilitation must focus on alternative species, or on protecting survivors that may have a degree of disease tolerance. These animals can be invaluable as the progenitors for controlled breeding programmes for disease resistance.

Special support mechanisms and programmes can be considered to allow affected farmers and fishing communities to get back on their feet after an economically devastating disease outbreak. Providing full or partial compensation to fish farmers for their losses due to a disease epizootic or to government-mandated destruction of infected stocks is a political decision, based of a range of factors (usually prescribed in legislation). Responsible authorities should consider these issues when developing the legislative frameworks to support contingency planning. It should be noted that compensation is rarely considered for recurrent diseases, especially in open water. Restocking vulnerable species in waters where significant disease agents are known to occur should be given serious risk assessment consideration for the potential of a repeat disease outbreak, prior to stocking.

12. Staying free

Prevention is the key to staying free from serious infectious diseases, especially since the number of cases of successful eradication are quite limited compared with examples where diseases have established wherever they have spread.

A thorough "post-mortem" review should be carried out while the events of the emergency disease outbreak are still fresh in peoples' minds. This review should be led by the Responsible Officer and should include key representatives of each organization involved in the contingency plan, as well as private stakeholders directly affected by the disease outbreaks. This review should include:

- analysing how the disease entered the country and the mechanisms (proven or suspect) for its subsequent spread, in order to strengthen measures that can effectively prevent the disease from re-emerging or spreading;
- determining how or if disease surveillance and early detection procedures can be improved and which geographical areas contain vulnerable resources that require the greatest concentration of surveillance effort (e.g. those with indirect contact with exposed populations or with inconclusive diagnostic results);
- reviewing suggested revisions to parts of the contingency plan that were determined to be weak under the real-time exercise;
- identifying any communication problems encountered with public awareness or information dissemination (e.g. language translation issues, not enough pamphlets, wrong media outlets etc.).
- identifying gaps in legislative or other support frameworks that need to be revised or otherwise improved;
- assessing the need for further training programmes and identifying any specific areas needing improvement, such as diagnostic methodologies.

Another serious risk associated with staying free following a significant disease outbreak is increasing complacency as populations recover naturally or are replaced by other commercial species. This is especially important where vulnerable populations are separated by a buffer/surveillance zone from infected populations. Vigilance is especially critical when infected populations show reduced levels of mortality or evidence of infection. Nature frequently takes care of survival through developing inherited tolerance of infection; however, this often leads to temptation to move apparently healthy stocks between sites, bays or farms, or for open-water holding and remote processing. Therein lies the risk of spread of the disease and a repeat outbreak emergency.

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