Manual of procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals

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PREPARATION OF THIS DOCUMENT

This document presents the *Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals*. The *Manual of Procedures* provides background material and detailed technical procedures to assist countries and territories in the Asia Region in implementing the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals*. The *Technical Guidelines,* and the associated *Beijing Consensus and Implementation Strategy* (BCIS), (see FAO Fish. Tech. Pap. 402) are the result of an extensive consultative process, undertaken between 1998-2000, involving input from government-designated National Co-ordinators (NCs), Network of Aquaculture Centres in Asia-Pacific (NACA), FAO, Office international des ēpizooties (OIE), and regional and international specialists. The *Technical Guidelines* were unanimously endorsed at the Final Workshop of the FAO/NACA TCP RAS 6714 (A) and 9605 (A) "Assistance for the Responsible Movement of Live Aquatic Animals" held in Beijing, PR China, from 27 to 30 June 2000.

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ABSTRACT

The *Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* provides background material and detailed technical procedures to assist countries and territories in the Asia Region in implementing the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals*. The *Technical Guidelines* and their associated implementation plan, *the Beijing Consensus and Implementation Strategy* (BCIS), (see FAO Fish. Tech. Pap. No. 402) provide expert guidance for national and regional efforts in reducing the risks of disease due to trans-boundary movement of live aquatic animals. The *Technical Guidelines* were initiated due to increased recognition that disease emergence is often linked to live aquatic animal movements, and that the associated economic losses, including impacts on rural livelihoods and national efforts in poverty alleviation and food security, are highly significant. New trade agreements and requirements generated by the World Trade Organization (WTO) further reinforced the necessity for improved live aquatic animal health management. Recognizing the need for a region-wide approach to aquatic animal health management, the national governments of countries of the Asia Region requested FAO, through NACA, to assist production of a set of technical guidelines that could be used to improve and harmonize aquatic animal health management strategies for responsible trans-boundary movement of live aquatic animals.

An FAO Technical Cooperation Programme (TCP) Project - "Assistance for the Responsible Movement of Live Aquatic Animals" was launched by NACA in 1998, with the participation of 21 countries from throughout the region. This programme complemented FAO's efforts in assisting member countries to implement the relevant provisions in Article 9 - Aquaculture Development - of the *Code of Conduct for Responsible Fisheries* (CCRF), at both the national and regional levels. A set of Guiding Principles, formulated by a group of aquatic animal health experts at the Regional Workshop held in 1996 in Bangkok, formed the basis for an extensive consultative process, between 1998-2000, involving input from government-designated National Co-ordinators (NCs), the Network of Aquaculture Centres in Asia-Pacific (NACA), FAO, the Office international des ēpizooties (OIE), and regional and international specialists. The *Technical Guidelines* were unanimously endorsed at the Final Project Workshop on Asia Regional Health Management for the Responsible Trans-boundary Movement of Live Aquatic Animals, held in Beijing, China, from 27 to 30 June 2000. Recognizing the crucial importance of implementation of the *Technical Guidelines*, the participants prepared a detailed implementation strategy*, the Beijing Consensus and Implementation Strategy* (BCIS), focussing on National Strategies and with support through regional and international co-operation. The NCs gave unanimous endorsement of the *Technical Guidelines*, in principle, as providing valuable guidance for national and regional efforts in reducing the risks of disease due to the trans-boundary movement of live aquatic animals, and the workshop participants unanimously approved the associated implementation strategy.

Implementation of the *Technical Guidelines* will contribute to securing and increasing income of aquaculturists in Asia by minimizing the disease risks associated with trans-boundary movement of aquatic animal pathogens. They will also contribute to regional efforts to improve rural livelihoods, within the broader framework of responsible management, environmental sustainability and protection of aquatic biodiversity.

(Key words: Asia, Aquaculture, Health Management, Aquatic animal diseases, Quarantine, Health Certification, Guidelines)

PREFACE

The Food and Agriculture Organization of the United Nations (FAO) and the Network of Aquaculture Centres in Asia-Pacific (NACA) are pleased to present this document entitled the *Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals*. The *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* (hereafter referred to as the "*Technical Guidelines*") and their associated implementation plan, the *Beijing Consensus and Implementation Strategy (BCIS*), (see FAO Fish. Tech. Pap. No. 402) were developed by representatives from 21 Asian governments[1], scientists and experts on aquatic animal health[2,3], as well as by representatives from several national, regional and international agencies and organizations[4].

The *Technical Guidelines* provide valuable guidance for national and regional efforts in reducing the risks of disease due to trans-boundary movement of live aquatic animals. Their implementation will contribute to securing and increasing income of aquaculturists in Asia by minimizing the disease risks associated with trans-boundary movement of aquatic animal pathogens. In many countries in Asia, aquaculture and capture fisheries provide a mainstay of rural food security and livelihoods, and implementation of the *Technical Guidelines* will contribute to regional efforts to improve rural livelihoods, within the broader framework of responsible management, environmental sustainability and protection of aquatic biodiversity.

An FAO Technical Co-operation Programme (TCP) Project (TCP/RAS 6714 (A) and 9065 (A) - "Assistance for the Responsible Movement of Live Aquatic Animals") was launched by NACA in 1998, with the participation of 21 countries from throughout the region. This program complemented FAO's efforts in assisting member countries to implement the relevant provisions in Article 9 - Aquaculture Development - of the *Code of Conduct for Responsible Fisheries* (CCRF), at both the national and regional levels. A set of Guiding Principles, formulated by a group of aquatic animal health experts at the Regional Workshop held in 1996 in Bangkok, formed the basis for an extensive consultative process, between 1998-2000, involving input from government-designated National Co-ordinators (NCs), NACA, FAO, OIE, and regional and international specialists. Based on reports from these workshops, as well as intersessional activities co-ordinated by FAO and NACA, the final *Technical Guidelines* were presented and discussed at the Final Project Workshop on Asia Regional Health Management for the Responsible Trans-boundary Movement of Live Aquatic Animals, held in Beijing, China, 27 to 30 June 2000.

The *Technical Guidelines* were reviewed and discussed by the participants of this meeting, which included the NCs, FAO, NACA, OIE (Representatives of the Fish Disease Commission and Regional Representation in Tokyo), and many regional and international aquatic animal health management specialists. The NCs gave unanimous agreement and endorsement of the *Technical Guidelines,* in principle, as providing valuable guidance for national and regional efforts in reducing the risks of disease due to the trans-boundary movement of live aquatic animals.

Recognizing the crucial importance of implementation of the *Technical Guidelines*, the participants prepared a detailed implementation strategy, the *Beijing Consensus and Implementation Strategy* (BCIS), focussing on National Strategies and with support through

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[1] For the purpose of this *Manual of Procedures*, the term "country" covers an entity that may be a nation, a region of a country or a government.

[2] See Annex I for the list of National Co-ordinators who represented the participating countries during drafting of the *Manual of Procedures.*

[3] See Annex II for the list of Regional Working Group (RWG) and Technical Support Services (TSS) members who assisted with the *Manual of Procedures*.

[4]See Annex III for the list of agencies and organizations that participated in the development of the *Manual of Procedures*.

regional and international co-operation. This comprehensive implementation strategy was unanimously adopted by the workshop participants.

In addition to the *Manual of Procedures,* the *Technical Guidelines* are also supported by the Asia Diagnostic Guide to Aquatic Animal Diseases. The *Diagnostic Guide,* which will be published in late2001, was prepared to support regional countries in diagnosis of aquatic animal disease.

The countries that participated in the development of the *Technical Guidelines* and *BCIS,* and the associated *Manual of Procedures* and *Diagnostic Guide* are Australia, Bangladesh, Cambodia, China P.R., China Hong Kong SAR, India, Indonesia, Iran, Japan, Korea (D.P.R.), Korea (R.O.), Lao (P.D.R.), Malaysia, Myanmar, Nepal, Pakistan, the Philippines, Singapore, Sri Lanka, Thailand and Vietnam.

FAO and NACA extend special thanks to all the governments, agencies, and organizations that took part in this significant, and sometimes daunting, endeavor, as well as to all the individuals who generously contributed time, effort and expertise to the compilation of this document and other information produced during the process.

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FOREWORD

Movement[5] of live aquatic animals is a necessity for development of aquaculture on both a subsistence and commercial level. However, such movements increase the probability of introducing new pathogens, which can have dire consequences on aquaculture, capture fisheries and related resources, as well as the livelihoods which depend on them. In order to minimize or avoid the risk of pathogen transfer via aquatic animal movements, it is essential that the individuals and organizations involved in such activities appreciate, and participate in, the overall health management process[6].

The adverse social, economic and environmental impacts that have resulted from the irresponsible or ill-considered movement of live aquatic animals and their products have led to global recognition of the need for health management protocols to protect aquaculture, fisheries resources and the aquatic environment. In many cases, these impacts have been a direct result of the absence of effective national and regional health management strategies. However, formulation of effective quarantine measures[7], health certification and guidelines applicable on an international scale is complicated. A wide range of social, economic and environmental circumstances have to be considered, along with the range of aquatic animal species involved and their pathogens and diseases. In addition, differing reasons for moving live aquatic animals and products impose a further set of variables to the process. Nevertheless, the serious impacts of unrestricted regional and international movement of aquatic animals merit international recognition - a fact clearly reflected in the *International Aquatic Animal Health Code* and the *Diagnostic Manual of Aquatic Animal Diseases* of the Office international des epizooties[8], which provide guidelines and recommendations for reducing the risk of spreading specific pathogens considered relevant to international trade of aquatic animals.

Since present international protocols are not always applicable to the disease concerns of aquatic food production and trade in the Asia Region, the need for effective health management protocols that focus on the species and disease problems of this region has been recognized for many years. A regional, as opposed to national, approach is considered appropriate, since many countries in the region share social, economic, industrial, environmental, biological and geographical characteristics. A regionally adopted health management program will facilitate trade, and protect aquatic production (subsistence and commercial) and the environment upon which they depend, from preventable disease incursions.

A joint FAO/NACA Asia-Regional Programme on Aquatic Animal Health Management was undertaken to review the need for better health management to support safe movement of live aquatic animals and the applicability of existing international codes on aquatic animal health management, quarantine and health certification, including those of the OIE, the European Inland Fisheries Advisory Commission (EIFAC), and the International Council for Exploration of the Sea (ICES) to Asian circumstances.

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[5] Terms used in this document are defined in Section 3, Definitions, of the *Manual of Procedures*.

[6] For the purpose of this document, the health management process is defined (see the *Manual of Procedures,* Section 3) as "aquatic animal health management in its broadest sense, encompassing pre-border (exporter), border and post-border (importer) activities, as well as relevant national and regional capacity-building requirements (infrastructure and specialised expertise) for addressing health management activities, and implementation of effective national and regional policies and regulatory frameworks required to reduce the risk of disease spread through movement (intra- and international) of live aquatic animals."

[7] Measures developed as a result of risk analysis to reduce the disease risks associated with the transfer of disease agents with live aquatic animal movements. This usually refers to trans-boundary movements, with pre-border, border, and post-border health management processes, however, such activities are equally applicable to intra-national movement of live aquatic animals.

[8] see OIE. 2000a. International Aquatic Animal Health Code. 3rd edn. Office International des Epizooties, Paris, 153 p.; and OIE. 2000b. Diagnostic Manual for Aquatic Animal Diseases. 3rd edn, Office International des Epizooties, Paris, 237 p.

This review highlighted the fact that the disease risks associated with pathogen transfer in the Asia Region can only be reduced through a broader approach to aquatic animal health management than currently outlined in disease-specific codes of practice (e.g., the OIE code) or in codes and protocols developed specifically for northern hemisphere countries (e.g., the ICES and EIFAC codes)[9]. In addition, it underlined the need for pre-border (exporter), border and post-border (importer) involvement in the program, to ensure co-operative health management of aquatic animal movement. With the support of an FAO Technical Co-operation Programme (TCP) implemented by NACA, the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* is a document that was compiled by a group of aquatic animal health experts within and outside the region to assist the development of effective health management procedures for safe movement of live aquatic animals within and between countries in the region. This companion document, the *Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals,* provides background material and detailed technical procedures to assist countries and territories in the Asia Region in implementing the *Technical Guidelines*.

[9] see Humphrey, J.D., J.R. Arthur, R.P. Subasinghe and M.J. Phillips. 1997. Aquatic Animal Quarantine and Health Certification in Asia. Proceedings of the Regional Workshop on Health and Quarantine Guidelines for the Responsible Movement (Introduction and Transfer of Aquatic Organisms), Bangkok Thailand, 28 January 1996. FAO Fish. Tech. Pap. No. 373, 153 p.

ACRONYMS AND ABBREVIATIONS

Acronyms and abbreviations appearing in the *Manual of Procedures* stand for the following organizations, programs, titles, diseases and pathogens:

AAHRI	Aquatic Animal Health Research Institute
AAPQIS	Aquatic Animal Pathogen and Quarantine Information System
ACIAR	Australian Centre for International Agriculture Research
ADB	Asian Development Bank
ADG	Asia Diagnostic Guide to Aquatic Animal Diseases
AFFA	(Department of) Agriculture, Fisheries and Forestry – Australia
AG	Advisory Group on Aquatic Animal Health
APEC	Asia Pacific Economic Co-operation
AQIS	Australian Quarantine and Inspection Service
ASEAN	Association of Southeast-Asian Nations
AVA	Agri-Food and Veterinary Authority of Singapore
BCIS	Beijing Consensus and Implementation Strategy
BFRI	Bangladesh Fisheries Research Institute
BFAR	Bureau of Fisheries and Aquatic Resources of the Philippines
BKD	Bacterial Kidney Disease
CA	Competent Authority
CAQ	Centres for Agriculture Quarantine of Indonesia
CBD	Convention on Biological Diversity
CCRF	Code of Conduct for Responsible Fisheries
CEFAS	Centre for Environment, Fisheries and Aquaculture Science of the United Kingdom
CIDA	Canadian International Development Agency
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COFI	Committee on Fisheries of FAO
CPE	Cytopathological effect
CSIRO	Commonwealth Scientific and Industrial Research Organisation of Australia
CVO	Chief Veterinary Officer
DFID	Department for International Development (United Kingdom)
DFO	Department of Fisheries and Oceans of Canada
DIAS	Database on Introduced Species
EIFAC	European Inland Fishery Advisory Commission
ERM	Enteric Redmouth Disease
ETF	Emergency Task Force
EU	European Union
EUS	Epizootic Ulcerative Syndrome
FAO	Food and Agriculture Organization of the United Nations
FDC	Fish Disease Commission (of OIE)
FHMC	Fish Health Management Committee of Australia
FQS	Fisheries Quarantine Service of BFAR
GAA	Global Aquaculture Alliance
GATT	General Agreement on Tariffs and Trade
GLP	Good Laboratory Practices
ICAR	Indian Council of Agricultural Research
ICES	International Council for the Exploration of the Sea
ICLARM	International Center for Living Aquatic Resources Management
IFC	Iranian Fisheries Company
IFRTO	Iranian Fisheries and Training Organization
ITC	Introduction and Transfers Committee

IVO	Iranian Veterinary Organization
IHN	Infectious Haematopoetic Necrosis
IRA	Import Risk Analysis
IPN	Infectious Pancreatic Necrosis
ISA	Infectious Salmon Anaemia
JFA	Japanese Fishery Agency
LIFDC	Low-Income Food-Deficit Country
MAFF	Ministry of Agriculture, Forestry and Fisheries of Japan
MOFARD	Ministry of Fisheries and Aquatic Resources Development of Sri Lanka
MOU	Memorandum of Understanding
MRC	Mekong River Commission
LEC	Local Emergency Committee
NACA	Network of Aquaculture Centres in Asia-Pacific
NC	National Co-ordinator
NBFGR	National Bureau of Fish Genetics Research of India
NEC	National Emergency Committee
NFEC	National Fisheries Extension Centre of China PR
NFRDI	National Fisheries Research and Development Institute of Korea RO
NICA	National Institute of Coastal Aquaculture of Thailand
NIWA	National Institute for Water and Atmospheric Research Ltd of New Zealand
NORAD	Norwegian Agency for Development
OIE	Office international des ēpizooties (the World Organization for Animal Health)
PPD	Primary Production Department of Singapore
QA	Quality Assurance
RIA 1	Research Institute for Aquaculture No. 1 of Vietnam
RRC	Regional Resource Center
RWG	Regional Working Group
SAARC	South Asia Association for Regional Co-operation
SEAADCP	Southeast Asia Aquatic Disease Control Project
SEAFDEC -AQD	Southeast Asian Fisheries Development Center – Aquaculture Department
SPS	WTO Agreement on the Application of Sanitary and Phytosanitary Measures
SVC	Spring Viremia of Carp
TSS	Technical Support Services
TCP	Technical Co-operation Programme
UNCED	United Nations Conference on Environment and Development
VHS	Viral Haemorrhagic Septicaemia
WB	World Bank
WSSV	White Spot Syndrome Virus
WTO	World Trade Organization
YHD	Yellow Head Disease

CONTENTS

1 SCOPE AND PURPOSE

This *Manual of Procedures* provides background material and detailed technical procedures in support of the *Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals* (FAO/NACA, 2000). The *Technical Guidelines* are designed to assist countries and territories in the Asia Region with responsible national and international movement of live aquatic animals, and to reduce the risk of disease spread through trade and movement of live aquatic animals within and between regions. The *Technical Guidelines* provide an outline of procedures and considerations required for achieving effective aquatic animal disease control. They also outline procedures required to implement relevant provisions in the FAO *Code of Conduct for Responsible Fisheries* (CCRF) (FAO 1995) and to meet standards of related international treaties and agreements applicable to the Asian Region. The *Manual of Procedures* provides details and approaches which need to be developed to meet the outlines given in the *Technical Guidelines*. It is intended for use by workers involved in, and responsible for, aquatic animal production and movements. This includes people at the farm site right up to the highest governing authorities. Both documents were developed with the goal of providing a region-wide approach to aquatic animal disease control which can be used to build support infrastructure, capability and collaboration under a uniform reference umbrella. These documents will be available to all countries in the Asia Region that wish to reinforce or revise their capability in this area. In doing so, it is hoped that all countries will be capable of controlling aquatic animal disease emergencies within their national boundaries, reducing the risk of introduction and spread of disease between countries and last, but not least, gain equivalency at the global level for dealing with trade issues associated with aquatic animal health. In compiling both documents, many regional and international specialists in aquatic animal health management have been consulted, however, this is a dynamic field, so specific examples and details have deliberately been omitted. These details are covered by specialized documentation which is referenced, where appropriate, throughout the *Manual of Procedures*. In addition, separate references are being compiled for the Asia Region which cover specialized topics, e.g., disease diagnostic protocols.

1.1 References

FAO. 1995. Code of Conduct for Responsible Fisheries. FAO, Rome, 41 p.

FAO/NACA. 2000. Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals. FAO Fish. Techn. Pap. No. 402, 53p.

2 BACKGROUND

2.1 Purpose

This section provides background information to support Section 2, Background, of the *Technical Guidelines*. It contains in-depth information on aquaculture production, both world wide and in the Asia Region; introductions and transfers of aquatic animals and their pathogens, including their socio-economic impacts; and reviews of pertinent treaties, agreements, codes of practice and guidelines.

2.2 Aquaculture Production

Aquaculture continues to be the world's fastest growing food production sector, exhibiting an overall growth rate of over 11.0% per year since 1984 (Figure 1), compared with 3.1% for terrestrial farm animal meat production, and 0.8% for production from capture fisheries. By economic country grouping, approximately 90.0% and 82.2% of total world aquaculture production in 1998 was produced within developing countries (35.49 mmt) and in particular within LIFDCs (Low-Income Food Deficit Countries[10]) (32.41 mmt). The developing country contribution to global aquaculture production has increased from 72.6% (7.37mmt) in 1984 to 90% (35.49 mmt) in 1998, while the share of production from developed countries has decreased from 27.4% (2.78 mmt) in 1984 to 10% (3.93 mmt) in 1998 (Figure 2). Aquaculture production within LIFDCs has been growing over 5 times faster (13.7% per year since 1984) than within developed countries (2.7% per year since 1984), with aquaculture production within developing countries displaying an average growth rate of 12.8% per year between 1984 and 1998.

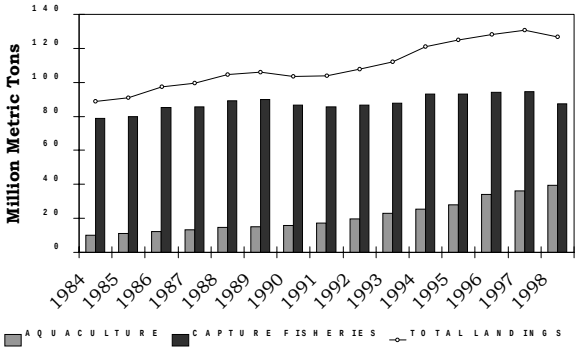

Figure 1 Contribution of aquaculture to total world fisheries production 1984-1998 (FAO, 2001)

By region, Asia produced over 90.8% of total global aquaculture production by weight in 1998 (35.81 mmt). Production in China represents 68.6% of the total global aquaculture production amounting to 27.1 mmt in 1998. Apart from China, all of the world's top ten aquaculture producing nations were found in Asia in 1998. These top ten producing countries represent 89.1% of total global aquaculture production by weight (Figure 2). Second major region in terms of production by weight was Europe (4.97% or 1.96 mmt).

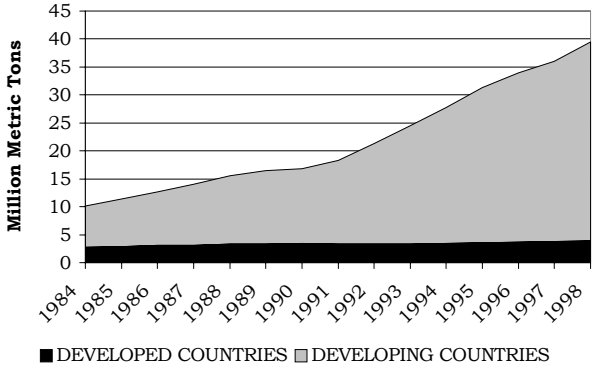

Figure 2 Aquaculture production in developed and developing countries 1984-1998 (FAO, 2001)

Interestingly, analysis of global aquaculture production excluding China, showed a moderate growth rate, with production doubling from 6.32 mmt in 1984 to 12.36 mmt in 1998, and the sector growing at an average rate of 5.3% per year since 1984 (Figure 3). In general terms, aquaculture's contribution towards total world fisheries production has increased three fold since 1984; aquaculture

[10] LIFDC's having an average per capita income <US$1505/year in 1996.

production increasing from 10.15 mmt or 11.4% of total fisheries production in 1984 to 39.43 mmt or 31.1% of total fisheries production in 1998 (Figure 1).

As the bulk of aquaculture is rural and subsistence, it plays a major role as a provider of direct and indirect employment to the rural poor and thereby contributing towards alleviating poverty. In many developing countries, aquaculture provides opportunities for diversification of farming systems, risk reduction and integration with agriculture. In terms of production, all regions, except Africa, have recorded a significant increase in per capita production between 1984 and 1998. While Asia continues to dominate world aquaculture in overall tonnage as well as in every major commodity, Latin America has registered a very high average annual growth between 1984 and 1998. In the following years, aquaculture will continue to be a major supplier of aquatic food. The primary aim of increasing aquaculture production should be pursued towards alleviating poverty and contributing to food security of the masses. This can only be achieved if further developments in aquaculture are environmentally sustainable, economically viable and socially responsible (FAO, 2001).

The favorable potential for aquaculture in Asia is vulnerable to increasing levels of disease and, unless appropriate measures are taken, losses will continue to increase proportionately (ADB/NACA, 1991). With intensification of production, aquaculture systems become increasingly reliant upon external inputs, such as seed and feed. This increases the risk of accidental introductions of pathogens into the aquaculture systems. The introduction and transfer of pathogens, along with the uncontrolled movement of live aquatic animals, is associated with many recent disease outbreaks which have caused significant losses to aquaculture production and revenue (Subasinghe *et al.* 2001). An understanding of how to deal with such situations is imperative for sustainable aquaculture production. Establishing effective measures to minimize risk of introduction of pathogens is, therefore, a pivotal component of the overall objective of optimization of sustainable aquaculture and minimizing effects on surrounding wild resources.

2.3 Trans-boundary Movement of Aquaculture Species

The use of exotic species to increase food production and income has been an established practice since the middle of the 19th Century. However, the practice dates back much further, to the ancient Romans and medieval European monks, who transported common carp, *Cyprinus carpio*, and perch, *Perca fluviatilis*, around Europe and the Roman Empire; and to the Greeks, who transplanted oysters around the Greek Islands during the Golden Age of Greece (Sahrage and Lundbeck 1992, Balon 1995). These early transplants and introductions were largely for a primitive type of aquaculture where fish were held in impoundments or reservoirs. Little controlled reproduction was practiced, except for the common carp, which is easily bred in captivity. Advances in controlling the spawning of salmonids, primarily rainbow trout, *Oncorhynchus mykiss*, in the mid-1800s led to increased exportation of these fish to other areas (Welcomme 1988). Recent advances in trade and transport have further enhanced the feasibility of large-scale movements of many species over great distances, both within Asia, and between Asia and other parts of the world.

Controversy over the use of exotic species has arisen from many highly publicized successes and failures. For example, Chile has become the world's second leading producer of farmed salmonids, an industry based on introduced coho salmon (*O. kisutch*), Atlantic salmon (*Salmo salar*), and rainbow trout. The Chilean salmonid culture industry provides foreign exchange and employment for thousands of people in areas where there are few other opportunities for development. In contrast, the introduction of the golden apple snail (*Pomacea canaliculata*) to the Philippines to increase rural aquaculture production and for export purposes, has resulted in severe rice production losses, with the infested area expanding rapidly and the snails becoming the most serious pest problem of rice in the major growing areas (Halwart 1994).

Perhaps one of the most controversial introductions is the Nile perch (*Lates nilotcus*) into Lake Victoria, which has turned a primarily artisanal fishery into a multi-million dollar industrial fishery and processing operation. Tremendous income has been generated, but the socio-economic system of the community surrounding the lake has also changed. There are estimates of hundreds of indigenous fish species being lost to predation by the Nile perch (Reynolds and Greboval 1989). The practice of introducing aquatic species into new geographic areas continues, with controversy over protection of native biodiversity, spread of pests and disease, and accompanying ecological, environmental and socio-economic impacts.

To better understand the magnitude of the use of introduced species and their impacts, a global review was undertaken on the international movements of inland finfish by FAO (Welcomme 1988); this work has been expanded to include crustaceans, molluscs and marine species (Garibaldi and Bartley 1998; Bartley and Casal 1998). Widely moved species include common carp, Nile tilapia (*Oreochromis niloticus*), and rainbow trout. They, along with others, such as, black bass (*Micropterus* spp.), mosquito fish (*Gambusia affinis*), and grass carp (*Ctenopharygydon idellus*), now occur on every continent, except Antarctica, as a result of human-assisted movement. Welcomme (1988) reported a peak in the introduction of freshwater fishes in 1960, followed by a gradual decline in such movements.

The revision of Welcomme (1988) includes an attempt to compile information on the ecological and socio-economic impacts of aquatic animal introductions. A questionnaire was distributed globally asking for three types of information on introduced species:

- Basic data, such as species, importing and exporting countries, year of introduction, reason, and who made the introduction;
- Status, such as whether or not the introduction resulted in self-sustaining populations and whether the organism is still used in aquaculture; and
- Impacts on ecological and socio-economic systems.

The expanded database contains 3150 records on introductions. Aquaculture was the main reason for the deliberate movement of species, and national governments were most often cited as the party responsible for the introduction. Overall, the socio-economic impacts of introductions for aquaculture were reported to be beneficial, and there were many more reports of positive socio-economic impacts than adverse environmental impacts. Information on introductions is available on the FAO DIAS, the *Database on Introduced Species*, available on the FAO web site (http://www.fao.org) and a copy of the MS Access database is available on request. Besides new introductions, considerable movement of live aquatic species exists within and between regions of the world. The increase in aquaculture activities in Asia and related trade activities have evidently contributed to increased movement of live aquatic animals within Asia and between Asia and other regions of the world. This trend will continue, as aquaculture has become a major activity supporting production, trade, income generation, poverty alleviation, and improving livelihoods of the poorer sectors of many countries in the region.

2.4 Trans-boundary Movement and Associated Pathogen Transfer

Quarantine measures are outlined in most codes on introduced fishes. Policies dealing with introduction of aquatic species, including methods to minimize disease transfers, have also been developed by the International Council for the Exploration of the Sea (ICES) for marine introductions (ICES 1995). The Office International des Épizooties (OIE) has also developed recommendations and protocols for prevention of international spread of specific diseases of aquatic organisms, as described in the *International Aquatic Animal Health Code* (OIE 2000a). This also includes protocols for health surveillance of animals for domestic and international trade. More regionally oriented guidelines are provided by the Great Lakes Fish Disease Control Committee of the Great Lakes Fishery Commission (Meyer *et al.* 1983) and the North American Commission of the North Atlantic Salmon Conservation Organisation (Porter 1992), among others.

There are an enormous number of cases where parasites and diseases have been spread to new regions by human activity (e.g, see the reviews by Hoffman 1970, Bauer and Hoffman 1976, Bauer 1991, Williams and Sindermann 1992, Humphrey 1995, and Arthur 1995). Most well documented cases involve international movements and diseases introduced with species exotic to the receiving waters. Despite these examples and the codes and protocols described above, fish and shellfish continue to be introduced into new areas, with little consideration of potential disease consequences. Additionally, transfers (movements of aquatic animals to areas within their areas of historical distribution) are commonly regarded as less risky, and thus are poorly documented, which complicates investigation of concurrent movements of pathogens and parasites. It should be noted, however, that there are equally significant health risks associated with transfers of aquatic animals within their geographic range. A population that is adapted to a specific pathogen can carry it with no sign of infection. There is a high risk of disease outbreak if that pathogen is introduced to a naive (non-adapted) population of the same host species.

2.5 Pathogen Introduction and Economic Significance

The cost of quarantine must be evaluated in light of potential losses from introduction of a significant pathogen or contagious disease. A number of pathogens which are believed to have been introduced with movements of aquatic animals have caused significant economic losses to Asian aquaculture. These include the copepod *Lernaea cyprinacea* and myxosporeans of the genus *Myxobolus* which have caused problems in Indonesia (Djajadiredja *et al.* 1983), epizootic ulcerative syndrome (EUS) which has spread through much of Asia, and several viral diseases (e.g., yellowhead disease and white spot syndrome) which continue to impact shrimp production in much of Asia (Lightner 1990, Arthur and Shariff 1991). Combined losses from EUS in several Asian countries before 1990 were more than US$ 10 M; losses in Thailand alone from 1983-1993 were US$ 100 M. EUS continues to spread, the latest expansion being into the rivers of the Indus in the Punjab of Pakistan (Lilley *et. al.* 1998).

Box 2.1 Major international codes and guidelines for aquatic animal health and movement of aquatic animals.

- The Office International des Epizooties (OIE) *International Aquatic Animal Health Code* (OIE 2000a).
- The *ICES Code of Practice on the Introductions and Transfers of Marine Organisms - 1994* (ICES 1995).
- The International Council for The Exploration of the Sea (ICES) and the European Inland Fisheries Advisory Commission (EIFAC) *Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms* (Turner 1988).
- The ICES *Guidelines for the Implementation of the ICES Code of Practice Concerning Introductions and Transfers of Marine Species* (ICES 1984).
- The ICES *Overview of Current Molluscan Disease Control Measures* (ICES 1991).

Nash *et al.* (1995) estimated losses of US$30.6 million to the Thai shrimp industry in 1992, due to yellowhead disease (YHD). Huge economic losses due to white spot syndrome virus (WSSV) in Asia are ongoing, and during the preparation of this document, WSSV outbreaks have been detected in several countries in Central and South America (Lo *et al.* 1999). In Asia, based on data from the OIE and the FAO/NACA Quarterly Aquatic Animal Disease Reporting System, WSSV has been officially reported from 10 countries in the Asia-Pacific Region, including Bangladesh, China P.R., Korea RO, India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand and Vietnam. As of 1999, WSSV has been officially confirmed in at least nine countries in the Americas: USA, Honduras, Mexico, Nicaragua, Guatemala, Panama, Peru, Columbia and Ecuador. Losses were in the range of US$ 400 M in China (1993), US$ 17.6 M in India (1994), and over US$500 M in Thailand (1996), with a global estimate of US$ 3000 M in losses per year (Subasinghe *et al.* 2001).

Trade in live aquatic animals with no risk of transfer of disease or pathogens is impossible. There are a number of health issues which have to be considered in the management of risk associated with the

trade in live aquatic animals. The *Technical Guidelines* and this associated *Manual of Procedures* provide details of the health management procedures. These procedures, including policies and practices, operate under the concept of minimizing risk of spread of disease, while ensuring trade in live aquatic animals is not impeded by unjustifiable or unnecessary restrictions.

Health management measures, and the programs designed to implement them, provide a strategy to guard against adverse effects of pathogen spread associated with trans-boundary movements of aquatic animals. Such programs must address this problem within the context of larger national and international plans. "Codes of Practice" for international movement of aquatic animals, developed by international organizations, as well as international agreements, provide a strong starting point for national and regional aquatic animal health legislation. To succeed, however, such efforts must be accompanied by regionally agreed-upon guidelines for health management, including lists of notifiable pathogens, standardized diagnostic techniques, and the production of health certificates of unambiguous meaning. Strong commitments by aquaculturists and governments, as well as cooperation from all stakeholders involved in trans-boundary movement of live aquatic animals (including producers, importers and exporters), are all essential elements in the success of these programs. Effective disease prevention is also directly related to: (i) the ability of countries to reduce their dependence on imported broodstock and seed (larvae and postlarvae, fry, fingerlings); and (ii) effective regulation of the movement of ornamental fish and shellfish, particularly wild-caught species.

2.6 International Conventions and Codes of Practice

Policies, legislation, practices and guidelines concerning aquatic animal health and the movement of live aquatic animals are in a state of constant change. Frequent revisions and modifications are necessitated by: (i) rapid world-wide developments in aquaculture and culture-based fisheries; (ii) increasing knowledge on diseases of aquatic animals; (iii) improved or new diagnostic tools; and (iv) improved pathogen detection procedures. In addition, changing trade patterns that reflect changes in the political, social, industrial and economic environments of individual countries and regions also contribute to the dynamics of risk assessment sensitivity. As an adjunct to national legislation, policies, guidelines and codes of practice have been developed by international agencies or working groups with responsibility for aquatic animal disease control. These have been developed to provide a degree of international standardization for prevention of pathogen transfer with movements of live aquatic animals. Box 2.1 shows some of the major international initiatives. There are also relevant items within the *Code of Conduct for Responsible Fisheries* (CCRF), the *Convention on Biological Diversity* (CBD), and the World Trade Organization's (WTO) *Sanitary and Phytosanitary Agreement*. This section introduces some of the major conventions and codes and their relevance to regional quarantine and health certification.

FAO Code of Conduct for Responsible Fisheries (CCRF)

The present FAO Regional TCP Programme was conceived to develop effective mechanisms for implementation of FAO's *Code of Conduct for Responsible Fisheries* (CCRF) (FAO 1995). This voluntary code was adopted by government representatives at the FAO conference in October 1995, with the objective of providing a framework to ensure national and international exploitation of aquatic living resources in sustainable harmony with the environment. Article 9 of the code refers specifically to aquaculture and provides several principles relating to aquatic animal disease control. Article 9.3.3 (shown in Box 2.2) is particularly relevant. The CCRF also emphasizes a number of issues which are addressed in the *Technical Guidelines*:

- the importance of cooperation with neighboring states in the introduction of species in trans-boundary aquatic ecosystems (Article 9.2)
- the need to establish databases and information networks to collect, share and disseminate aquaculture data, at national, regional and global levels (Article 9.2.4); and
- the need for cooperation in the elaboration, adoption and implementation of international codes of practice and procedures for introductions and transfers of aquatic organisms (Article 9.3.2).

Significantly, Article 9.4 also identifies the importance of producers (farmers, fishery stakeholders, etc.) in the development and implementation of practices for the responsible development of aquaculture, including aquatic animal health management and disease control. This issue is given special attention in the *Technical Guidelines.*

Box 2.2. FAO Code of Conduct for Responsible Fisheries: Article 9.3.3
"States should, in order to minimise risks of disease transfer and other adverse effects on wild and cultured stocks, encourage adoption of appropriate practices in the genetic improvement of broodstocks, the introduction of non-native species, and in the production, sale and transport of eggs, larvae or fry, broodstock or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect."

Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit"). The Convention, which came into force on 29 December 1993, emphasizes the conservation and management of aquatic animal biodiversity. This includes clear recognition of the importance of protocols to minimize the negative impact on aquatic biodiversity due to movement of exotic species and uncontrolled spread of aquatic animal pathogens.

The Parties to the CBD agreed on a program of action for implementing the CBD with respect to marine and coastal biodiversity at their second conference, held in Jakarta in 1995. This program, termed the "Jakarta Mandate on Marine and Coastal Biodiversity," contains five "Action Items." Two are directly relevant to the development of these regional guidelines: Action Item 4: "*Ensure that mariculture operations are sustainable*," and Action Item 5: "*Prevent introduction of, and control or eradicate, harmful alien species*." The latter identifies introductions of pests and diseases with alien species as important risks which should be assessed and managed (de Fontaubert *et al.* 1996). The Jakarta mandate also recommends the implementation of the relevant articles of the *Code of Conduct for Responsible Fisheries* (FAO 1995) and of relevant international guidelines. The development of databases to share information on important pathogens to assist risk assessments is also recommended.

Implementation of the *Technical Guidelines* and this *Manual of Procedures*, with appropriate reference to national circumstances, will assist countries in implementing the provisions of the CBD.

The International Aquatic Animal Health Code

The Office International des Épizooties (OIE), an international veterinary organization with 151 member countries, has recently revised recommendations and protocols for the prevention of the international spread of diseases of fish, molluscs and crustaceans in its *International Aquatic Animal Health Code* (OIE 2000a). The principal policy of the OIE is to facilitate international trade in animals and animal products, including aquatic animals and their products, on the basis of health control and preventative measures. The OIE also recognizes public health issues connected to the consumption of animal products e.g., drug residues, radioactive pollution and related health risk analyses. The OIE Code was first published in 1995, with a second edition in 1997, and a third edition in 2000. The principal topics covered in the code are shown in Box 2.3.

Box 2.3. The principal topics covered by the OIE *International Aquatic Animal Health Code.*

- Definitions
- Notifications and epizootiological information
- Ethics and aquatic animal health rules for international trade
- Import risk analysis
- Import/export procedures
- List of notifiable diseases to be reported to OIE
- List of other significant diseases
- Health control and hygiene
- Destruction of pathogens
- Model international certificates approved by OIE

Future editions of the OIE code will include chapters on Good Laboratory Practice (GLP), Quality Assurance (QA) and categorization of diseases. The advantage of the OIE code is that it is developed by an international, science-based organization that is politically independent.

Currently, the OIE code lists two categories of diseases: (i) notifiable; and (ii) other significant diseases. The aquatic animal diseases included in these categories are listed in Annex V this *Manual of Procedures*. The OIE *Diagnostic Manual for Aquatic Animal Diseases* (OIE 2000b) covers diagnostic methods for both categories of diseases listed by the OIE. This *Manual of Procedures* provides a basis for health surveillance and disease control, in support of a comprehensive approach towards health control in aquatic animals including, and compatible with, building the infrastructure required to support the requirements outlined in the OIE code. This includes the standardized methodology recommended by OIE for detecting and identifying the agents listed, in order to meet the health certification requirements of the OIE.

The OIE code provides a basis for legal, ethical and moral standards in connection with health certification. Proper certification based on standardized international surveillance will facilitate trade in live aquatic animals and their products. This will give importing countries optimal guarantees of freedom from infections prevalent in exporting countries. The World Trade Organization (WTO) has developed a Memorandum of Understanding (MOU) to make the provisions of the OIE code obligatory. Originally, the OIE *International Aquatic Animal Health Code* was intended as a guide for reducing health risks associated with international trade, however, as part of the *General Agreement on Tariffs and Trade* (GATT), the international standards governing the movement of animals are now those of OIE. The OIE code has, thus, assumed greater legal trade importance than originally intended. This means that countries placing restrictions on trade outside those included in the OIE code could face legal petitions to the WTO, under the MOU. In general, countries cannot apply standards higher than those specified by the OIE code, however, if any country wishes to apply more stringent measures, then a risk assessment must be undertaken to justify those measures.

It is generally accepted that the current version of the OIE code does not readily apply to developing countries. Responsibilities for reporting disease occurrences to OIE rest with the veterinary administration of member countries. In the Asia-Pacific Region, however, veterinarians are often less involved in aquatic animal health than the various national fishery departments. Since official channels of communication with OIE are through the Chief Veterinary Officer for each member country, OIE receives little or no information on aquatic animal diseases from Asia-Pacific countries. A need to better organize the communication channels for aquatic animal disease information to OIE exists. Furthermore, communications need to be developed and/or strengthened between veterinary and fisheries departments to facilitate information flow. The objective behind developing this *Manual of Procedures* and, in particular, establishing the FAO/NACA and OIE Quarterly Aquatic Animal Disease Reporting Systems (see *Technical Guidelines*, Section 9), is an example of such communication development.

ICES/EIFAC Code of Practice

International Council for Exploration of the Sea (ICES) and the European Inland Fisheries Advisory Commission (EIFAC) Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms.

Recommendations for policies dealing with the introduction of aquatic species and guidelines for their implementation, including methods to minimize the possibility of disease transfers, have also been developed by the International Council for the Exploration of the Sea (ICES) and the European Inland Fisheries Advisory Commission of the FAO (EIFAC) (Anon. 1984, Turner 1988, Carlton 1993). These documents detail codes of practice for the transfer of live aquatic organisms, including

inspection, certification, quarantine, pathology and environmental impact, which are consistent with the objectives of this *Manual of Procedures*.

Additional ICES Codes and Guidelines

The *Revised 1990 ICES Code of Practice to Reduce the Risks of Adverse Effects Arising from the Introduction and Transfers of Marine Species* was developed by the ICES Working Group on Introductions and Transfers of Marine Organisms (Carlton 1993). This Code of Practice is divided into five major parts: (1) a recommended procedure for assessment of all new species for introductions; (2) actions regarding introductions; (3) use of strict quarantine measures; (4) species involved in current commercial practice; and (5) different approaches toward the selection of the place of inspection and control of the consignment.

The ICES (1991) *Overview of Current Molluscan Disease Control Measures* recognized the rapidly expanding aquaculture industries based on molluscs, difficulties in the treatment and control of disease outbreaks in molluscs in open waters, and demands for transfers and introductions of indigenous and non-indigenous molluscan species; noted considerable diversity among countries in disease control and quarantine legislation; and concluded that certification practices and procedures were of questionable value and required better definition regarding sampling regimes, numbers, and methods for disease detection.

Other codes, guidelines and directives

Outside the Asian-Pacific Region, regionally oriented guidelines are provided by the Great Lakes Fish Disease Control Committee of the Great Lakes Fishery Commission (Meyer *et al.* 1983) and the North American Commission of the North Atlantic Salmon Conservation Organisation (Porter 1992), among others. European Community (EC) regulations governing the trade in living or dead aquatic animals (fish, molluscs, crustaceans) have recently been established (de Kinkelin and Hedrick 1991). The European Council Directive of 28 January 1991, concerning the animal health conditions governing the placing on the market of aquaculture animals and products (91/67/EEC), was amended by Council Directives 93/54/EEC, 95/22/EEC, 97/79/EC, and 98/45/EC (Council of the European Communities 1991). Infectious salmon anaemia (ISA), viral haemorrhagic septicaemia (VHS), infectious haematopoietic necrosis (IHN), *Bonamia ostreae*, *Marteilia refringens*, infectious pancreatic necrosis (IPN), spring viraemia of carp (SVC), bacterial kidney disease (BKD), furunculosis, enteric redmouth disease (ERM), *Gyrodactylus salaris* and crayfish plague are included in the three lists (List I, II, and III – Fish, Molluscs, and Crustacea). Guidelines are provided for conducting fish inspections and diagnostic procedures. These are conducted to determine the fish health status of aquatic zones (freshwater and marine) within EC countries. Confluent waters containing fish with identical health profiles for specified pathogens can constitute a single zone. Fish from within such zones can receive certificates of health status which permit like-to-like transfers. The EC can also approve zones outside the EC, if the inspection and diagnostic procedures meet or exceed EC specifications. Such approvals and zonations closely parallel those of the OIE.

2.7 Recommendations for the Asian Region

The need for drafting programs for aquatic animal quarantine and health certification in the Asian Region has been the subject of a number of workshops, reports and recommendations (ADB/NACA 1991; Arthur 1987, 1995, 1996; Davy and Chouinard 1983; Davy and Graham 1979; Roberts 1981). A number of general principles have been recognized and recommended for implementation, as a result of these deliberations:

- Establishment and implementation of a quarantine process for aquatic animals which is consistent with those used for other animal species.
- Establishment of reference aquatic animal disease laboratories with high level diagnostic capabilities and information support.
- Establishment of quarantine controls consistent with international and regional standards.

- Specific health certification by exporting countries.
- Inspection and laboratory examination of imported aquatic animals.
- Treatment and observation of aquatic animals in quarantine.
- Safe disposal of imported water, packaging materials and any accompanying organisms or waste.
- Sanitary surveillance of aquaculture premises.
- Penalties for non-compliance.

The following list summarizes the recommendations related to legislation and the control of aquatic animal diseases made by scientists attending the Asian Development Bank/Network of Aquaculture Centres in Asia-Pacific (ADB/NACA) Regional Study and Workshop on Fish Disease and Fish Health Management held in Bangkok in 1991 (Wootten 1991). These experts agreed that countries of the region should:

- prepare legislation to prevent the translocation of serious aquatic animal diseases both within and outside the region;
- develop the capability of testing exports of aquatic animals to an agreed-upon regional standard;
- develop quarantine systems where imports of aquatic animals may be tested to regional standards;
- establish a standardized system of disease testing, including a common format of health certificate;
- compile a regional handbook of diagnostic methods (*Regional Diagnostic Manual*);
- develop quarantine and tests for disease, applicable to introductions of new species, in accordance with the ICES Code of Practice; and
- establish a working group of regional and international experts to deal with the above recommendations.

2.8 Asian Sub-regional Initiatives

The Association of Southeast Asian Nations (ASEAN) is committed to an "ASEAN Free Trade Area" by the early 2000s, and is currently conducting a review of the quarantine and health certification programs within the 10 ASEAN member states. Thailand is the Chair of this activity, and is currently collecting the information required on regulations related to quarantine and certification programs from ASEAN members (ASEAN Secretariat, pers. comm.). The objective is to seek harmonization of national programs to facilitate development of the free trade area. No initiatives were reported for the South Asian Association for Regional Cooperation (SAARC) area, although there are free trade initiatives between the SAARC members which have implications for potential movement of aquatic animal diseases.

The Asia Pacific Economic Cooperation (APEC) clearly identifies disease control as an important issue within the Region. The Osaka Action Agenda for Implementation of the Bogor Declaration included an Action Program for Fisheries with the goal to "*Maximise the economic benefits from, and the sustainability of, fisheries resources for the common benefit of all APEC members.*" The Fisheries Working Group has identified several objectives that will be addressed within its mandate in order to achieve its stated goals, including "*solutions to aquaculture disease control*." The APEC Action Program for Fisheries also emphasizes the importance of economic cooperation among member nations.

2.9 Industry Codes of Practice

There are a number of countries promoting the development of industry codes of practice for different forms of aquaculture and the ornamental fish trade. Such codes can be a powerful means of improving aquatic animal health management and can also be important, and complementary, to government efforts to manage risks associated with pathogen transfer with movements of aquatic species.

Malaysia, for example, has drafted a code of practice for shrimp and marine fish farming, based partly on the *Code of Conduct for Responsible Fisheries* (CCRF). The Malaysian code includes provisions for improving aquatic animal health within hatcheries and grow-out

facilities, but does not refer specifically to quarantine measures (Anon. 1998). Australia is also developing a code of practice and "Prawn Health Management Guidelines." Compliance with these guidelines is expected to benefit farmers through providing a set of standard procedures for action in the event of a disease emergency, to minimize losses and enhance long-term sustainability of the industry (Donovan 2000). Thailand has developed a Code of Conduct for Responsible Shrimp Aquaculture which includes elements on improving shrimp health management. The Global Aquaculture Alliance (GAA) has also developed some general codes of practice for shrimp farming, including one to improve health management practices.

Marine and freshwater ornamental fish are the subject of several codes, including an industry code developed by Singapore. The United Kingdom also has a code of conduct for ornamental fish importers, which has the objective of improving the health and welfare of transported fish.

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3 DEFINITIONS

3.1 Purpose

The following section provides definitions for the most important terms used in the *Technical Guidelines* (where possible, definitions provided by the *International Aquatic Animal Health Code* (OIE 2000) have been adopted).

3.2 Terms and Definitions

TERM	DEFINITION
Aquatic animals	Live fish, molluscs and crustaceans including their reproductive products, fertilized eggs, embryos and juvenile stages, whether from aquaculture sites or from the wild.
Aquaculture site	Hatchery, nursery or grow-out area, including land-based, flow-through, and open-water based systems.
Competent authority	National veterinary authority, or other aquatic animal health authority of a country/territory, with the officially approved responsibility and competence to ensure and supervise the implementation of aquatic animal health management in line with the OIE's International Aquatic Animal Health Code and the *Technical Guidelines*.
Contingency plan	A detailed plan of action for dealing with serious aquatic animal disease outbreaks.
Diagnosis	Identification of the cause of a specific disease or syndrome.
Disease	Clinical or non-clinical infection with an aetiological agent (as applied to the *Technical Guidelines*). NB. The classic definition of disease includes non-infectious pathology, however, this does not normally apply to health management measures related to movement of live aquatic animals.
Health certificate	A certificate issued by an exporting country's competent authority attesting to the health status of a shipment of aquatic animals (also see the OIE's International Aquatic Health Code and its model health certificates).
Health management process	Aquatic animal health management in its broadest sense, encompassing pre-border (exporter), border and post-border (importer) activities, as well as relevant national and regional capacity-building requirements (infrastructure and specialized expertise) for addressing health management activities, and implementation of effective national and regional policies and regulatory frameworks required to reduce the risk of disease spread through movement (intra- and international) of live aquatic animals.
Holding facilities	Facilities used to hold live aquatic animals for disease inspection at an importing border.
Import risk analysis (IRA)	The process by which hazards associated with the movement of a particular commodity are identified and mitigative options are assessed. The results of these analyses are communicated to the authorities responsible for approving or rejecting the import..
Introduction	The human-assisted movement of an aquatic animal to an area outside its natural range.
Monitoring	Collection and analysis of information necessary to detect changes in prevalence or intensity of infection.
Movement	Human-mediated movement of aquatic animals within or across political borders (international, state/provincial or regional boundaries).
Pathogen	An infectious agent capable of causing disease.

TERM	DEFINITION
Quarantine	Holding or rearing of aquatic animals under conditions which prevent their escape, and the escape of any pathogens they may be carrying, into the surrounding environment. This usually involves sterilization/disinfection of all effluent and quarantine materials.
Quarantine measures	Measures developed as a result of risk analysis to prevent the transfer of disease agents with live aquatic animal movements. This usually refers to trans-boundary movements, with pre-border, border and post-border health management processes, however, such activities are equally applicable to intra-national movements of live aquatic animals.
Risk	The probability of negative impact(s) on aquatic animal health, environmental biodiversity and habitat and/or socio-economic investment(s).
Surveillance	Systematic observation and examination of samples of population(s) of aquatic animals designed to detect the presence of infectious agents or occurrence of clinical disease in order to control disease outbreaks/spread.
Transfer	The movement of an aquatic animal to an area within the established or historical range of the species.
Movement	Human-mediated movement of aquatic animals within or across political borders (international, state/provincial or regional boundaries).
Zone	1. An area containing an aquatic species which has been determined to have a homogenous health profile for a specified pathogen or disease. The pathogens or diseases used to delineate these areas as positive or negative are those considered to pose significant risk if transferred from infected to uninfected populations of the same (or related) species. 2. An area of one or more countries/territories comprising: i) an entire catchment area from the source of a waterway to the estuary; ii) more than one catchment area; iii) part of a catchment area from the source of a waterway to a barrier; iv) a part of a coastal area; or v) an estuary with a precise geographical delimitation, that consists of an homogeneous hydrological system.
Zoning	Identifying zones for disease control purposes

3.3 References

OIE. 2000. International Aquatic Animal Health Code. 3rd edn. Office International des Épizooties, Paris, 153 p.

4 GUIDING PRINCIPLES

These *Technical Guidelines* have been developed based on a set of Guiding Principles, which were reached by consensus among the participating countries during the Second Workshop of the FAO/NACA TCP/RAS/6714 (A) Project "Assistance for the Responsible Movement of Live Aquatic Animals", held in Bangkok, Thailand, in February 1999. They are:

1. Movement of living aquatic animals within and across national boundaries is a necessity for economic, social and development purposes.

2. Such movements may lead to the introduction of new and emerging pathogens and to disease establishment and, therefore, may pose risks to the importing country's animal, plant and human health status.

3. The role of health management is to reduce the risks arising from the entry, establishment or spread of pathogens to a manageable level with the view to protecting animal, plant and human life. Health management should also protect living aquatic resources, the natural aquatic environment and aquatic biodiversity, as well as support the movement of aquatic animals and protect trade.

4. The health management process is defined, in the broad sense, as aquatic animal health management encompassing pre-border (exporter), border, and post-border (importer) activities, as well as relevant national and regional capacity-building requirements (infrastructure and specialized expertise) for addressing health management activities, and development and implementation of effective national and regional policies and regulatory frameworks to reduce the risk of disease spread through movements (intra- and international) of live aquatic animals.

5. Health management measures should be practical, cost-effective and easy to implement by utilizing readily available facilities. Individual countries may need to adopt, modify or vary these *Technical Guidelines* to suit their own particular situations and resources.

6. The varying capacity of developing countries to implement programs on health management should be acknowledged by relevant international organizations and financial institutions. These organizations should give full recognition to the special circumstances and requirements of many developing countries.

7. Health management measures shall be based on an assessment of the risk to animal, plant and human life or health. In assessing the risk, prevalence of specific pathogens in both the region of origin and the region of destination shall be a crucial issue. The likelihood of new or emerging pathogens becoming established in the region of destination is a major consideration.

8. All movements of aquatic animals should be conducted within the provisions given in existing relevant international agreements and instruments. Health management measures should not be applied in a manner which would constitute a disguised restriction on trade. Health management measures should be applied only to the extent necessary to protect animal, plant or human life or health, and must be based on scientific principles and not be maintained without sufficient scientific evidence.

9. In determining the appropriate level (stringency) of health management measures to be applied, relevant economic and ecological factors have to be taken into account. These are, *inter alia*: potential damage due to loss of production or value, and the cost of control or eradication. A conservative approach should be adopted in cases where insufficient knowledge exists in relation to disease risks posed by a particular import; a higher stringency of health management procedures should be adopted where inadequate knowledge exists.

10. The first movement (introduction) of a new species into a new area will require special health management considerations in light of the need to evaluate scientific evidence regarding the risk of introducing pathogens to new areas.

11. Different regions should attempt to harmonize health management procedures to facilitate safe movements of aquatic animals within and between regions.

12. Considering the free movement of aquatic species in trans-boundary waterways, division of regions into manageable sub-regional units based on factors such as geography, hydrography, ecosystems, epizootiological surveillance and effectiveness of control is necessary for the effective implementation of health management procedures. The basis for the establishment of such units should be uniform, clear and unambiguous.

13. Honest, conscientious and transparent reporting is essential for health management to be effective.

14. Technical cooperation among regional experts is essential to promote exchange of information and expertise.

15. Collaboration among the governments, public institutions, and the private sector, including all stakeholders, is important to achieve the full purpose of implementing effective health management. Opportunities for sharing the benefits of health management among all stakeholders should be explored.

5 PATHOGENS TO BE CONSIDERED

5.1 Purpose

The purpose of this section is to support the criteria outlined in the *Technical Guidelines* Section 5 - "Pathogens to be Considered" on developing national and regional lists of pathogens. One of the foundations in the development of health management procedures for responsible movement of live aquatic animals is the identification of pathogens of major concern. The development of a national pathogen list may take several years of monitoring and/or surveillance for specific disease agents. It will also require investigation of the regional and international literature, as well as public domain databanks (see Section 5.6 - Regional Disease/Pathogen Inventories and Databases), for disease information relevant to aquatic animals present in the country's waters.

5.2 Reasons for Inclusion of a Pathogen on a National List

Diseases which are included on a national list of significant pathogens should merit the effort which will be required to control their entry, establishment or spread within the country and Region. Although this usually means that diseases of commercially important species are given priority, diseases of other species that may be of socio-economic importance (e.g., those affecting artisanal fisheries) should not be overlooked. An example of the process of preparing a national disease list is given in Box 5.1).

Pathogen status within a country

Exotic to an entire country
The disease and its causative agent have never been found, or reported, in any aquatic animal species in the country (see Box 5.2). The disease is known to have a significant socio-economic impact in other countries growing the same or related aquatic animal species. If no form of surveillance is in place to provide data to show the disease is absent, a specific surveillance program may be required.

Box 5.2 Regional Example of Exotic Pathogen which merits inclusion on a national list.

Yellowhead Disease (YHD) of shrimp is exotic or not native to Australia; the disease had significant impact on aquaculture elsewhere in the world and there is a range of susceptible species in Australia; the disease is listed in Australia's 'National List of Reportable Species of Aquatic Animals'.

Occurs in certain parts of a country only
Significant or persistent losses occur in one part of the country due to infectious disease. Other parts of the same country are unaffected, but contain susceptible aquatic species. Surveillance is required to clearly delineate the areas/stocks that are affected and unaffected.

Occurs in part of a country – active control and eradication programs underway
A disease is under a strict control program designed to reduce or eliminate it from the area of the country affected. If successful, some areas (or zones) may change disease status, or the disease may be redefined as exotic (this is rare).

Box 5.1. An Example of Development of a National Lists of Diseases.

In early 1998, Australia's Fish Health Management Committee (FHMC) formally proposed to establish a *National List of Reportable Diseases of Aquatic Animals*. FHMC recommended that States and Territories implement the *National List* under State/Territory notifiable disease legislation or equivalent. In mid-1998, after considerable consultation with State and Territory governments and the private sector, the Commonwealth Government and the States and Territories governments endorsed the *National List,* as well as the formally proposed generic reporting strategy (see below).

The *National List* is a list of diseases, some exotic to Australia and some occurring in parts of Australia. The *National List* is **not** an inventory of diseases occurring in Australia. Diseases listed meet at least one of the following criteria:

- a disease is internationally notifiable to OIE;
- a disease is reportable to NACA/OIE under a regional reporting scheme (note that there is no legal reporting obligation to NACA/OIE); **or**
- a disease is of national and genuine concern to Australia..

For a disease to be listed because it is deemed to be of national and genuine concern to Australia, the following criteria must apply:

- a disease is exotic to Australia, or a disease does occur in parts of Australia, but vigilance is necessary to minimize its spread; **and**
- a disease would have significant socio-economic impacts if it occurred; **and**
- a disease can be clearly described by its etiology (causative agent).

An additional, but not compulsory criterion is met when control or eradication programs exist in one or several States/Territories, so that other States/Territories may wish to gain information on the status of the disease in the particular State/Territory administering the controls.

Whereas the OIE and NACA/OIE lists are internationally agreed upon, it is Australia's decision to add to, or delete from, the *National List*.

The *National List* is meant to be a tool to collate and disseminate information on diseases of national importance. "Reportable" in the national context implies merely the reporting *sensu stricto*. The *National List* is not intended to impose mandatory control measures for these diseases; therefore, the term "notifiable" has been deliberately avoided due to the connotations it carries in some States/Territories. Control measures would fall into the State/Territory portfolios and it is at their discretion to decide on appropriate control strategies.

Reporting on the diseases on the *National List* of reportable diseases of aquatic animals shall:

- meet international disease reporting obligations;
- provide a tool for negotiations in trade fora to support export certification and quarantine import policy;
- enable international acceptance of disease free "zones;"
- enhance the effectiveness of the control programs administered by individual States/Territories by ensuring national awareness of the diseases of concern of each State/Territory;
- guide the further development of diagnostic tests and surveillance protocols to meet the needs of Australian aquatic industries; and
- guide the development of an aquatic animal disease surveillance and monitoring system.

Pathogenicity

A disease to be listed should not only be exotic, but also demonstrate a significant impact on species present in the unaffected country. This is relatively easy where the same species affected by the disease elsewhere, is/are present in the unaffected country, and where growing conditions are similar. Complications may arise, however, if the disease to be listed as "exotic" occurs in species and growing environments that differ significantly from those in the unaffected country. For example, the listing of white spot syndrome virus disease as an exotic disease in a national disease list for Nepal would be inappropriate, as penaeid shrimp do not occur in Nepal and the country has growing conditions which differ significantly from countries which have WSSV disease.

Infectious etiology of the disease

The disease is caused by an infectious agent which can be transmitted horizontally (from individual to individual by direct contact; or via water-borne infectious stages, contamination of food or environmental surfaces; or vertically (through inclusion within eggs of infected broodstock (mainly viruses) or surface contamination of spawning products. Pathogens can also be included in national lists where they can be introduced by transmission via an intermediate or carrier host that exists in both affected and unaffected countries or zones. If transmission requires a specific intermediate host (e.g., many digeneans), and that host does not exist in the importing waters, such parasites may not merit listing, since they will have a curtailed life-span without their required host(s).

Adverse socio-economic or ecological impacts

In addition, to a disease having a direct impact on the health of the susceptible aquatic animal species, it may also be listed if that impact is known, or likely, to cause significant adverse impacts on:

- socio-economics – (e.g., loss of jobs)
- food production
- traditional community structure
- the environment (e.g., via enhanced susceptibility to predation or reduced biodiversity through population reduction or ecological niche competition)
- mass mortality
- degradation of water quality

Pathogens of public health significance are not covered under the *Technical Guidelines*, although such concerns can justify national listing. Human health concerns usually fall under the mandate of public health or food inspection authorities.

5.3 Reasons for Exclusion of a Pathogen from a National List

Pathogens which do not merit control efforts should not be included on national lists. These include pathogens which:

- have a broad geographic range, making control of entry/spread difficult to impossible, e.g., *Vibrio harveyi* (see Box 5.3);
- are opportunistic and whose pathogenicity is reduced by improved husbandry or handling, e.g., *Aeromonas hydrophila;*
- are difficult or impossible to distinguish from related established pathogens, using available diagnostic screening techniques.

Box 5.3. Reasons for excluding *Vibrio harveyi* (luminescent vibriosis) in the Philippines from the FAO/NACA and OIE pathogen lists:

- the bacterium is ubiquitous in the environment
- it occurs in the gut of healthy shrimp as part of their normal microflora
- it is an opportunistic pathogen that can be controlled by improved husbandry and/or water quality.

5.4 Existing International Pathogen Lists

As indicated above, not all infectious agents believed to be exotic to country need quarantine measures or health certification. Those which do are described in the following lists, and more details on their screening and diagnosis are provided in the *Asia Diagnostic Guide to Aquatic Animal Diseases* (ADG).

OIE lists of diseases of aquatic animals

The OIE has two lists of diseases of aquatic animals (see Annex V):

Diseases notifiable to the OIE
Previously known as "List B" diseases, these diseases are now defined as "…the list of transmissible diseases that are considered to be of socio-economic and/or public health importance within countries and that are significant in the international trade of aquatic animals and aquatic animal products" (see Annex IV and OIE 2000). These diseases are normally reported only once a year, unless specific conditions require more frequent or interim reporting (e.g., the emergence of a notifiable or a significant "new" disease for the first time).

Other significant diseases
These diseases are defined as "…diseases that are of current or potential international significance in aquaculture but that have not been included in the list of diseases notifiable to the OIE because they are less important than the notifiable diseases; or because their geographic range is limited; or it is too wide for notification to be meaningful; or it is not yet sufficiently defined; or because the aetiology of the diseases is not well enough understood; or approved diagnostic methods are not available" (see Annex IV and OIE 2000a).

Information on OIE-listed diseases is available via *the International Database on Aquatic Animal Diseases*, which is housed at the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) Laboratory, Weymouth, United Kingdom (http://www.cefas.co.uk/oie/index%5Fold.html).

NACA/FAO and OIE lists of diseases of aquatic animals
The NACA/FAO and OIE lists of diseases reportable in the Asia-Pacific Region were developed to reflect the Asian situation. These lists include all OIE "notifiable diseases" and "other significant diseases," as well as a number of other serious diseases that occur in the Asia-Pacific Region (see Annex VI). This list is expected to be refined, as more data begins to emerge from national surveillance programs and development of diagnostic infrastructure. The diseases included on this list have been reviewed by NACA, FAO and OIE representatives, as well as the National Co-ordinators (NCs) and the Regional Working Group (RWG) at the two RWG meetings of the FAO/NACA Regional Technical Cooperation Programme (TCP) on "Assistance for Responsible Movement of Live Aquatic Animals" (TCP/RAS/6714 (A), TCP/RAS/9605 (A)). This review process became the responsibility of the Advisory Group on Aquatic Animal Health (AG), under the NACA Governing Council, following completion of the FAO/NACA Regional TCP. The OIE and FAO/NACA Quarterly Aquatic Animal Disease Reports (Asia and the Pacific Region) are published on a quarterly basis by FAO/NACA and OIE Regional Reptresentation for Asia and the Pacific; available on the website of the OIE Regional Representation for Asia and the Pacific (http://oie-jp.org); while the FAO/NACA disease reports will be made available at the website of NACA (http://www.enaca.org).

5.5 Process of Compiling a List of Diseases

The list of diseases, as described above, should take into account the risk associated with a potential introduction into or spread within a country. The former is a fundamental component of import risk analysis (see *Technical Guidelines* – Section 11 and *Manual of Procedures* - Section 10 - Import Risk Analysis). The decision-making process should be a consultative and transparent process, involving

responsible agencies (fisheries, border control, quarantine officers, industry stakeholders, aquatic animal pathologists and epidemiologists, etc.).

5.6 Regional Disease/Pathogen Inventories and Databases

Background

To prepare pathogen lists and evaluate the risks posed by proposed importations of live aquatic animals, quarantine workers and government policy makers must have access to accurate, comprehensive and up-to-date information on the known and potential pathogens occurring in their countries (e.g., identities, hosts, distributions, pathogenic significance, life cycles, zoonotic importance, etc.), as well as comparable information from the exporting countries. This information is essential for scientifically based risk assessments. Decisions based on such risk assessments must be timely, and be reached using standardized, rational and defensible decision-making procedures.

As noted by Humphrey (1995), the long-term management of national fisheries resources and protection of the aquatic environment require a thorough knowledge of the prevalence, distribution and pathogenic significance of infectious agents. A comprehensive understanding of the national disease status is also essential for establishing effective national strategies for aquatic animal health risk analysis, quarantine, certification, treatment, control and eradication programs. This is also a fundamental component of strategies for the protection of national biodiversity. Inventories of pathogens and parasites, therefore, form an essential component of any program that aims to prevent the international spread of diseases of aquatic animals. Some idea of the extent of our current knowledge on the parasites and diseases of aquatic animals can be gained by examining the number of species of fish occurring in the waters of countries of the Asia Region and, where possible, comparing these numbers with the numbers of species studied to any extent for parasites. For example:

- More than 2198 species of fish occur in Philippine waters (1916 marine, 166 freshwater and 116 euryhaline species) (FishBase 97). In the checklist of Arthur and Lumanlan-Mayo (1997), only 201 named species of parasites are recorded from 172 species of fish. Thus, less than 8% of the fish species found in the Philippines have been studied to any extent. The parasite and pathogen faunas are reasonably well known for only a handful of cultured species, and most of these are exotics introduced from other countries.

- For the nematodes of South Asian fishes (Soota 1983, Sood 1988) slightly over 410 species are reported from 180 species of fish. Since India alone has almost 1400 species of fish occurring its waters (FishBase 97), less than 13% of the species occurring in this region have been studied.

- Gussev (1974) reported that the Monogenea of about 60 of the 400+ freshwater fish species in the Indian fauna had so far been studied. He estimated that the number of monogeneans on the Indian subcontinent must be at least 5-10 times greater than the number of known forms.

These examples highlight the fact that the parasites and diseases of fishes of the Asia Region are very poorly known. However, it must be recognized that the knowledge base for cultured species is much stronger. Arthur and Ogawa (1996) noted that more than 70 marine and diadromous fishes are cultured in East and Southeast Asia. The economic importance of these species has lead, in some cases, to their intensive study. Furthermore, some species cultured in Asia (e.g., the carps and tilapias) have been widely distributed around the world for culture and other purposes, and thus their diseases have received additional attention in other regions, including Europe and North America.

Although the number of inventories of parasites and pathogens of molluscs has recently increased (e.g., Liu *et al*. 1993, Bower *et al.* 1994, Anderson *et al*. 1995, Cuif and Dauphin 1996, Hine 1996, Perkins 1996, Hine and Wesney 1997, Pass *et al.* 1997, Hine *et al*. 1998, Hine and Thorne 1998,

Miyazaki *et al*. 1999, Wu and Pan 1999), our knowledge of their diseases is still less comprehensive than for many fish species. In contrast, the diseases of important cultured Asian crustaceans, such as the black tiger prawn (*Penaeus monodon*), the kuruma prawn (*P. japonicus*) and the giant freshwater prawn (*Macrobrachium rosenbergii*) are well studied. Since Lightner's *A Handbook of Pathology and Diagnostic Procedures for Diseases of Penaeid Shrimp* (Lightner 1996) was produced, there have been close to 200 new publications on prawn diseases, most of which have been from the Asia-Pacific Region. A few recent examples include: Flegel 1997, Owens 1997, Wang *et al*. 1997, Zhou *et al*. 1997, Zhan *et al.* 1998, Vandenberghe *et al*. 1998, Owens *et al*. 1998, Park *et al.* 1998, Sudha *et al.* 1998, Peng *et al.* 1998, Lavilla-Pitogo *et al.* 1998, Karunasagar *et al.* 1998, Tsai *et al*. 1999, Sukhumsirichart *et al*. 1999, Otta *et al.* 1999, and Liu *et al.* 1999.

Sources and status of existing data

Historical Data

With the possible exception of a few countries such as Australia and Japan, the published literature is the sole source of historical data on diseases and pathogens occurring in the Region. Original records of pathogens are widely scattered in the scientific literature, and appear in various types of documents. These range from peer-reviewed articles published in internationally recognized journals; reviewed and unreviewed proceedings, reports and abstracts of meetings and conferences; regional and national journals; departmental reports (both published and internal); and society and institutional newsletters; to photocopies of manuscripts and handouts distributed at workshops and training sessions and, more recently, electronic media (e.g., webpages).

The quality and reliability of data contained in these sources are quite variable, and reflect both the expertise of the workers and the stringency of scientific review given the publication. Individual data reports are also quite variable in the details given. While some authors give precise and detailed descriptions of pathogens, disease outbreaks, species affected, pathogen prevalence and intensities of infection, estimates of mortalities and economic losses, etc., such detailed reports are few. Many reports are only taxonomic (descriptive) in nature, which is also important in diagnosis, however, they contribute little information in other areas required for health management use.

In general, there is a paucity of trained specialists in the Asia Region. This, and other problems (e.g., lack of access to scientific literature, inadequate/inaccurate taxonomic descriptions, etc.), have led to difficulties in understanding the geographic distributions of individual pathogens that occur in the Region. As a result, much taxonomic review and revision is needed.

Summaries (e.g., synopses, checklists, guidebooks, identification guides, keys, etc.) of the parasites and pathogens infecting aquatic animals in the region are few. The following paragraphs briefly review the status of knowledge for the various sub-regions and mention some of the key references available to regional workers as starting points for the compilation of national pathogen databases.

South Asia

The parasites of fishes were included in the series *The Fauna of British India including Ceylon and Burma* (Baylis 1936, 1939; Southwell 1930; etc.). The monographs of Soota (1983) and Sood (1988) summarize the nematodes reported from fishes of the South Asian Region, including records for Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka (Sood 1983, also includes Burma (Myanmar)). Soota (1983) deals with over 200 species of nematode infecting some 156 named marine and freshwater fishes of the Region. Sood (1988) considered the nematode fauna of fishes in South Asia to be fairly well known. He listed over 410 named species occurring in 180 named species of fishes. For the Digenea, Mehra (1980) provides a monograph of the Order Fasciolatoidea infecting the Indian fauna, including species described up to about 1963. This volume was up-dated to 1978 by Srivastava (1982).

Gussev (1974) found that 27 of 37 fish species examined were infected by a total of 57 monogenean species, 40 of which were new to science. The total number of freshwater monogeneans described

from the Indian subcontinent prior to Gussev (1974) was 80 species from 45 fish species, approximately 10% of the total freshwater fish fauna. An additional 20 species were noted in Sri Lankan freshwater fishes, Sri Lanka being considered faunistically indivisible from the Indian Peninsula.

Das and Das (1997) recently published *Fish and Prawn Diseases in India - Diagnosis and Control*, a volume useful to fish health workers and aquaculturists of South Asia. The book contains chapters on water quality, viruses, bacteria, fungi, protozoans, helminths, crustaceans, epizootic ulcerative syndrome, laboratory methods, disease management and surveillance. Another recent volume by Das (1997) provides a review of the status of epizootic ulcerative syndrome in India, while the diseases of cultured penaeid shrimp in India have recently been reviewed by Karunasagar *et al*. (1998).

Southeast Asia

Kabata (1985) provided keys and illustrations to the parasites and diseases occurring in cultured fish of Southeast Asia. Unfortunately, the field of aquatic animal health has advanced so rapidly in the region that this volume is now out-dated.

Arthur (1992) compiled a comprehensive bibliography, including abstracts, from the fish health literature of Southeast Asia up to the end of 1990. Information is presented from over 800 articles originating from nine countries. In the only monograph on fish parasites so far published for Southeast Asia, Velasquez (1975) listed 50 named species of adult and 20 named species of larval Digenea occurring in 43 named species of marine and freshwater Philippine fish.

Arthur and Lumanlan-Mayo (1997) provide a comprehensive checklist of the parasites of Philippine fish. These authors list 201 named species of parasites (1 Apicomplexa, 16 Ciliophora, 2 Mastigophora, 1 Microspora, 9 Myxozoa, 90 Trematoda, 22 Monogenea, 6 Cestoda, 20 Nematoda, 5 Acanthocephala, 1 Mollusca, 12 Branchiura, 21 Copepoda and 5 Isopoda), but note that the parasites of the vast majority of native freshwater and marine fishes in the Philippines remain poorly studied or completely unknown.

Lavilla-Pitogo and de la Peña (1998) recently reviewed the bacterial diseases of cultured black tiger shrimp in the Philippines. Other valuable texts include a short review of the parasites of Malaysian fish by Leong (1979) and the volume *Health Management in Shrimp Ponds* by Chanratchakool *et al*. (1998). The latter contains a chapter on diseases of black tiger shrimp based on the authors' experiences in Southeast Asia (mainly Thailand). Another recently addition to shrimp disease information for Southeast Asia is the CD-ROM "*Diagnosis of Shrimp Diseases with Emphasis on the Black Tiger Shrimp (Penaeus monodon)*" by Alday de Graindorge and Flegel (1999), based mainly on the authors' experiences in Thailand.

Most recently, Tonguthai *et al.* (1999) have published a very useful diagnostic manual for finfish diseases that was developed especially to assist workers in the least developed countries of Southeast Asia.

East Asia

In Japan, there has been considerable research effort on the parasites and diseases of the principal cultured species. A number of recent papers have reviewed the bacterial and viral diseases of kuruma shrimp (*Penaeus japonicus*) (Takahashi *et al*. 1998) and the parasitic (Ogawa and Yokoyama 1998), viral (Nakajima *et al*. 1998), and bacterial diseases (Kusuda and Kawai 1998) of cultured marine fishes. Japanese publications on fish health are listed in the bibliography published by the Fish Health Section, Asian Fisheries Society (Wakabayashi 1994). A checklist of the parasites of Japanese salmonids has also been published (Nagasawa *et al*. 1987), as has a checklist of the parasites of freshwater fishes of Hokkaido (Nagasawa *et al*. 1989). However, to date, no comprehensive guidebook to the Japanese fauna has been prepared. Books in Japanese dealing with fish diseases and pathology include those of Hara (1972) and Egusa (1978, 1983).

For China, *An Illustrated Guide to the Diseases and Causative Pathogenic Fauna and Flora of Fishes of Hubei Province* was published some 27 years ago (Anon. 1973), and the series *Fauna Sinica* includes volumes on the Digenea (Chen *et al*. 1985), Hirudinea (Yang 1996) and Myxosporea (Chen and Ma 1998). A handbook on the diagnosis and prevention of fish diseases has also been published (Pan 1988), and a review of white spot syndrome of shrimp in Taiwan Province of China has recently become available (Lo and Kou 1998). Recently, Zhang *et al.* (1999) have published *Parasites and Parasitic Diseases of Fishes*, a guide to the genera of fish parasites reported from China.

For Korea, a review of the viral diseases of cultured marine fish was recently published by Sohn and Park (1998).

Australia

Humphrey (1995) provides a checklist and selected bibliography of the pathogens, parasites and commensals of Australian aquatic animals. These data are the basis for definition of diseases exotic to Australia, disease diagnosis and control within Australia, and as a reference for research on diseases of aquatic animals. Information is presented in 52 tables giving: the etiological agent, disease name, host species affected in Australia, geographic distribution by province, and the reference(s) used. For each host category (finfish, crustaceans, and molluscs), individual tables for each taxon of disease agent (viruses, bacteria, fungi, protozoa, algae, poriferans, acanthocephalans, nematodes, annelids, cestodes, digeneans, monogeneans, aspidogastreans, turbellarians, molluscs, branchiurans, copepods, isopods, decapods, ostracods, insects, and arachnids) are presented. In addition, tables are included for bacteria and fungi isolated from Australian aquatic organisms, but not associated with disease. More than 1700 transmissible agents have been reported from Australian aquatic animals, however, only a few are considered as having major pathogenic or socio-economic importance, and most have a restricted geographic distribution. The majority of are protistans or metazoans with no ascribed pathology. A recent review of the viral diseases of fish and shellfish in Australian mariculture has also been published (Munday and Owens 1998).

The Australian Quarantine and Inspection Service (AQIS) has recently published the results of import risk analyses (IRA) on non-viable salmonids and non-salmonid marine finfish (AQIS 1999a) and on live ornamental finfish (AQIS 1999b), and a handbook on the AQIS IRA process (AQIS 1998). Another useful publication is the *Australian Aquatic Animal Disease Identification Field Guide* (Herfort and Rawlin 1999). *Aquaplan. Australia's National Strategic Plan for Aquatic Animal Health 1998-2003*, was published in 1999 (AFFA 1999).

Other sources of information

Because aquatic animal health is a relatively new field in most countries of the Asia Region, few, if any countries have yet attempted to establish national pathogen databases. Unpublished diagnostics records exist at a number of regional and national lead centers (e.g., AAHRI, Bangkok, Thailand; the Agri-Food and Veterinary Authority of Singapore (AVA); the National Fisheries Research and Development Institute (NFRDI) of Korea RO) and SEAFDEC-AQD, Tigbauan, Philippines;), however, the extent and potential usefulness of these for national aquatic health programs has not yet been examined.

Some countries, such as Japan and Australia, which report regularly to the Office International des Épizooties (OIE), have a significant amount of epidemiological data for nationally important pathogens in national data banks. However, many countries have little or no epidemiological data. OIE has developed an *International Database on Aquatic Animal Diseases*, which is housed at the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) Laboratory, Weymouth, UK[11]. Information on recent outbreaks of internationally important diseases can also be obtained through the OIE and FAO/NACA Quarterly Aquatic Animal Disease Reports (Asia and the Pacific Region) (e.g., see NACA/FAO 1999), and are also available from the websites of the OIE Regional Representation for Asia and the Pacific (http://www.oie-jp.org).

[11] http://www.cefas.co.uk/oie/index%5Fold.html

Following work conducted some time ago by regional contributors, under partial IDRC support, the FAO assembled a bibliography and abstracts of the aquatic animal health literature for South Asia. Although this bibliography was considered too incomplete to justify publication (only an estimated 40-50% of the vast Indian literature was included), it has been made available to National Co-ordinators and will be incorporated into the Aquatic Animal Pathogen and Quarantine Information System (AAPQIS).

5.7 Aquatic Animal Pathogen and Quarantine Information System (AAPQIS)

AAPQIS provides a mechanism for the comprehensive tracking and reporting of diseases and parasites on a regional basis. It can also be adapted by national governments for use in establishing national systems of disease reporting and tracking. The information system is delivered via Internet and the world-wide web (WWW). The initial server for the Asia-Pacific Region is operated by NACA (http://www. enaca.org). The software framework to support the system has been developed to meet the specific information needs of fish health quarantine officers, diagnosticians, researchers and government policy makers. The capabilities of AAPQIS include:

Pathogens/parasites

The system permits users to find information on pathogens and parasites reported from any region or country. A variety of types of information are (or can be) included: taxonomic and systematic information, hosts, geographic distributions, pathogenicity, OIE disease status, economic and zoonotic importance, biology, identification problems, list of taxonomic experts capable of confirming identification, possible treatments, line drawings, photomicrographs, etc. The system permits the construction of dynamic distribution maps, allowing users to see the currently known distribution of any pathogen. Although this information is currently being compiled on a regional and national scale, it is hoped that it will expand to other aquatic animal producing regions (Latina, Mediterranea and Africa).

Hosts

Users can obtain current information on pathogens and parasites from fish, crustaceans, molluscs or other commercially important invertebrates. For more comprehensive information on the taxonomy, common names, distributions, introductions, etc. of fish hosts, AAPQIS users are referred to the species database of FishBase (ICLARM/EC/FAO; http://www.fishbase.org).

Country check

Users can obtain a list of pathogens and parasites reported to occur in a host from a particular country. They can compare this list with the list of pathogens/parasites known from the same host (if it is present) in their own country. This will facilitate accurate health risk analysis of proposed live aquatic animal imports or highlight areas that require greater surveillance.

Country lists

It will be possible to generate a current listing of all parasites/pathogens listed by host species for any country.

References

A literature database, including all references used to construct the pathogen/parasite database is maintained.

Other components

These will be added as required by the user community. This could include information on the status of quarantine legislation in each country, lists of institutions and researchers working on fish health (by country or region) and Internet connection information, fora for discussion of specific problems, newsletters (e.g., newsletters of the Asian Fisheries Society, Fish Health Section; the American Fisheries Society, Fish Health Section; Aquatic Animal Health Research Institute; International Ichthyoparasitology Newsletter) etc.

Database structure

The structure of the database has been developed by FAO through collaboration with aquatic animal health researchers and/or the responsible quarantine officers from (or linked to) focal points in participating countries. These national focal points, along with other interested parties, within and outside the region, are able to contribute to developing and maintaining the database. Experts can "adopt" a given pathogen species or taxonomic group (data moderator) and, along with other recognized international specialists, will ensure the accuracy of information entered for that pathogen/group into the database. Users from within and outside a region will be able to comment, contribute and correct information contained in the database via communication with the relevant moderator. Database security is the responsibility of a "data master" who has sole control over final entry changes into the master database.

National responsibilities and participation

AAPQIS is being established in the national fisheries or veterinary department responsible for implementing quarantine and certification programs for aquatic animals in each participating country. These departments are the focal point for AAPQIS, and have responsibility for data collection and networking within the country. Due to the large size of some countries, particularly China and India, a large network of in-country disease institutions (“nodal points”) is necessary to access the relevant information. These nodal points are responsible for collating data for entry into AAPQIS on a regular basis. They have access to the regional database to deliver data, however, data already entered and screened at the national level within the database can only be accessed via password through the Internet.

AAPQIS is designed for use by the following:

- National policy makers responsible for assessing individual country's needs for aquatic animal quarantine and certification programs.
- International and regional agencies involved in research or policy formulation for aquaculture and aquatic animal health.
- Aquatic animal health workers, diagnosticians and scientists from governments, universities and private sector aquaculture.

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6 DISEASE DIAGNOSIS

6.1 Purpose

The material presented in this section supports Section 6 of the *Technical Guidelines*. Diagnosis requires several levels of data, starting with farm- or site-level observations and progressing in technical complexity to electron microscopy, immunology, nucleic-acid assays and other biomolecular methods. This means that all levels of expertise, including that of the farmer and extension officer, make contributions that are critical for rapid and accurate disease diagnosis. The *Technical Guidelines* deliberately emphasize capacity building (facilities and expertise) for basic diagnosis and surveillance at the farm level (Level I). This is the essential foundation for early disease detection and implementation of effective response protocols that can minimize social and economic losses.

In addition to disease diagnostic input levels, this section further describes the diagnostic issues that relate specifically to the movement of live aquatic animals.

Regional and national policy makers need to consider disease diagnosis at all of the three levels agreed-upon by the countries participating in the development of the *Technical Guidelines* (see Section 6 of the *Technical Guidelines* and Table 6.1, below). Countries can move from one level to the next as they build up their infrastructure, capacity and experience.

6.2 Levels of Disease Diagnosis

The accurate diagnosis of aquatic animal diseases requires different levels of disease surveillance and data collection, ranging from farm-site observations through to the use of state-of-the-art diagnostic technology. Development of expertise at each level of diagnosis requires investment in training and infrastructure, with successive levels requiring more complex training and greater financial resources. Table 6.1 shows the investment required at the three different levels of disease surveillance (termed Levels I-III). Some countries will need to increase investment to meet diagnostic requirements for listed diseases which need Level II and III capability for their identification and/or confirmation. Where such diseases (or the potential for their introduction) have limited probability of occurrence, diagnostic/surveillance assurances can be achieved by enhanced links with the required diagnostic capabilities in other participating countries. For OIE-listed diseases (see Annex V), OIE Reference Laboratories can be used. For other diseases of regional concern (see additional diseases listed in Annex VI), Regional Resource Centers (RRCs) can be consulted (see Section 6.4). It is important to note, however, that all three levels of diagnostics capability are necessary for the diagnosis of new or rare diseases.

As shown in Table 6.1, Level I activities include farm-site monitoring and provide information essential for making presumptive diagnoses. In some cases, this may provide sufficient information to make adequate health management decisions (see Box 6.1). Level I diagnostics is especially valuable for compiling complete case-histories which can accompany and assist diagnosis of samples submitted for Level II or III diagnosis (see Box 6.2). Such information helps focus diagnostic effort, enhancing speed and accuracy of results. Level I diagnosis is generally appropriate for:

- diseases with specific gross pathology, and
- farms/sites with an established history and/or susceptibility to specific diseases.

Although Level I diagnostics rarely results in a conclusive disease diagnosis, it provides an essential starting point for reducing the risk of pathogen transfer via movement of live aquatic animals. Microbial or internal infections are generally not readily detectable using Level I techniques. Furthermore, latent (sub-clinical) infections may, in some cases, also evade diagnosis at Level II and III. However, Level I monitoring activities provide information essential for detecting emerging

Box 6.1. Examples of diseases that can be managed using Level I capability

- **Black Splint Syndrome** of *Penaeus monodon* (and possibly other penaeids), caused by *Vibrio penaeicida* group bacterial agent. These consist of blackening along the fish articular connective tissues. This makes confirmatory diagnosis reliable at Level I, directs attention towards pond management, rather than an infectious disease and can be used to permit movements.
- ***Agmasoma sp.*** in penaeids causes "cotton shrimp" which is characteristic of microsporidian diseases. Diagnosis is possible using gross observation of muscle whitening (Level I). This is sufficient to initiate remedial husbandry, such as removal of fish from the culture system.

clinical infections (e.g., deviations from the established "normal") thus, they should not be undervalued in any diagnostic program. In some cases, they also provide information vital to meaningful interpretation of laboratory findings derived from Level II and III activities. Conscientious observations and recordings of shipments or receipt of grossly diseased aquatic animals is also frequently sufficient to provide a presumptive diagnosis which will lead to prevention of disease spread or transfer. Thus, all countries should ensure that Level I diagnostic capabilities are well-established, in addition to obtaining access to and/or developing Level II and III resources (within or outside the region/country).

Level II diagnostics is required for diseases whose clinical signs could be caused by a variety of infectious (and non-infectious) agents. Level II (and occasionally, Level III capability) is also required for external and internal pathogens that are not readily recognized by gross examination using the naked eye (e.g., microbial agents, many types of parasites). In these cases, bacteriology (culture characteristics, chemical profiles or light microscope examination), mycology (as for bacteriology) or histology (preserved and stained sections of tissue 5 micrometers thick for microscopic examination of cell structures) (see Box 6.2 - EUS example) is required. In addition, many parasitic infections are impossible to identify accurately without specialized morphological study (e.g., trichodinid ciliates; most monogeneans, digeneans and cestodes). Bacteriological, mycological and parasitological investigations all pivot on association with disease signs. In some cases, however, the cause of clinical disease signs cannot be identified from lesion smears, cultures or squashes (see Box 6.3). In these cases, tissue samples have to be collected and preserved for light (or Level III electron) microscopy. As with bacteriology, mycology and parasitology, trained expertise and equipment is necessary. This is particularly true for many molluscan and crustacean diseases, where tissues may have to be collected for virology and/or electron microscopy (Level III activities). Personnel involved in Level II diagnostics require specialized training and access to necessary equipment.

Box 6.2. Presumptive vs. confirmatory diagnoses – example: Epizootic Ulcerative Syndrome.

EUS causes grossly visible skin lesions. These first manifest as small red spots, which progress to acute dermatitis. The raised, whitened edges of such lesions can be used, with Level I observation, to diagnose *presumptive* EUS in species such as snakehead.

The presence of the oomycete fungus *Aphanomyces invadans* is recognized as the essential component for confirmatory diagnosis of EUS. This requires histopathological preparations to detect and identify the characteristic fungal hyphae of *A. invadans* along with associated granulomatous lesions and surrounding epithelioid cells.

Where personnel have not had dedicated undergraduate training in such diagnostic techniques, the period required to gain independent capability and diagnostic confidence can exceed two years. This includes a period where diagnosticians have to establish “normal” base-line references and material. With undergraduate technical training, the period is shortened (6 months – 1 year workplace training), since the personnel only require slight adaptation of techniques and familiarization with aquatic animal pathogens. Introductory workshops for personnel with some aquatic animal health background can further shorten Level II training. As with other Levels, all Level II training requires linkage to specialists and established reference resources. This is most easily achieved via the Internet; however, additional provisions must be made for trainees/employees who do not have access to this communication infrastructure.

Level III diagnostic capabilities are required for problematic pathogens and those that are difficult or impossible to identify at Levels I and II. As noted above, this is especially applicable to sub-clinical infections. Level III training requires more experience than Level II. Electron microscopy requires acute attention to preparation details, as well as awareness of normal sub-cellular structures in different tissues from

Box 6.3. Evolution of diagnostic confidence with level of diagnosis – white spot syndrome virus (WSSV).

Diagnosis by gross observation of white spot lesions was initially considered sufficient, until other etiological agents were discovered to cause similar lesions. This reduced confidence for first time diagnoses.

Subsequent Level II diagnosis achieved through histology and microscopic observation of intranuclear inclusion of herpesvirus bodies in gill epithelial cells as well as elsewhere (see ADG). This is sufficient to confirm diagnoses done at Level I. Both levels are insufficient, however, for sub-clincial carriers of the virus.

Level III diagnosis using DNA probes for various molecular diagnostic techniques provides the ultimate diagnostic confidence (to date) for positive and negative cases.

different hosts. Immunological and molecular diagnostic techniques require a refined background knowledge of normal host and pathogen physiology and genetics, as well as extreme sensitivity to contamination which can affect results. This is particularly important where whole infectious organisms or *in situ* evaluation of pathology is not a component of the diagnosis. Classic virology requires knowledge of the differing maintenance requirements of living cell-lines for intracellular pathogen isolation and culture, as well as detailed knowledge of virogenesis, cytopathological effects (CPE) and molecular virology. These diagnostic fields have only developed relatively recently for aquatic organisms, and classic techniques are lacking for invertebrate hosts, thus, training in this area is particularly extensive and specialized.

Development of competency at each level of diagnosis is the basis for effective export certification. In many countries, such certification is currently based on Level I diagnosis (e.g., visual examination and country/enterprise history of disease), or no aquatic animal health training. Development of diagnostic competence will allow more accurate pre-export surveillance and diagnosis, and will result in a significant improvement in the assurances currently provided by many certification systems.

6.3 OIE Reference Laboratories

Diagnostic capability and specialized expertise on specific diseases and disease agents is best developed at laboratories with day-to-day experience with these diseases (usually laboratories in enzootic areas for each disease). In recognition of this, the OIE has designated laboratories with such expertise in OIE-listed diseases as "OIE Reference Laboratories." These are listed on the OIE website (http://www.oie.int/diseases/A_list.htm). With website access, a diagnostician can click on a disease of concern and find the OIE-approved reference laboratory contact information. Since some laboratories are located in areas with more than one OIE-listed disease, they may function as Reference Laboratories for each of these diseases.

The role of an OIE Reference Laboratory is:

- to co-ordinate/conduct surveillance for the specific listed diseases they are responsible for;
- to provide diagnostic confirmations for material submitted by other laboratories which are believed to have suspect or presumptive infections; and
- to ensure that diagnostic methodologies for the specific disease agents are regularly evaluated and improved, as required, through appropriate research.

These responsibilities are undertaken with government support from the country, union, or region with such reference laboratories. OIE may provide supplementary support, however, reference capability is considered to be provided on stand-alone resources. Laboratories wishing to be considered as OIE Reference Laboratories submit applications to OIE; OIE cannot request or demand Reference Laboratory services.

6.4 Regional Resource Centers

Many non-OIE-listed diseases are of regional concern, with respect to accurate diagnosis, as well as trans-boundary trade. As with the OIE-listed diseases, laboratories with strong capabilities and established expertise with such diseases are those which have to deal with them on a regular basis. This means that equally competent laboratories in areas where the disease does not normally occur, or those laboratories in the process of developing such capability, may lack the requisite experience for diagnostic confidence for these diseases. In such instances, Regional Resource Centers (RRCs) should be made available for sample submission by laboratories/field sites making presumptive diagnoses (Level I or II), as well as to provide "second opinion" confirmations for Level II/III laboratories that have diagnosed the disease/disease agent in question. Such RRCs would participate in this program voluntarily through application for inclusion on a laboratory referral list maintained by NACA Headquarters. They could function, additionally, as RRCs for training in diagnostics (all Levels) for the disease(s) for which they have expertise.

Basic criteria for recognition as a Regional Resource Center are:

At least five years experience in diagnosing and studying the disease(s)/pathogens(s) for which the RRC application is made.

Presence of more than one diagnostician (scientist, biologist or technician) with competence in the disease(s) in question. Where such is not the case, the laboratory can by listed, but should that specialist leave the laboratory, it must withdraw its RRC services.

Ability to accept without charge samples submitted for diagnostic confirmation of infection by the pathogen(s) for which RRC designation has been given.

Ability to provide confirmatory diagnosis (or re-directed diagnosis, as appropriate) to the submitter (laboratory, farm site, government authority) within 3-4 weeks (or in the shortest period of time required to apply confirmatory diagnostic techniques).

Easy accessibility by standard rapid communications avenues (telephone; fax; e-mail).

Willingness to host training workshops on a regular basis (annually or bi-annually) in diagnosis (at all Levels) of the disease(s)/pathogen(s) for which the RRC is recognized.

6.5 Capacity and Institutional Implications

The requirements for each diagnostic Level are described in Table 6.1. At Level I, the best training is experience. Apprenticing (shadow training) of young/inexperienced personnel on farm sites with farm workers or managers, is frequently sufficient to provide the capability to distinguish significant losses from routine losses, as well as abnormal from routine mortalities. If fishery extension officers and local fishery/aquaculture biologists can be included in such "orientation" training, this will enhance collaborative efforts, as well as communication links. This applies also to aquatic veterinary support.

In order to minimize the risk of trans-boundary pathogen transfer, it is important that some level of harmonization in basic diagnostics be established within the Region. Considering the significant differences in diagnostic capacity and infrastructure, countries within the region should attempt, at least as a starting point, to develop Level I diagnostic capabilities for the diseases and disease agents on the NACA/FAO and OIE Regional Disease Reporting Lists (Annex VI), as well as basic recognition of clinical pathology associated with known serious pathogens. Such information is available through regional diagnostic manuals and the *Asia Diagnostic Guide to Aquatic Animal Diseases.*

Table 6.1. Diagnostic case-history contribution levels.

Level	Activity	Work requirements	Responsibility	Technical requirements to support activities
I	Observation of Animal and Environment Gross Clinical Examination	Knowledge of normal health status (feeding, behavior, growth) of stock. Frequent/regular observation of stock. Regular, consistent, record-keeping and maintenance of records – including fundamental environmental information. Knowledge of contacts for health diagnosis assistance (Level II, III). Ability to submit and/or preserve representative specimens for optimal diagnosis.	Farm workers/ managers Fishery extension officers On-site veterinary support Local fishery biologists Quarantine Inspectors	Field keys, farm record keeping formats, equipment lists, model clinical data sheets, pond-side checklist. Protocols for sample preservation/transport for Level II/III examinations. Model job descriptions/skill requirements. *Asia Diagnostic Guide to Aquatic Animal Diseases*. Access links to Level II and Level III.
II	Parasitology Bacteriology Mycology	Laboratories with basic equipment and personnel trained/experienced in aquatic animal pathology. Keep and maintain accurate diagnostic records. Preserve and store specimens. Knowledge of/contact with different areas of specialization within Level II. Knowledge of who to contact for Level III diagnostic assistance.	Fish biologists/ technicians Aquatic veterinarians Parasitologists/ technicians Mycologists/ technicians Bacteriologists/ technicians Histopathologists/ technicians	Model laboratory record-keeping system. Protocols for preservation/transport of samples for other Level II and Level III analysis. Model laboratory requirements/equipment/consumables lists and model job descriptions/skill requirements. Contact information for Level II and Level III expertise. Access to *Asia Diagnostic Guide to Aquatic Animal Diseases;* OIE *Diagnostic Manual for Aquatic Animal Diseases;* regional general diagnostics manuals. Access links to Level I and Level III resources.
III	Histopathology Virology Electron Microscopy Molecular Biology Immunology	Highly equipped laboratory with specialized and highly trained personnel. Keep and maintain accurate diagnostic records. Preserve and store specimens. Maintain contact with people responsible for sample submissions.	Virologists/ technicians Ultrastructural histopathologists/ technicians Molecular biologists/ technicians	Model laboratory requirements/equipment/consumables and model job descriptions/skill requirements. Contact information for reference laboratories. Protocols for sample preservation for consultation/validation. Access to *Asia Diagnostic Guide to Aquatic Animal Diseases;* OIE *Diagnostic Manual for Aquatic Animal Diseases;* and molecular and microbiology diagnostic references. Access links to Level I and Level II resources.

7 HEALTH CERTIFICATION AND QUARANTINE MEASURES

7.1 Purpose

The material presented in this section supports Section 7 of the *Technical Guidelines.*

7.2 General Considerations

In view of the current freedom from many serious diseases, documented disease introductions elsewhere, and the economic importance of fisheries and aquaculture industries, a compelling case exists for health certification and the quarantine of aquatic animals for the Asia Region. Health certification and quarantine should facilitate the movement of healthy aquatic animals, be practical, readily implemented, use available facilities (where possible) and be cost efficient. It should not pose unjustifiable or excessive restrictions on trade.

A minimum standard of health certification and quarantine should be applied to all movements, with increasing levels of stringency/conditions, as the risk of introducing disease increases. Classification into lower risk and higher risk categories is, therefore, essential.

Health certification and quarantine measures should be implemented on a case by case basis, taking into account all circumstances and factors relating to the proposed movement see (Boxes 7.1 and 7.2). A full disease history of the candidate species, including a detailed review of specific pathogens and their status in the country or region of origin, should be compiled.

Box 7.1 – Example of Quarantine Measures for First Time Introduction of a New (Exotic) Aquatic Species Destined for Release into Open Water for Culture Purposes.

Development of quarantine measures for a first time introduction requires a detailed knowledge of the disease status of aquatic animals within the region, as well as the nature and range of specific exotic diseases which may affect, or be carried by, the candidate species. A national or regional database, which can be continuously updated as new information becomes available (see Section 5.7) will greatly assist in this process. Freedom from disease concerns, in this case, is best assessed by holding and observing animals in quarantine facilities, whereby testing for infectious agents can be undertaken at the same time as protecting surrounding water and aquatic animals from exposure to the potential introduced species or any living effluent from its holding facility (various mechanisms exist to ensure effluent from quarantine facilities is sterile or directed away from surrounding waters for land-based disposal. Access to more specialized laboratories and resources may be necessary to diagnose certain diseases (for more details see Section 11.3).

NB. Strict quarantine facilities differ from quarantine holding facilities used for low risk or routinely transferred aquatic animal species.

Box 7.2 Low-Risk Movements

Animals have been moved routinely between growers from Bay X in Country Y to Country A for over 20 years, with no evidence of disease problems. When quarantine measures are introduced in Country A, it is assessed that this movement represents minimal risk, as long as there is no change in health status in Bay X. Thus, the quarantine measure imposed is entry into Country A via holding facilities to check for overt disease for a short period, plus an agreement with Country Y to report any health changes in stocks in Bay X.

Quarantine and health certification protocols should be developed in collaboration with fisheries scientists, veterinarians, quarantine authorities and industry stakeholders. An advisory authority on quarantine and health certification, including such expertise, should be formed to report to government and act as a forum for all issues relating to trans-boundary movement of live aquatic animals (see Section 10 – Import Risk Analysis, Introductions and Transfers Committees).

Since development of quarantine and health certification protocols requires detailed knowledge of the disease status of aquatic

animals within the region, national and regional databases should be developed and updated as new information becomes available (see Section 5.7). While such databases are under development, disease status can be assessed by holding shipments of aquatic animals in quarantine and, where appropriate, treating them. Access to specialized laboratories and resources may be necessary to diagnose certain diseases (See Section 6.3, OIE Reference Laboratories, and Section 6.4, Regional Resource Centers).

Quarantine and health certification considerations should be treated separately from ecological/environmental or genetic concerns, since the latter do not, normally, fall within the capability of aquatic animal health specialists.

7.3 Health Certification Process

Health certification provides documented assurance that a stock of live aquatic animals to be moved from one area to another (usually trans-boundary) is free of disease agents of concern to the importing country. Such certification also provides documentation for the shipper, in the case of a subsequent disease outbreak. Both aspects of certification assist effective tracing of the source of infection and the control or prevention of repeat infections. Two examples of internal (within country) health certification processes currently used in the Asian Region are given in Boxes 7.3 and 7.4.

Box 7.3. Example of an Internal Health Certification Process

"The Marine Products Export Development Authority (MPEDA) in cooperation with the Ministry of Agriculture (Department of Animal Husbandry & Dairying), is embarking on a major self-certification program by the hatchery operators to promote trade of shrimp larvae for use in stocking farms.

The long-term objective of self-certification is aimed at the private sector, including farms. The goal of this government and private sector collaboration is to promote responsibility for production of healthy stocks by the shrimp hatcheries and, thereby, sustainable markets".

Box 7.4 Health certification for shrimp postlarvae in the Philippines.

Marketing of shrimp postlarvae is being undertaken by the industry through a selection system using a set of criteria mutually agreed upon by farmers and hatchery operators to determine fry quality. The criteria is based on postlarval physical characteristics, such as muscular development, rostral spine number (age determination) and microbial load (bacterial and protistan epibionts). Viral diseases that can be detected rapidly through squash microscopy, and other techniques such as PCR for WSSV screening, are also included. The health certificate issued by a government or private laboratory becomes the basis for *acceptance or rejection of the batch of postlarvae.*

Certification, by definition, means that the signing authority takes responsibility for the accuracy of the statements made on the certificate. This is especially important when the certificate is a condition for issue of a transfer license under an established legal framework. This means that the signing authority has a legal, as well as moral, obligation to ensure that the statements included in the certificate are accurate to the best of his/her knowledge. Thus, the signing authority must have direct experience, or authority over employees who provide the scientific advice upon which the authority decides whether or not to sign a health certificate. This requires:

- training in aquatic animal diseases of concern to importers,
- accurate knowledge of the health status of the source of the exports being certified, and
- accurate knowledge of the health status of the same/related species in the receiving (import) waters.

Certificates signed by personnel with inadequate training and experience provide little assurance against disease transfer. Such certificates are a liability to both the importer and exporter. It should also be noted that border checks for gross signs of disease, which currently form the basis for issue of health certificates in many countries, are of little value in detecting most aquatic animal pathogens.

In many countries, current infrastructure may not permit immediate improvement of health

certification and quarantine procedures. In addition, many living aquatic animals (e.g., shrimp postlarvae and broodstock, fish fry and fingerlings, and live fish for direct consumption) pose logistical complications for effective post-border quarantine processing. For such cases, an accurate pre-border risk assessment is the pivotal factor for deciding what level of quarantine is necessary. Alternative procedures, such as accreditation of hatcheries, grow-out facilities, holding establishments etc., should also be considered as mechanisms to reduce the risk of trans-boundary introduction of aquatic animal pathogens.

7.4 Quarantine Process

Minimum quarantine requirements

Minimum quarantine requirements are those applied to all transfers or introductions assessed as having minimal risk of disease transportation. Additional measures will be required for cases with higher risk of disease transfer (Section 10). Minimum quarantine requirements include, but are not necessarily limited to:

- some mechanism of assurance (e.g., pre-border health certification) that the source is free of diseases of concern;
- border Level I examination for gross signs of disease/ill-health; and
- shipment rejection, or border containment, of any shipments showing signs of disease/ill-health that are not likely to be attributable to shipping stress or damage.

Levels of risk can be minimized through biological awareness, as well as physical infrastructure. Eggs, embryonic or juvenile life stages should selected for transfer, where possible, since these generally carry fewer primary or sub-clinical infections than do adult aquatic animals, and they are generally easier than adults to maintain under quarantine conditions.

Candidate stocks should be transferred on a batch-by-batch basis, where a batch is defined as a group of animals of the same age, from the same population, and maintained as a discrete group. Mixing of animals, water or equipment between batches means that, for disease-screening purposes, those batches must be considered as a single batch (see also Section 8).

Duration of quarantine

It is not possible to stipulate the duration of quarantine evaluation or containment, since this will vary depending on the candidate species and the risks associated with its movement. Most protocols for international introductions recommend spawning under quarantine containment conditions, with release of the F1 generation after the broodstock has passed health surveillance/diagnostic screening (e.g., see ICES 1995). This is applied mainly to first-time introductions or high-risk introductions. Introductions from sources that have passed a quarantine containment process may receive "approval" status (see Section 8 – Disease Zoning) if conditions do not change at the export site, reducing further quarantine requirements/duration.

Pre-transfer quarantine

Animals destined for transfer should be placed in a quarantine facility for health examination, certification and disease testing, as required. Any therapeutant used must be reported to the Competent Authority (CA) of the importing country. Health examinations should include sub-sampling for pathogens at least once prior to transfer. The cause of any disease detected should be determined or the transfer aborted.

Post-transfer quarantine

Animals should enter quarantine in the importing country for health examination and disease testing. Depending on the risk assessment of the source, sub-samples may be taken for examination for specific

infectious agents of concern. Any animal that shows signs of disease should be examined, and the cause of the disease determined. If the cause cannot be determined, or if pathogens or parasites of concern are found, the transfer should be aborted and transport materials disinfected or disposed of in a sterile manner. Closed circulation quarantine containment facilities, used for higher risk transfers, should be thoroughly disinfected following detection of disease.

Quarantine inspection procedures

To ensure compliance with all import conditions, each consignment of animals should be inspected on entry by an official appointed by the importing authority. The CA may have additional responsibilities to inspect for requirements other than health (contamination by other organisms, human health requirements, etc.).

7.5 Pathogen Containment Facilities

A pre-transfer facility should ensure minimal exposure to infection risks at the export site. Post-transfer facilities should ensure prevention of escape of any animals or their disease agents into waters of the importing country prior to health screening.

Physical security

Quarantine containment facilities used for introductions of high or unknown risk should be capable of preventing:

- entry by unauthorized people,
- loss or release of quarantined animals, and
- loss of contaminated water or equipment.

The facility should be located within, or close to, existing fisheries or animal health facilities and, preferably, should have 24 hour supervision. The facility should be lockable and access restricted to designated personnel.

Containment facility location

Tanks, ponds, pools or other containers of an appropriate size and volume for the aquatic animal species in transit should be isolated from aquaculture facilities, and municipal and open waters. Construction and siting should be such that, in the event of an accidental spill or discharge, no water, animals or equipment will gain access to surrounding waters.

Intake water
Intake water should be obtained from a clean, unpolluted source to prevent physiological stress or masking of infectious agents by opportunistic infections. Incoming water should be filtered, wherever possible, for pre-transfer quarantine, to prevent exposure to infectious agents during the pre-transfer. This is not required for the post-transfer facility, however, filtered influent water is recommended for containment of high or unknown health risk animals. This helps in identifying the source of any disease outbreak that may occur during the quarantine containment period.

Discharge water
All water leaving a post-transfer quarantine facility should be regarded as potentially infected. Thus, effluent from high-risk aquatic animals should not be discharged directly into surrounding waterways. Effluent containment in a sump, reservoir or pond which permits chemical disinfection, or discharge into a land-based pit or pond, is recommended for such cases. Any chemically disinfected (e.g., chlorinated) water should be neutralized prior to release into the environment.

Containment facility equipment

All equipment used for high disease-risk transfers/introductions (e.g., nets, containers, pipes, hoses, pumps) should remain within the containment facility and not removed or used for any other purpose unless disinfected.

Containment facility laboratory area

An enclosed area, which can be used as a laboratory, is necessary to prepare samples and, where possible, undertake microscopic examinations, during quarantine evaluation of high-risk transfers/introductions. Containers and reagents should be available to permit sample dispatch to diagnostic laboratories for examination, if necessary. Samples leaving a high-risk quarantine containment facility should be delivered by approved quarantine personnel or be preserved and secured for handling by non-quarantine personnel (clear handling and delivery instructions, sealed water-proof containers, documentation, etc.).

7.6 Disease Diagnosis and Health Examinations

Gross examination for evidence of disease is a minimum requirement for minimum quarantine measures. Microscopic examination for surface parasites can also be readily undertaken by personnel with basic training in fish health and access to dissecting and compound microscopes. Such training should include recognition of the broad taxonomic groups of protistan and metazoan parasites of fish and aquatic invertebrates, as a basis for treatment.

All animals that die or appear unhealthy should be examined. Access to specialized laboratory facilities, and/or personnel with experience in fish and shellfish diseases, is necessary if disease problems cannot be resolved within the quarantine facility. OIE Reference Laboratories and Regional Resource Centers with expertise in microbiology and pathology exist in many countries within the region. (For current information on these laboratories, contact the NACA Secretariat.) In addition, a number of illustrated textbooks and diagnostics manuals are available as reference resources (e.g., Tonguthai *et al.* 1999, FAO/NACA 2000).

Examination of healthy animals may be required to screen for sub-clinical infections. This is the case for introductions or transfers that have been assessed as being of high or unknown health risk. At least one such examination should be conducted pre-transfer and at least one other examination made post-transfer. The number of animals sampled should be in accordance with standard sampling procedures. This typically requires the use of specific diagnostic procedures and tests and the use of quarantine containment laboratory facilities.

Freedom from specific diseases

A checklist of diseases and parasites known to affect the candidate species should be used as the basis for health certification of freedom from such diseases.

Treatment

Many diseases, especially the common diseases caused by external parasites, can be treated with readily available treatments (e.g., salt baths, fresh water, formalin). Other registered treatments may be available, but may require veterinary prescription or administration. Many organisms, especially internal agents, cannot readily be treated. It should be noted that the misuse of chemical treatments can cause additional health complications, such as the development of antibiotic-resistant strains of bacteria. Chemical therapy should, therefore, be used with due caution and expert advice. Wild stocks are particularly susceptible to outbreaks of external parasites. This can be prevented by an initial treatment of animals

entering a quarantine facility or by careful monitoring and husbandry modification (e.g., temperature reduction, decreased feeding regime or holding density).

7.7 Capacity and Institutional Implications

Diagnostic expertise is required to support health certification initiatives and improvements. This expertise should report to the Competent Authority. The signing authority for health certification should either have direct diagnostic capability or have direct supervisory responsibility for such expertise.

Personnel who specialize in aquatic animal health and disease diagnosis, and who have received specific training and have accumulated experience in this field, significantly enhance the quarantine and health certification process. Personnel with terrestrial or human health diagnostics training can adapt their experience to aquatic animal health diagnosis, but require specific training to be effective and accurate. Rapid employee turnover in any quarantine or certification program is highly detrimental to effective aquatic animal health management.

A legislative framework or national policy should be in place, which can be used to ensure compliance with health certification or quarantine procedures. Some measure of enforcement is required, such as inspection capability and documentation verification (e.g., nationally approved health certification signatures).

High or unknown health risk transfers or introductions (e.g., from areas where exotic diseases are known to occur) should only take place where full containment facilities and support services (diagnostics capability, security, inspection) are in place. Where facilities are currently limited to minimum quarantine requirements, only low risk introductions and transfers should be approved.

7.8 References

FAO/NACA. 2001. Asia Diagnostic Guide to Aquatic Animal Diseases. FAO, Rome, and NACA, Bangkok, (in press).

ICES. 1995. ICES Code of Practice on the Introductions and Transfers of Marine Organisms 1994. International Council for the Exploration of the Sea, Copenhagen, 12 p.

OIE. 2000. Diagnostic Manual for Aquatic Animal Diseases. Office International des Épizooties, Paris, 237 p.

Tonguthai, K., S. Chinabut, T Somsiri, P. Chanratchakool and S. Kanchanakhan. 1999. Diagnostic Procedures for Finfish Diseases. Aquatic Animal Health Research Insitiute, Bangkok.

8 DISEASE ZONING

8.1 Purpose

This section supports Section 8 of the *Technical Guidelines* and provides guidance in how to develop zoning plans. Because there is little experience in aquatic animal disease zoning in the Asia Region, the information in this section is based on experience from other regions.

Zoning for disease purposes allows the identification of specific geographical areas within a country or neighboring countries, as having a defined status with respect to a particular disease. This can facilitate the continuation of trade activities, despite a disease incursion into a particular area, through the establishment and identification of specified zones free of the disease so that only the infected zone is placed under movement restrictions.

8.2 Background

Traditionally, when evaluating the animal (terrestrial and aquatic) disease situation within a country, the country has been judged as a whole. Thus, if an infectious disease existed somewhere within a country's borders, or if its presence was strongly suspected, the whole country was considered to be infected.

However, ecological, geographical and hydrographical barriers, rather than a country's frontiers, can be effective in containing diseases (or keeping them out). Such barriers can be used to delineate "zones," whether "infected" with, or "free" of, a specific disease, or where they are of uncertain status and under surveillance. When a country suffers a disease incursion into a particular farm or water system, an effective zoning scheme can allow the rest of the country or other ("free") zones within the country to continue trade. Only the infected zone is placed under movement restrictions. The OIE code provides technical guidance to member countries planning to adopt the zoning concept i.e., zonation based on the distribution or absence of certain diseases/agents within a country or adjacent countries. This has two objectives:

- it shows that there is a surveillance program in place, with clear documentation (see 8.4) of the health status of exported aquatic animals, and
- it provides importing countries and zones free of specified disease(s) with justification for import conditions/restriction based on the clear definition of the health status of aquatic animals in the receiving waters.

This chapter describes the different types of zones currently recognized by the OIE for aquatic animal diseases, details movement principles under a zoning policy, explains general requirements for zoning, lists the OIE zoning requirements for freedom from specific diseases notifiable to the OIE (the list of OIE-notifiable diseases is given in Box 8.1), and highlights issues that countries need to consider for following a zoning approach for aquatic animal diseases. The chapter draws on information in the OIE *International Animal Health Code* (2000a) and the OIE *International Aquatic Animal Health Code* (2000b). It also describes how the European Union (EU) is achieving zonation for two major salmonid diseases (viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN)) under EU Directive 91/67/EEC. It is important to note, however, that this requires significant financial and specialized expertise

Box 8.1. Diseases of aquatic animals notifiable to the OIE (see OIE 2000b).

Fish
Epizootic haematopoietic necrosis
Infectious haematopoietic necrosis
Oncorhynchus masou virus disease
Spring viraemia of carp
Viral haemorrhagic septicaemia

Crustaceans
White spot syndrome virus
Yellow-head Disease Virus
Taura Syndrome Virus

Molluscs
Bonamiosis
Haplosporidiosis
Marteiliosis
Mikrocytosis
Perkinsosis

support through well-established industry and/or government agencies or programs. Since such support structures are still relatively rare, on a national and international scale within the Asia Region, this chapter outlines both the OIE standards, as well as other methodology which will help develop zonation until the OIE standards can be met.

8.3 Definition and Description of Zones

What are "zones"?

Zones are usually clearly delineated geographical areas within a country, but they can cross borders of adjacent countries sharing one or more water catchments. Coastal zones can also be defined, but this is more difficult and requires oceanographic information (tidal exchange, current dynamics, etc.). Different diseases have different means of spread, thus, delineation of zones may vary depending on the particular disease or host(s) concerned. Zones usually refer to a particular disease, rather than several, or all, significant diseases.

How are zones delineated?

For terrestrial animals, an infected zone on land may simply be defined as an area of a specified radius around an infected property. For aquatic animals, delineation of zones is more difficult. Most inland farms or sites are connected, at some point, to river systems or other waterways. This means any infectious agents present can be released to surrounding wild populations or to farm sites downstream and could result in disease spread and/or establishment of persistent reservoirs of infection. Thus, for culture production in freshwater systems, a zone is usually an entire river system or water catchment area. In certain cases e.g., upstream of a permanent physical or ecological barrier that prevents upstream migration of fish, the river system may be subdivided. If a disease emerged upstream of such a barrier, this could not be isolated from downstream waters, so all become one infected zone for that disease. Another freshwater example of possible sub-zonation within a catchment area are farm sites supplied only with well-water or spring sources and without effluent discharge or drainage into surrounding river-water resources in the vicinity. These can be treated as isolated sites that are not affected by the disease status of the river system and can be treated as individual “mini-zones.” Generally, however, the presence of disease in a pond farm may influence zonation for the entire river system and other farms connected to the same drainage system.

Types of zones defined by OIE

The OIE recognizes three types of zones for diseases of aquatic animals: i) free zones; ii) surveillance zones; and iii) infected zones. The criteria for each are:

Free zone

"A free zone can be established within a country or countries where the disease is present (see Box 8.2). In the free zone, there must be knowledge of the location of all aquaculture establishments and populations of wild aquatic animals containing susceptible species. Suspected outbreaks of the disease must be investigated immediately by the Competent Authority (CA). Outbreaks must be reported to the OIE. If necessary, the free zone is separated from the rest of the country and from the infected neighbouring countries by a surveillance zone. Importation of aquatic animals from other parts of the country or from countries where the

Box 8.2. Example - CE infected but SVC free zone.

Country ‘X’ has widely dispersed inland carp farms. Carp erythrodermatitis (CE) is enzootic in a particular river system of X, and is carried by wild fish populations in the river system. There have been no attempts at eradication or detailed monitoring, thus the entire river system, and its tributaries, are considered to constitute a single "CE-infected zone." All farms in Country X, however, are believed to be free of spring viraemia of carp (SVC), and the country is concerned about SVC introduction. Therefore, the Competent Authority of Country X runs a surveillance and monitoring program throughout the entire country aimed at detection of this virus. The program uses OIE guidelines, and, after two years of no detection of SVC, the entire country is recognized by OIE as "SVC-free". Thus, Country X is "CE infected, SVC free".

disease still exists into the free zone must take place under strict controls established by the Competent Authority."

"The free zone should not be dependent on importation of aquatic animals or aquatic animal products from infected zones or countries which could introduce the disease agent" (OIE 2000b).

Free "aquaculture establishments" can be located within an infected zone, if they use a protected independent water supply, and meet other strict conditions, to demonstrate freedom of a the disease of concern (record-keeping, surveillance and monitoring logs, etc.).

Box 8.3. Example - SVC virus detection in a previously SVC-free country

Country 'X' is officially (internationally) recognized as SVC free. There have never been any recorded outbreaks of the disease and the country runs a surveillance program to specifically detect the virus, even in the absence of clinical signs. The program uses OIE guidelines, thus Country X is recognized as being 'SVC-free". During routine monitoring, carp on a small farm are found to be infected with SVC virus. This farm, the river system to which it connects, plus all farms connected to the river thus become a single "SVC-infected zone" and should be separated from the rest of the country by a "surveillance zone". If the disease is "stamped out" on the affected site(s), the infected zone may be re-categorized as a "surveillance zone". All farms unconnected to the affected river system, maintain "SVC free zone" status, but the national "SVC-free country" status is lost.

Surveillance zone

"A surveillance zone must have certain minimum dimensions, with a precise geographical limitation based on hydrological data and the nature of the disease (see Box 8.3). Aquatic animal movements must be controlled. The surveillance zone must have an advanced degree of disease control and surveillance. Suspected outbreaks of the disease must be investigated immediately and, if confirmed, eliminated. A mechanism for immediate reporting to the Competent Authority must be in place. Adequate surveillance activities must follow in order to ascertain the potential spread of such outbreaks. Accordingly, it may be necessary to modify the boundaries of the zone."

"Importation of susceptible aquatic animals into the surveillance zone from parts of the country or from other countries where the disease exists can only take place under controls established by the Competent Authority. Freedom from infection should be confirmed by appropriate tests" (OIE 2000b).

Surveillance zones are sometimes established as "buffers" between an infected zone and a free zone. They serve to protect, and often to expand the free zone. They are also used to define zones for the pre-approval period (2 year minimum). when surveillance data are being gathered to demonstrate freedom from one or more specified disease(s).

Infected zone

"An infected zone is a zone where the disease is present, in an otherwise disease free country [or adjacent countries]. A surveillance zone will separate the infected zone from the remainder of the country [or countries]. Movement of susceptible aquatic animals out of the infected zone into the disease free parts of the country must be strictly controlled. Four alternatives can be considered:

- no live aquatic animals may leave the infected zone, or
- aquatic animals can be moved by mechanical transport to special aquatic animal slaughtering premises/mollusc and shrimp production facilities located in the surveillance zone for immediate slaughter, or
- exceptionally, live aquatic animals can enter the surveillance zone from an infected zone under suitable controls established by the Competent Authority. For diseases in which the disease agent constitutes a surface pathogen, appropriately disinfected eggs can enter a surveillance zone. Freedom from infection of these aquatic animals must be confirmed by appropriate tests before entering the zone, or
- live aquatic animals can leave the infected zone if the epidemiological conditions are such that disease transmission cannot occur." (OIE 2000b).

8.4 Movement of Aquatic Animals between Zones

Box 8.4. The movement principle of zoning.

Live aquatic animals may be moved between zones with the same infectious agents present, or from zones with fewer/none of the same infectious agents that are present in the receiving waters. They may not be moved from zones with infectious agents that are absent from the receiving zone.

The principal aims of zoning are to facilitate trade for free zones within an otherwise infected country, and to protect those free zones against the introduction of pathogens. It may be possible to geographically expand zones, in situations where pathogens can be eradicated (although possible in isolated pond or land-based facilities, this is rarely achieved in open-water aquatic systems). To achieve these aims, control of movements of aquatic animals between infected zones, surveillance zones, free zones and zones of unknown status, is necessary (see Box 8.4). In order to accurately assess the health risks associated with moving aquatic animals from one zone to another, it is necessary to know if the animals to be moved are susceptible to the disease(s) of concern. This may not always be known. "Susceptibility" can range from manifest disease, to non-clinical "carriage" of the infectious agent. For notifiable diseases, OIE advises that export stocks are certified as coming from sources free of these diseases, regardless of species susceptibility. Such certification requires OIE-based surveillance to establish "free-zone" status[12]. The European Union regard all live fish species not known to be susceptible to their listed diseases of concern (currently IHN and VHS for finfish) as being potentially capable of transferring these diseases to free countries, zones or farms, from infected waters, unless otherwise proven (see example given in Box 8.5). Alternative methods of surveillance and zonation may be used for diseases of importance to the region, but not listed as "notifiable" by OIE e.g., EUS (see *Technical Guidelines* Sections 8 and 9).

8.5 Requirements for Disease-Free Zoning

General requirements

Free zones can be developed within a country, according to a surveillance scheme developed by that country or by mutual agreement between neighboring countries sharing one or more river systems. In most cases, the OIE guidelines are followed in order to meet international trade requirements under World Trade Organization (WTO) protection from non-tariff trade barrier disputes. OIE requirements to achieve disease-free zone status are the following:

Box 8.5. Example - export of carp from a VHS-infected zone into a country recognized as VHS free

A fish farmer in a VHS-free country wishes to import carp for grow-out. A potential supplier is located in a neighboring country, within a VHS-infected zone. Although carp are not listed as being susceptible to VHS, they could potentially transfer the virus. Based on OIE guidelines, all live fish imported into a VHS-free country must be from other countries with VHS-free status or from VHS-free zones within a country not declared VHS-free. This import restriction should only be lifted when a particular species is clearly demonstrated to be unable to carry viable VHS virus.

effective organization and infrastructure within a country for aquatic animal disease control, including administrative, legal and financial resources;

effective disease control and surveillance, including resources to supervise boundaries, ensure prompt reporting of disease outbreaks, and within-country capability to diagnose OIE-listed diseases (or have access to OIE reference laboratories);

mandatory reporting of all OIE-listed diseases and/or disease agents, as soon as they are detected (see Annex V);

establishment and enforcement of zones by national legislation;

clear delineation of zones by effective boundaries;

prevention of the movement of live animals across zone boundaries, unless from a zone of equal or better (disease agents present in receiving waters but absent from exporting waters) aquatic animal health status.

[12]OIE *International Aquatic Animal Health Code* (3rd edn., 2000) Part 1. Section 1.5. Import/Export Procedures. Chapter 1.5.2. Aquatic Animal Health Measures Applicable Before and After Departure. Article 1.5.2.2.; and Chapter 1.5.5. Aquatic Animal Health Measures on Arrival. Article 1.5.5.1., item 3.

For zonation in countries lacking some or most OIE requirements, it is important to note that these are aimed at international trade and are not necessary for establishing zones based on mutual regional or intra-national health concerns. In addition, diagnostic expertise, related infrastructure, and legal foundations often require time to become established. Under these circumstances, the OIE requirements can be used as guidelines, since *any* surveillance data will be a valuable resource to enhance identification and development of potential OIE-level zones. If not already underway, this work should be started as soon as possible for all aquatic animals with live trade value. Diagnostic capabilities for Level I-III screening are described in Section 6 and surveillance strategies are described in the *Technical Guidelines,* Section 9.)

Disease-specific requirements

The OIE code provides a generic template of requirements for the diseases notifiable to the OIE. However, different diseases may have different profiles within a country, including host range and mode(s) of spread. Thus, different diseases usually require different zoning boundaries.

A disease-free zone may be established within the territory of one or more countries if:

- aquaculture establishments and wild populations containing susceptible species have been tested in an official fish health surveillance scheme for at least the previous two years using the procedures described in the OIE *Diagnostic Manual for Aquatic Animal Diseases* (OIE 2000c);
- the disease agent[13] has not been detected during this two-year period.

Such free zones must comprise:

- one or more entire water catchment areas from the sources of the waterways to the sea, **or**
- part of a catchment area from the source(s) to a natural or artificial barrier that prevents the upward migration of fish from lower stretches of the waterway, **or**
- part of a coastal area, or estuary, with a precise geographical delimitation, that consists of an homogenous hydrological system.

Such zones must be clearly delineated on a map of the territory of the country concerned by the Competent Authority and must observe the conditions referred to in Articles 2.1.1.2., 2.1.1.3. and 2.1.1.4 of the OIE code (see OIE 2000b).

8.6 Practical Application of Zoning in the European Union

The legal framework: Directive 91/67/EEC

The application of a zoning system for aquatic animal diseases has been operated in the European Union (EU) since 1993. In the late 1980s, EU Member States agreed that a "single market" should be established within the European Community to allow free movement of goods, including live animals, between all Member States. However, it was recognized that animal health controls would be required to prevent disease spread within the EU, since Europe does not have a uniform fish health situation. This led to the introduction of harmonized fish disease control measures (EC Directive 91/67/EEC – see references), which came into force on 1 January 1993. This directive stipulates the animal health conditions used to govern marketing of aquaculture animals and products within the EU and from outside the EU i.e., from "third countries."

Three categories of disease are listed according to seriousness and economic impact

List I covers highly infectious diseases exotic to the European Community and deemed likely to have

[13] Note that it is not sufficient to declare absence of clinical disease outbreaks!

a major impact should they be imported. Member States of the EU are required to take *immediate* action to eradicate any outbreaks that occur (currently restricted to infectious salmon anaemia [ISA]).

List II deals with highly infectious diseases of major economic impact present in certain parts of the EU but absent from other parts. Examples of such diseases are viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN) of finfish, and bonamiosis and marteiliosis of bivalve molluscs. Zoning is applied for these diseases.

List III covers diseases that have a significant economic or ecological impact under certain circumstances and are considered by some Member States to warrant national control measures, particularly when a country is free of the disease(s) in question.

Approved zones and farms

In order to reduce the risk of List II fish diseases spreading within the EU, Member States with zones (or farms) deemed to be free of these diseases may undertake surveillance to maintain this status. The EU uses the term "approved zones" instead of "free zone" (used by OIE). In addition, the EU Directive does not recognize "disease-free country." Instead, emphasis is placed on establishing "approved zones," whether these are within a country, comprise the entire country, or cover parts or the whole of one or more country(ies).

Box 8.6. Continental and coastal zones.

Continental zones for fish
"A continental zone consists of::
a part of the territory comprising an entire catchment area from the source of the waterways to the estuary, or more than one catchment area, in which fish is reared, kept or caught,
or a part of a catchment area from the source of the waterways to a natural or artificial barrier preventing fish from migrating from downstream of that barrier.

The size and the geographical situation of a continental zone must be such that possibilities for recontamination, e.g. by migrating fish, are reduced to a minimum. That may require the establishment of a buffer-zone in which a monitoring programme is carried out without obtaining the status of approved zone."

Coastal zones for fish
"A coastal zone consists of a part of the coast or sea water or an estuary with precise geographical limits which consists of a homogeneous water system or a series of such systems. If necessary, a coastal zone may be deemed to consist of a part of the coast or sea water or an estuary situated between the mouths of two watercourses or of a part of the coast or sea water or an estuary where there are one or more farms, provided that *provision is made for a buffer zone on both sides of the farms*

Coastal zones for molluscs:
"A coastal zone consists of a part of the coast or sea water or an estuary with a precise geographical delimitation which consists of a homogeneous hydrological system."

There is provision for "*coastal zones,"* covering estuaries or lengths of coastline, or '*continental zones,*" consisting of one or more water catchment areas. Such zones are delineated by the CAsof the country(ies). The CAs must have legal powers to enforce the rules and conditions that apply to establishment and maintenance of an "approved zone." The EU definitions of continental and coastal zones are given in Box 8.6.

For continental territory, a zone usually comprises a minimum of an entire river system, including all tributaries, from their source(s) to the sea. Where a river system originates in one country and then passes through one or more other countries before reaching the sea, management requires cooperation and harmonization of rules/services in the countries involved, if conditions for approval of the zonation are to be met. As with OIE zonation, rivers with impassable barriers can have upstream sub-zonation and coastal zones are delineated using hydrographical parameters e.g., bay or coast between two peninsulas, or

areas separated by tide or currents.

Achievement and maintenance of "approved zone" status

Where a Member State of the EU considers that its territory, or part of its territory, is free of one or more of the List II diseases, it may submit to the European Commission evidence that the zone(s) concerned meet(s) the conditions laid down in Directive 91/67/EEC and, in particular, the detailed requirements of Annex B. In essence, all farms within the zone must have been under supervision of Official Services (Competent Authority) for at least two years, during which they have been found to be free from any clinical or other sign of List II disease(s) with two health inspections per year at a time when the water temperature favors development of the disease in question. The health inspections require examination of samples at an approved laboratory. The Member State (country) concerned must also provide evidence of its legal powers to enforce movement restrictions on fish (or bivalve molluscs) into the specified zone during the period of inspections, sampling and laboratory tests over this two-year period and thereafter. The European Commission examines the results, together with representatives of all EU Member States, and a decision (EC) for approval is reached based on these results.

Once a zone is approved, movements of aquatic organisms into the zone are restricted to those from other approved zones, where exporter and importer zone status is dependant upon continuing evidence that the disease agents(s) in question is (are) absent. This requires regular inspection of all the farms in the zone, with sampling and laboratory tests conducted at a defined maintenance size and frequency.

The EU Directive also provides for suspension, withdrawal and restoration of "approved zone" status if abnormal mortalities or clinical signs constitute grounds to suspect a listed disease. The CA(Official Services) of the country must be notified immediately and samples of clinically affected aquatic organisms sent to an approved laboratory to be tested for the listed pathogen. If results are positive, the CA (Official Services) will withdraw approved zone status for the entire zone or part of the zone, as necessary. The latter normally applies where an infected area can be separated from surrounding zones. Restoration of approved status is achieved following evidence of eradication.

Trade in aquatic animals between zones

Box 8.7. Examples of EU-approved zones

Since Directive 91/67 EEC came into force, approved zones have been established for VHS and IHN in several EU Member States (UK, Ireland, Denmark, France, Italy Sweden and Spain). Maps showing the delineated zones were submitted in support of the application for approved zone status. The European Commission provides a verbal description of the zones, based on these maps, in the Official Journal but the maps themselves are not published.

The movement of live farmed, or wild, fish and molluscs to waters within an "approved zone" is restricted to animals originating from within the same zone or from another zone with equal designation i.e., zones which are free of the same disease(s). There are no health-based restrictions to trade in live fish or bivalves, whether farmed or wild, within or between approved zones, or for introduction to any waters in non-approved zones within the EU (irrespective of which country the waters are in) other than for any safeguards agreed to by all Member States for List III diseases. For all movements of live fish and their ova, or of live molluscs, *into* approved zones, documentation is required certifying that the fish (or molluscs) originate from a zone having the same List II disease status. Such documents are completed by the national Competent Authority for every consignment, within 48 hours of loading, and must accompany the fish throughout their transportation.

8.7 Issues to Consider in Individual Countries of Asia

Implementing a disease zoning system in the Asia Region

Although it may not be possible in the near future for some Asian countries to meet all the provisions for zoning specified by OIE or as practiced in the EU, the general principles for zoning and movement can be applied. As experience is gained in the compilation of disease surveillance data, and national legislation and infrastructures developed to control disease spread, the accuracy of zone definitions will increase. During any data collection period, however, there are a number of important basic considerations for initial development of zones.

Selection of diseases for zoning should take into account the benefits *versus* the cost of setting up and maintaining the zoning system. Benefits include reduction of disease spread and enhancing trade to other countries, or zones with the same disease status. Costs include the costs of surveillance, legislation, enforcement, certification, etc. An additional consideration is where establishment of a zone in shared water bodies such as, for example, coastal areas or the Mekong River, requires cross-border cooperation between neighboring countries.

When a country wishes to gain official recognition as being free from one or more diseases it believes to be exotic to its territory, it will need to establish an official health surveillance and monitoring system (see *Technical Guidelines*, Section 9). The diseases selected must be notifiable (mandatory reporting), and resources for these activities have to be allocated with responsibility given for long-term maintenance of the zoning system.

Clarification of jurisdictional issues is essential, especially determination of the CA for aquatic animal diseases for each country and, in the case of shared water resources, the mechanism for harmonizing each party's activities and administration of the process. Within a country, the CA may be the veterinary authority, or some other regulatory agency with responsibility for the health of aquatic resources e.g., the national fisheries department. In the case of shared water resources, the CA may be a mutually agreed existing authority or a newly established bi- or multi-lateral decision-making body. The CA must have, or have access to, aquatic animal health expertise used to specify, delineate and control the boundaries of each zone, including aquatic animal movements into and out of each zone.

Although zoning presents logistical challenges, with sufficient political will, technical and human capacity, infrastructure and cooperation, it is a mechanism with proven efficacy in decreasing the spread of aquatic animal diseases and providing clear benefits in terms of facilitating trade activities.

8.8 References

Council Directive 91/67/EEC of 28 January 1991 concerning the animal health conditions governing the placing on the market of aquaculture animals and products (O. J. No. L 46/1, 19.2.1991 as amended by Council Directive 93/54/EEC (O. J. No. L 175/35, 19/7/1993), Council Directive 95/22/EEC (O. J. No. L 243/1, 11.10.1995), Council Directive 97/79/EC (O. J. No. L 24/31, 30.1.1998) and last amended by Council Directive 98/45/EC (O. J. No. L 189/12, 3.7.1998).

OIE. 2000a. International Animal Health Code. Ninth edn., Office International des Épizooties, Paris, 473 p.

OIE. 2000b. International Aquatic Animal Health Code. Third edn. Office International des Épizooties, Paris, 153 p.

OIE. 2000c. Diagnostic Manual for Aquatic Animal Diseases. Third edn. Office International des Épizooties, Paris, 237 p.

9 CONTINGENCY PLANNING

9.1 Purpose

This Section supports Section 10 of the *Technical Guidelines*. It provides details on the procedures required to support participating countries in establishing contingency planning, and provides some preliminary guidelines for the development of contingency plans, at both the national and farm levels. At the national level, this section is based largely on experience in the livestock sector, and requires further refinement to develop an effective system for aquatic animals. Farm-level contingency planning is based on experience with shrimp aquaculture, where some contingency planning experience exists.

9.2 Background

Advance planning to deal with serious disease outbreaks can significantly reduce the social and economic impacts of disease. In addition, prompt action, based on a solid contingency plan, can effectively reduce the potential spread of disease agents. Using fire as an analogy, economic losses will be smaller if the fire is detected quickly and fire-fighters arrive at the site promptly with the resources necessary to stop the fire. The speed of their arrival depends on the efficiency of the reporting system, speed of response and availability of fire fighting equipment. The efficiency of the fire-fighting team depends on their training and experience under different conditions. A similar scenario can be applied to reduction of economic and stock losses caused by disease. To minimize such losses, it is necessary to have good surveillance, accurate disease diagnosis, efficient reporting systems and well-trained specialists who know how to deal with different disease emergencies. Although the needs are the same for government/institutional levels and at the farm level, the extent and manner of action may differ between the two.

The failure to eliminate a new disease in a country is often due to failure to mount a rapid and effective disease containment and eradication campaign, rather than a lack of scientific knowledge, e.g.:

- ineffective disease surveillance and reporting systems – including denial and /or secrecy;
- lack of adequate diagnostic services;
- inadequate reporting structure;
- inexperienced or insufficiently trained manpower;
- lack of an emergency work plan;
- ineffective legal support to execute an eradication campaign, including compensation for stock destruction;
- lack of funds/equipment/supplies; and
- lack of public support and cooperation.

A contingency plan is a documented plan of action to ensure that:

as many likely scenarios as possible have been considered;
requirements to deal with these have been defined;
adequate resources are available in case of disease emergencies; and
the resources can be deployed promptly and efficiently.

Although they may differ in detail, all contingency plans contain three major elements: background information, disease outbreak scenarios and response actions.

Background Information

Specific background information is vital to make reasonable, well-informed decisions about how to contain and deal with a disease. Such information should include:

- a shortlist of diseases of major concern, with all available information on modes of transmission, prevention and control procedures;
- a full description of the various farm systems susceptible to the diseases of concern;

- names and phone numbers of individuals and government agencies who can help with disease control efforts;
- descriptions of physical, chemical and biological techniques that can be used to contain or deal with disease
- lists of available local resources, locations and contact people;
- lists of resources available nationally, within region, or in other countries;
- sources of finance for disease control measures/activities; and
- description of the communication system that will be used to co-ordinate personnel and agencies involved in the control effort.

Disease outbreak scenarios

It is impossible to know when a new disease is going to appear or how much of an impact it is likely to have on aquatic resources. Although generic disease outbreak contingency plans can be developed, diseases with established etiological information are more predictable and, thus, more easily circumvented or avoided. Some disease outbreaks are small and/or localized, and are easily controlled. Others may be large, spread rapidly and be difficult to manage. Disease outbreaks are influenced by different factors, including weather, geographic isolation and transmission dynamics. All affect the ability of personnel to respond to, contain and tackle a disease outbreak. Private companies, along with local, state and central government agencies, should be included in, or design their own, contingency plans to reflect the range of possible scenarios. These can be determined from the following information:

- disease(s) known to occur (frequently/infrequently) within an area, or of particular concern;
- conditions which predispose the aquatic animals to disease;
- proximity to other farms and areas where the disease may occur; and
- extreme weather conditions that might occur in the area at different times of year.

Contingency plans are designed to prepare for the kind of disease outbreak that is "most likely" to occur at a particular place/facility. On rare occasions, however, a new disease occurs, or the impact of a disease is greater than expected. To prepare for these unusual, but significant incidents, contingency plans must also include "worst-case" scenarios, such as, for example, a highly infectious disease that spreads rapidly and causes heavy mortalities.

One difficulty with “new” disease situations (not necessarily “worst-case”) is defining the problem i.e., at which point is it serious enough to warrant an emergency reaction? Diagnosis may be of limited value as a decision-making tool, since the origin (and cause) of the problem may be unknown during the initial outbreak. While samples should be sent for analysis to obtain pathology information, the time required for laboratory processing might be too long to assist a farmer with acute/severe mortalities, particularly where the pathology analysis requires identification of a new pathogen and its modes of transmission. However, definitive disease diagnosis is not always necessary for decisions to be made on “interim” control measures. Many diseases have been described on the basis of their gross pathology (e.g., YHD and WSSV of shrimp) or characteristic features (e.g., EUSof fresh- and brackishwater fishes). These descriptions allow farmers or extension staff to make a presumptive diagnosis with a clear, consistent case definition and a decision or recommendation for disease control measures. Laboratory results reinforce or refute presumptive diagnosis, increase the level of diagnostic certainty and permit refinement of effective control strategies. The development of a good working case definition should allow the identification of the specific disease or condition using facilities or techniques that are most commonly available to the outbreak investigators at the site of the outbreak. This may include diagnostic tests, but can also include observational criteria. Although the criteria used should clearly separate the specific disease, it is not generally necessary to do so to the highest level of certainty. For severe outbreaks with a high potential for rapid spread, it is often necessary to adopt a cautious approach and make decisions based on available, rather than ideal, information.

Response actions

A carefully designed contingency plan will describe major actions to be undertaken when a disease occurs. To optimize the efficacy and minimize spread of a disease, these actions should take place immediately following detection/reporting of the outbreak. Response actions include:

- notifying all staff, individuals, private companies and government agencies that are responsible for the disease control effort, as well as those likely to be affected by the disease or the control measures taken;
- getting trained personnel to the site quickly;
- determining the extent of the disease, its nature, speed of transmission, and likelihood of spread to neighboring farms, sites or environment;
- stopping continued entry of the disease agent onto a site or into a population, where possible;
- confining the outbreak to a limited area;
- eradicating the disease, where possible (usually only possible in land-based facilities or discrete ponds - there are few cases of successful eradication of a disease agent from open-water populations);
- rapid removal of moribund or dead animals from the water and sterile or land-fill disposal; and
- follow-up surveillance/monitoring after the disease outbreak is brought under control.

9.3 Government/Institutional-Level Contingency Plans

Contingency plans at the governmental and institutional level are required to deal with outbreaks that threaten regional environments, aquaculture sectors or national disease status (e.g., emergence of an OIE-listed pathogen considered exotic to national waters). Where no legislation is present, the process relies on voluntary compliance. In such cases, location of financial resources to fund the emergency response efforts, as well as effective and rapid communication, are major elements determining success.

Contingency planning for aquaculture is relatively new compared to other culture systems, however, some approaches based on terrestrial livestock can be applied. The following example describes various elements that could comprise a national level “task-force” approach. It is a comprehensive overview, and many countries may not have (or require) all the organizational levels described. It should also be noted that the issue of compensation for stocks that are destroyed in order to control disease spread is likely to be a major consideration, especially with high value or investment produce or for wide-scale disease containment (“disasters”). The decision to establish a compensation mechanism for farmers whose stock is destroyed as a means of disease control, and the setting of levels of compensation, should generally be the responsibility of national policy and legislative bodies.

Personnel

The task force approach requires the formation of flexible, multidisciplinary teams of specialists, seconded from their normal duties, who are mobilized under the specific conditions identified as constituting a disease emergency. The terms and conditions of such secondment should be clearly set out and agreed by the participating organizations in advance.

A formal organization structure should be established at a level appropriate to the problem. This may be either local or national, depending on the scale of the anticipated problem. The highest level of administration would be a national committee (in the case of a national disease contingency plan) or a local committee (for smaller scale planning) vested with the authority to act and take decisions to implement the emergency response plan. This committee is responsible for administration of the response to a disease problem and the co-ordination of resources (including funding) in support of the emergency task force(s). The committee should consist of key decision-makers in agencies or authorities with

responsibility or jurisdiction in areas likely to be involved in the emergency response. Depending upon the scale of the contingency plan, this may include representatives of ministries and organizations responsible for fisheries, animal health, finance, trade, transportation and law, local governments, aquaculture/fish producers associations, trade unions and the emergency task force (ETF) office. In general, the chairmanship of such a committee should rest with the head of the nationally recognized Competent Authority or his/her designated appointee, although in some cases it may be appropriate to appoint another person. The decision to implement the emergency response should be the responsibility of the CA, although the request for such a decision could be made by another concerned party.

Depending on the circumstances, one or more levels of control team may be established:

- a national emergency committee (NEC);
- a local emergency committee (LEC); and
- emergency task forces (ETF) - a team, or teams, of disease experts, with field operations and administrative staff.

These people are generally assigned on a case-by-case basis from their normal responsibilities on short-term or part-time basis. However, for the duration of the emergency they would be assigned to the team and answerable to the team leaders for their activities within the plan.

The NEC should consist of, at minimum, representatives for the Competent Authority, government authorities with relevant jurisdiction/responsibility, industry/trade association and ETF heads. Relevant specialists may be assigned to the committee on an *ad hoc* basis as required. If external funding is required, representatives of the funding agency should be included in the NEC. At the local level, a Local Emergency Committee (LEC) would have a similar composition, including representatives of the local government administration. The responsibility of the ETF, which will be located at the scene of the emergency, is to implement the plan and decisions of the NEC/LEC, and assist them in day-to-day decisions required for the Emergency Program.[14] The ETF must disseminate information as it is acquired in order to maintain credibility as the main source of reliable, unbiased information.

Task forces are by definition transient and *ad hoc* bodies established to deal with a specific task, and usually bring together a multi-disciplinary team from several organizations/agencies on a part-time or short-term secondment basis. Their existence is not permanent but ends once the specific task is completed. An Emergency Task Force (ETF) to deal with a disease situation should include at least:[15]

- a Director (with authority and responsibility for the conduct of the task force and its objectives);
- a Field Coordinator (responsible for day to day supervision of the effort in the field);
- an Administration Coordinator (responsible for administrative and logistical support of the ETF);
- a Laboratory Coordinator (responsible for specialist laboratory support and quality of services provided to the ETF);
- Aquatic animal producers' representatives; and
- an Information/Communications Officer.

Other task force members may be required for implementation of the Emergency Program, depending on the scale of the problem or response being considered. These may include police/fishery protection officers to assist in compliance with the elements of the emergency response plan, customs officials (where trans-boundary shipment issues are likely to arise) and administrators of the compensation program (where one exists). Additional technical support specialists may also be appointed to the committee on an *ad hoc* or permanent basis.

Training of personnel identified as members of the ETF should be organized on a regular

[14] For less serious disease problems using a task force approach, this body may act as both an NEC and ETF

[15] In some cases, two or more functions may be fulfilled by the same person.

basis to ensure that changes in personnel and likely disease scenarios do not render the contingency plan obsolete and that the elements of the plan are re-considered and fully understood by all members of the ETF.

Other Considerations

Emergency information systems
Fast dissemination of information is critical for effective control of a disease emergency. Depending upon the type and extent of the disease, this may involve liaison with other countries and agencies, including:

speedy information network (from the field to the central office);
informing neighboring countries; and
informing international authorities.

Diagnostic services
Rapid and reliable diagnostic services at an appropriate level of diagnostic capability must be confirmed by CA or their designated reference laboratories in order to enact national or local emergency controls. It is generally not appropriate to activate emergency responses as a result of a level I diagnosis, except where the disease can be reasonably suspected to be of significant concern or is a new finding with obvious contagious spread potential. Where possible, the initial findings should be confirmed by Level II or III diagnosis as quickly as possible.

Legal powers
Ideally, the activities of an ETF should be reinforced by legal provisions (e.g., quarantine, eradication, decontamination, vaccination, compensation, closure of markets etc.). Where this is not present, members of the NEC should raise public awareness and encourage voluntary cooperation for the measures to be taken.

Financial provisions
Contingency funds for emergency action, their sources and conditions for disbursement should be identified prior to the occurrence of disease emergencies. The funds should be available when a national emergency is declared. This will require the allocation of specific contingency funds, and procedures for their disbursement.

Equipment and supplies
Equipment and supplies such as vehicles, computers, mobile diagnostic laboratories, disinfection apparatus, mobile telephones, vaccines, disposable overalls etc., should be identified. Arrangements should be made in advance to ensure that they are available for disease emergencies.

Manuals (contingency plans)
Manuals that contain instructions for all members of an ETF should be prepared and available in advance of a disease emergency. These should also be revised as soon as new disease information and diagnostic techniques become available.

Training
Regular training courses, or simulation exercises, should be organized for members of the ETF, for field staff responsible for control of aquatic animal diseases and for farmers involved in disease situations.

Public education
Materials needed for public education, such as video tapes, films, leaflets and color slides, should be prepared, in advance where possible, or as rapidly as possible following collection of data and results, in order to provide accurate information to the public and awareness of emergency activities. It is useful to have a communications officer who is experienced in dealing with the media, and to identify appropriate information channels, since this will alleviate pressure on, and questioning of, field and

diagnostic personnel who are actively involved in tackling the disease emergency.

Action plan
An action plan should contain instructions that cover all aspects of control procedures, from recording details surrounding the onset of a disease to the final phase of its eradication/suppression. Such a plan can be based on experiences with disease occurrences elsewhere within the country, or through simulation exercises.

9.4 Farm-Level Contingency Planning

At the farm level, complexity (but not necessarily efficacy) of a contingency plan depends upon the size and scale of the operation. Small farms can usually manage with basic plans (gross surveillance/monitoring) due to a straightforward organizational structure (owner/operated, owner/manager, owner/technician) where everyone has clear roles and responsibilities and communication access. Large farms have more complex division of responsibility, and thus need more detailed contingency plans. The ability of farms and organizations to cooperate in these schemes depends upon the awareness of the importance (long-term and short-term benefits) of such planning operation. Cooperation is best served by assignment of responsibility to members from all parts of the organization, or representatives from the farms or organizations involved.

The development of a contingency plan at the farm level consists of several distinct steps:
- risk assessment/hazard identification;
- assessment of existing capability;
- development of the contingency plan;
- testing of the contingency plan; and
- evaluation and modification of the contingency plan.

Risk assessment/hazard identification

A risk assessment should be conducted to determine the disease events and environmental conditions that could adversely affect a farm, a site or the surrounding environment. This includes assessing the controls needed to prevent or minimize possible effects. Cost-benefit analyses to justify investment in control should also be considered. Examples of risk assessment considerations include:
- potential disease risks to the farm or surrounding environment;
- outside expertise required and available to assist in a disease emergency;
- vulnerabilities (neighboring activities, climatic factors etc.);
- risk reduction possibilities;
- acceptable risk levels; and
- existence/availability of appropriate response procedures and contingency plans

Procedures for risk analysis are outlined in Section 10, "Import Risk Analysis." Farmer attitudes to disease risks vary, but generally, diseases with high loss potential and a moderate or high risk of exposure should be considered as a priority in contingency planning. It is important to remember that for *all* risk analyses, the outcome is rarely fully predictable. This is especially relevant for aquatic diseases where we have relatively little knowledge about life-cycles, reservoir carriers, environmental survival and ability to detect sub-clinical infections. This makes the process highly subjective – a fact that has to be acknowledged and addressed in the risk analyses. Effort is best directed toward diseases of moderate to high risk and for which there is sufficient information to develop effective mitigative or contingency plans. For diseases of high risk (e.g., the pathogen is exotic and has caused significant losses elsewhere), where there is a lack of accurate epidemiological information, mitigative or contingency planning involves "guesswork." In such cases, the risk is "unacceptable."

Once a list of significant diseases has been developed (see Annexes V and VI), all available information on these diseases, both published and anecdotal, should be collated. The information should be regularly evaluated and updated, recognizing that any anecdotal information may need to be

corroborated to ensure it is reliable and consistent with published information. Reliable information sources should be identified and kept up to date.

Assessment of existing capability

Existing procedures should be evaluated to determine whether or not they are adequate in the light of new knowledge or the occurrence of previously unknown disease problems. Contingency planning is an ongoing process requiring regular re-assessment as new information is obtained, or when people with particular roles and responsibilities leave or their job functions change.

The assessment should cover all aspects of the farming system. Some examples of vulnerable areas are:

use of wild larvae/seed/fry versus hatchery-reared;
in-house larval production vs. externally produced;
quality of larvae/seed/fry available (handling and broodstock histories);
use of fresh feed or trash fish vs. commercially produced feeds;
water supply quality and treatment;
water exchange capability; and
lack of available resources capable of controlling a disease outbreak vs. presence of strong heath support resources.

Methods of reducing the risk of disease exposure through these routes can then be identified and evaluated. The impact of the environment should also be considered. Many diseases have distinct seasonal dynamics that need to be taken into account, since the extent of an outbreak and the capability to deal with it may be influenced by seasonal factors, such as rainfall and flooding.

Cost-benefits

If the risk and financial loss associated with a particular disease is perceived to be high, high-cost mitigating measures may be acceptable. In addition, if perceived benefits outweigh potential impacts, the cost of mitigative measures may be acceptable. The scale of the operation or potential environmental impact may also be a major factor in determining cost-effectiveness of mitigative or control programs.

Acceptable risk levels vary between farmers. Some farmers accept a high degree of risk, especially where potential returns are high, whereas other farmers are more cautious and prefer to accept lower levels of return for greater consistency or certainty of production. On a small farm, this conflict is unlikely to occur. As farms get larger, however, the degree of risk acceptable to different employees or managers becomes a problem in the development of a contingency plan. Acceptable levels of risk must, therefore, be agreed upon at the risk assessment phase, rather than during the course of an outbreak. It must also be noted that risk assessment for aquatic animal production rarely affects only individual production facilities/sites. Confluent waters and the productivity they support must also be taken into account ("good neighbor risk assessment"). Thus, it is important that neighboring farms cooperate in their risk assessments and the development of their contingency plans.

9.5 Contingency Plan Development

Farm site contingency plans should identify likely disease outbreak scenarios and determine strategies to deal with them. Farm contingency plans should:

identify available strategies, their effectiveness, advantages, disadvantages and cost;
identify off-site requirements;
identify information requirements;
identify on-site resource requirements;
establish clear decision-making criteria;
establish clear job descriptions and responsibilities;

develop emergency procedures where none exist; and
develop a communications process for managing an outbreak.

At the farm level, contingency plans will generally consist of two components, one of which is general and one which will be specific to the farm site. General components of a contingency plan will be details common to any farm or site experiencing the same problem, e.g., the kind of information to be collected, how it should be analyzed, and sources of external assistance. Examples of farm-specific components would be the on-site resource requirements, criteria for activating the contingency plan, and control activities based on water/stock susceptibility(ies).

Identification of disease control strategies

The first step is to analyze the impact of disease outbreak scenarios identified in the risk evaluation, as these will determine the range of control options. Where possible, specific control plans should be developed in consultation with people who have experience with similar situations.

It is possible to plan non-disease-specific control strategies. These can include:
establishing links to health support resources and determining optimum sampling procedures that will expedite delivery to diagnostic laboratories and turn-around time for results;
stocking disinfection supplies; and
ensuring that individual production tanks, sites, pens, cages can be isolated from the rest of the farm/site.

Disease-specific preventative measures can also be undertaken, such as controlling access to the farm or site by potential carriers of infectious agents (e.g., other crustaceans or aquatic animals, stocks from unscreened/certified sources, etc.), storm- or flood-damage controls, minimizing handling, maximizing water exchange, ensuring regular cleaning of pipes, tanks, nets and other equipment/clothing.

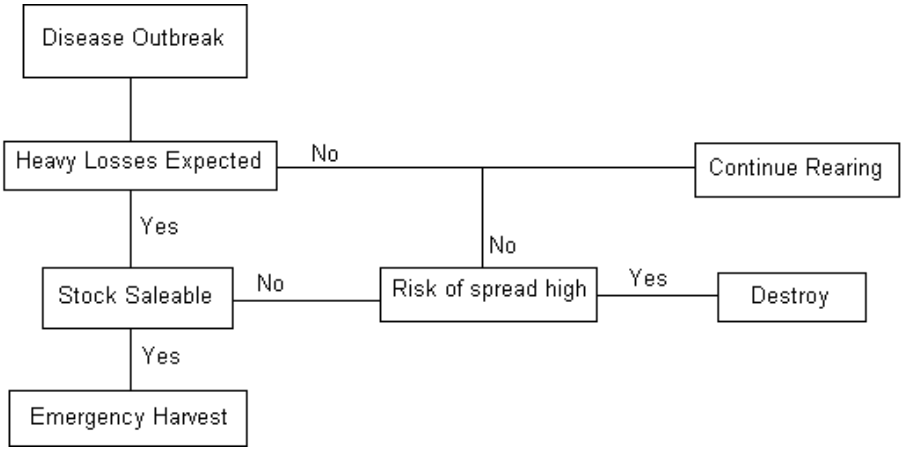
Identification of viable and cost-effective strategies

It is likely that a range of strategies will be identified. Although these can be prioritized, it is useful to develop several alternatives to maintain flexibility. These strategies can be consolidated into a master plan, which may consist of a "decision tree" (Figure 9.1). Important factors to consider are the existing capability to carry out the strategy and the additional capability and funds required. The cost of implementation should be considered in light of the assessed risk and potential losses.

Identification of information requirements

Record keeping and, more importantly, the analysis of records are essential components of a disease response contingency plan. Despite this, however, they are frequently neglected, especially in small farm operations, where written records may be basic and used for immediate information needs rather than evaluation and planning. Without adequate records, the assessment of risk is highly subjective, which makes development and evaluation of contingency plans virtually impossible. Even basic records can help the decision-making processes to be more effective. On top of on-site record keeping, it is important to maintain up-to-date information from outside resources. Such information should be shared with neighboring growers who share the same aquatic resources, wherever possible, in order to pool resources. Collaborative contingency planning is especially valuable for small or subsistence-level aquatic animal producers, as well as those operating far from health support resources.

Figure 9.1. Simple strategy decision tree for an infectious disease outbreak.



Decision-making and lines of responsibility

As for national level contingency plans, a key activity for the contingency plan is the identification of clear and unambiguous decision-making criteria and key decision-makers. The criteria may be general, such as shrimp or fish coming to the surface or the presence of moribund or dead animals. Fish or shrimp with clear signs of a particular disease form more specific criteria. If significant diseases share common clinical signs with relatively benign diseases, specific diagnostic procedures may be required. Rapid diagnostic tests or Level I procedures may be an important component of such criteria. General clinical signs or criteria should be verified using pre-established links to on- or off-site specialized expertise.

Key decision-makers must be identified and available. Where responsibility for a farm or site is delegated to a site or production manager, full authority to make decisions must also be clearly delegated, since delays in contacting key decision makers can result in increased losses. It is equally important that everyone on the farm/site understands who is responsible for decisions in the event of a disease outbreak, and what their individual roles are. Contact information should be readily available (posted) and clearly indicate key staff and who coordinates on-site communications. This may be a full-time role or it may be part-time (e.g., as a duty manager). If decision-making staff live off-site, provision for rapid communication should be made (radio, pagers, mobile telephones, etc.).

Communication

Communication between decision-makers and farm staff in the event of an outbreak and communication between staff are the most obvious requirements. However, two other key areas for communication are often forgotten - communication with staff who are not directly involved in the problem and communication with outside interests. Staff not directly involved usually live locally and are a source of information about the farm to the local community. By keeping them informed and encouraging their participation, it is possible to reduce any conflicts or misinformation that may occur. Communicating information about contingency plans and disease outbreaks to outsiders is also valuable, since external input can often provide new insights and sources of assistance. Keeping knowledge of a disease problem secret is counterproductive and prevents effective control using pooled farm experience and resources. The disease may become established in the aquatic system and/or spread to neighboring sites. This is obviously detrimental to effective control, as well as acquiring neighbor/community assistance, if required.

The need to communicate and coordinate activities with local authorities must also be considered. This is important where statutes and/or regulations exist which directly affect the contingency plan. Close

liaison with local government officers and laboratories is often essential for implementing and coordinating contingency plans. In the case of notifiable diseases, communication with the relevant authorities may be a statutory requirement.

9.6 Implementation

The implementation of even the best contingency plan is likely to reveal unforeseen difficulties. Even detailed plans can be affected by simple problems, such as difficulty in contacting a farm owner or decision maker who is on holiday. The implementation phase may include several activities:

- implementing and testing the plan;
- documenting and evaluating the results;
- reporting results/evaluation to management and the contingency plan team; and
- revising the plan, as necessary.

Documenting the contingency plan

The draft contingency plan should be written down and reviewed by farm/site workers to ensure it is clearly understood. Such plans should include flow diagrams outlining individual responsibilities and lists of contact numbers in the event of emergencies. This information should be prominently displayed at the farm. Given the high rate of staff turnover in many aquaculture operations, it is essential that procedures are written down, updated regularly and made available to new staff on their arrival. This ensures they know their roles and responsibilities prior to any disease problems.

Testing the contingency plan

Once the contingency plan is produced, it should be tested by staging a simulated outbreak of disease. This will be more useful (but more difficult) if it is not widely known to be a simulation. If this is not possible, efforts should be made to mimic all details outlined in the plan and honestly assess implementation success. It is useful to involve outside parties, where possible, to provide fresh viewpoints or to act as "devil's advocates." This gives the plan as thorough a review for weaknesses as possible. The value of testing of contingency plans should not be underestimated – although inconvenient, the discovery of problems during a disease outbreak is usually much more inconvenient!

Evaluation

Once the testing is complete, the contingency plan can be revised to incorporate the findings of the simulation. The final plan must be regularly reviewed and changes made to take into account new developments or knowledge discovered during the simulation (e.g., contact numbers of relatives, as well as staff themselves, where necessary). Possible redundancy of parts of the plan must also be considered and implications of their removal assessed. This is an ongoing process requiring the active participation of all employees.

Staff training and awareness

Training programs to improve awareness of disease risks and the need for contingency plans are essential. Programs to improve communication and coordination between different groups or departments, on-site and off-site, are also useful, since contingency plans may involve staff and resources from several different areas. Specialist training for key staff, such as diagnostic training, record keeping, and evaluation of recorded information, should also be included in training plans.

10 IMPORT RISK ANALYSIS

10.1 Purpose

Import Risk Analysis (IRA) is the process by which importing authorities determine whether live aquatic animal imports or their products pose a threat to the aquatic resources of their country. This is usually undertaken by the Competent Authority (CA) for the importing country, but risk analyses apply equally to the individual who wants to import live aquatic animals onto their farm or site. Adverse consequences arising from an inadequate or unconscientious IRA add significantly to the cost of any live aquatic animal import.

An import risk analysis involves the steps of hazard identification and characterization, risk assessment, risk management, and risk communication. This is visualized in Figure 10.1.

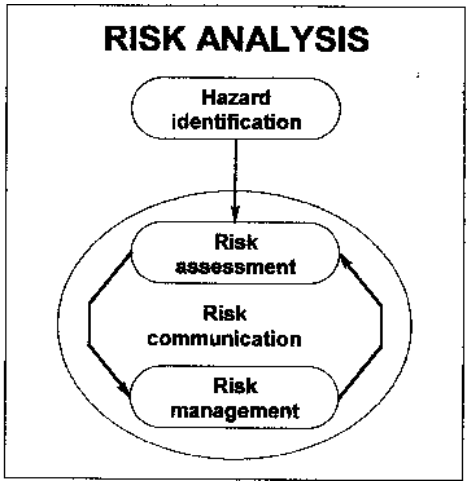
This chapter provides details of methods for Import Risk Analysis and its components in support of Section 11of the *Technical Guidelines*.

10.2 Import Risk Analysis Process

Hazard identification

This is the first step of any IRA. It identifies the pathogens of concern in the context of the commodity to be imported, and the possible countries of origin of that commodity. The following criteria are an example of such an identification process:

Figure 10.1. The four components of an import risk analysis.



A disease agent is infectious; **and** exotic to the importing country**, or** present in the importing country of parts thereof but subject to official control; **and** would cause significant disease in the importing country.

The risk analysis may be concluded here if the hazard identification fails to identify potential hazards associated with the importation.

An importing country, especially an OIE Member (see Section 10.4, International Trading Obligations), may then decide to permit the importation using the appropriate sanitary standards recommended in the OIE *International Aquatic Animal Health Code* (OIE 2000), thus eliminating the need for a detailed risk analysis as outlined below.

Risk assessment

Quarantine risk is composed of two related factors: (i) the probability of the disease agent entering and becoming established in the importing country, and (ii) the expected impact or significance (consequences) of such establishment. As discussed in the *Technical Guidelines*, evaluating these risks is the risk assessment step in the IRA. The OIE recommends that these risks be addressed in a structured, chronological manner, for example:

Release assessment — assessing the probability that the agent will enter the importing country as a consequence of the importation of the commodity.

Exposure assessment — assessing the probability of susceptible aquatic animals being exposed to a dose sufficient to cause infection, once the disease agent has entered the country in the commodity.

Consequence assessment — assessing the consequences of the disease agent establishing in the importing country.

The OIE categorizes various factors that should be considered in evaluating the probability of an exotic disease agent becoming established as a result of import introduction. These include known epidemiological characteristics of the disease agent; current geographic distribution, prevalence and seasonal dynamics; host range; export source; likelihood of pathogen detection, etc.

Effective IRAs consider all possible avenues (natural and human-mediated) for transmission. These infection "pathways" determine the probability of the pathogen becoming established in the import waters. Pathway analysis involves assessing the probability of occurrence at each critical step in each pathway.

The IRA then evaluates the consequences of disease establishment in an importing country. These may be economic, environmental (ecological) or social. They include impact on fisheries, sustainable aquaculture and biodiversity of native fauna (including threatened or endangered species).

For the final risk estimation, the results from the release assessment, exposure assessment and consequences assessment are integrated to produce overall estimates of risks associated with the hazards identified at the outset. The overall risk posed by a disease agent with low likelihood of establishment and very serious consequences may be similar to the risk posed by an agent with a high likelihood of establishment and less serious consequences.

Risk management

Once the risks associated with the importation of a commodity have been assessed, risk management measures need to be identified which can reduce those risks to a level acceptable to the importing country. It is important to realize that this is a re-iterative process (see Figure 10.1); the risks need to be re-assessed once the measures are taken into account. For example, the disease risks associated with the importation of live trout from country X may have been assessed as too high to be acceptable to the importing country, however, sourcing trout only from particular farms in country X may reduce the risk, since those farms are known to be free of the disease(s) of concern. The reduced risk now needs to be re-assessed, to determine whether it is acceptable to the importing country.

Risk communication

As Figure 10.1 shows, risk communication takes place throughout the entire IRA process. It is important to keep all stakeholders involved in the process, including the potential exporters.

Multidisciplinary approach

Because the factors which need to be considered are broad in scope, many countries use multidisciplinary committees to undertake the IRA. The conclusions from these committees are documented and submitted to the Competent Authority (CA) for use by personnel responsible for import approvals. The committees may suggest mitigative measures (where practical) that importing authorities can use as conditions for import approval (e.g., surface disinfection of eggs, quarantine-isolation of stocks, mandatory reporting and/or submission of samples of in-transit or post-transit mortalities, sterile disposal of all shipping materials). In some cases, the CA may submit the import license back to the committee to ensure that conditions meet scientific criteria, prior to release to the importer.

The multi-disciplinary committee, often called an "Introductions and Transfers Committee (ITC)" or a "Transplant Committee," can vary substantially in nature and still be effective. Such ITCs may be chaired by a representative from the CA or Chief Veterinary Office (CVO). Membership can be on an *ad hoc* basis, where the import application dictates the types of specialists asked to provide risk assessment and mitigative advice. Alternatively, membership can be general, including specialists across the range of possible applications e.g., different levels of appropriate government representation, aquatic animal health experts (microbiologists, parasitologists, veterinarians), industry association representatives and legal/enforcement advisors. Specialist committees have the advantage of focussed case-by-case examinations, but only work well for countries where the number of different import applications is relatively limited and such specialists are readily available. The broader-based ITC works most effectively for countries or regions with multiple government authorities and a high volume of diverse import applications. It also has the advantage of a broad perspective on perceived and real risks, as well as IRA experience accumulated over time. The two types of committee can work in harmony, with the general format used for "routine" application assessment and specialist groups being assembled for complex or unusual requests. One critical factor for optimum operation of any ITC, however, is sufficient time for accurate analysis.

Applications for live imports that need "rush" IRAs should be discouraged unless there is a well-established certainty that they are low risk. Applications that lack strong back-up data cannot be rushed without high risk.

Questions that need to be addressed follow, quite closely, those of the *ICES Code of Practice* (ICES 1995) and the OIE *International Aquatic Animal Health Code* (OIE 2000). For example:

Does the source of the import have a health history?
Is the health history based on reliable surveillance programs or expertise?
Has the stock undergone any unexplained mortalities in the last two years?
Are the export waters free of diseases of concern?
Does the importer have strong control of spread of the introduced stock or its offspring?
Are the import waters located close to significant aquatic resources (aquaculture investments, non-discretionary fisheries, recreational or tourism-driven aquatic investments, sensitive ecological systems)?
Are any neighboring resources vulnerable to disease transmission from the imported stock?

10.3 Three Examples of Risk Scenarios

A low-risk example

A grower wants to import shrimp from Person X in Country Y. The exporter has a long history of health surveillance and screening by a diagnostic laboratory with trained and established expertise. The shrimp have suffered no mortalities from diseases of concern to the importer. All mortalities that have occurred have been examined and results are available for import authority review. The importer has a site that is located in the middle of significant shrimp culture investment. IRA determines that this case has low import risk, *but* recommends that the disease history compiled at the export site must be submitted to the CA for evaluation prior to import of the stock. This condition ensures that no surprises accompany the shipment. The exporter is protected by World Trade Organization (WTO) conditions that prevent non-tariff trade barriers being based on unjustifiable restrictions. Documentation reveals no surprises and the grower receives an import license for that specific shipment with no conditions.

A high-risk example

A grower wants to import tilapia from Person X in Country Y. The exporter has stocks from mixed sources with poor documentation on their origins. Person Y has no recent health records and reports sporadic mortalities that have been dealt with by re-stocking. No diagnostic tests have been performed. Country Y has enzootic diseases that are exotic to the importing country. The fish species affected by

these diseases in Country Y are present in the importing waters. The IRA determines that this is a high risk proposal and recommends that the grower find another source. The CA decides not to issue an import license for fish from Person X in Country Y. Refusal documentation cites the lack of health history, mixed stocks, unexamined mortalities and presence of diseases of concern as the reason for refusal.

A moderate-risk example

A grower wants to import scallops from Person X in Country Y. Person X has no health history information, but is willing to get a health check done prior to shipment. The laboratory normally diagnoses fish diseases, but has well-established credibility. There have been no diseases of concern or abnormal mortalities in Country Y. The importer has holding facilities which will contain the imported scallops, although spawn may escape. The scallop species exists in the import waters, but is scarce. The IRA determines that the risk is moderate and recommends pre-shipment screening *plus* quarantine containment of pre-spawning scallops on arrival at the import site. This containment must be maintained until the scallops have spawned and mollusc health specialists have lethally examined all the broodstock. The grower must decide if the cost of quarantine merits use of introduced scallops rather than indigenous stocks.

These examples provide a general indication of only some of the questions/conditions that can influence IRAs and decision-making. Socio-economics also have a strong influence. Job-creation can outweigh concern over indigenous resources if the latter do not provide adequate income or security for a community. The single factor that should *not* influence IRAs is politics. A vote cannot outweigh aquatic animal health risk or food production sustainability.

10.4 International Trading Obligations

Members of the World Trade Organization (WTO) have certain rights and obligations under WTO agreements, including the *Agreement on the Application of Sanitary and Phytosanitary Measures* (the "SPS Agreement"]. Under the SPS Agreement, members are encouraged to have health control measures that are consistent with international standards. The SPS Agreement uses the standards, guidelines and recommendations developed by the OIE for animal health and zoonoses as the international benchmark. This means that a Member can adopt the OIE control measures as outlined in the OIE code after the hazard identification step has been conducted, without the need for a more detailed IRA. Members may adopt a higher level of protection, but this must be based on a scientific risk analysis. Such risk analysis needs to address the following elements:

evaluate the risk of entry, establishment or spread of these diseases, as well as potential biological and economic consequences; and

evaluate the risk of entry, establishment or spread of these diseases according to the SPS mitigative measures which might be applied

Members are obliged to ensure that the level of protection provided by any mitigative measures is consistent with the SPS "*appropriate level of sanitary or phytosanitary protection,*" and that, within this level of protection, the measures proposed are least trade restrictive. The SPS Agreement defines "*appropriate level of sanitary or phytosanitary protection*" as the level of protection deemed appropriate by the member country establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory. This means, membership to the WTO does not override a country's sovereign right to set its own level of protection.

10.5 Capacity and Institutional Implications

For most countries, conducting an IRA is a new concept and a new process. It is important to understand and embrace the concept of an IRA first, and not be discouraged by the anticipated complexity of the process. As stated above, IRAs can range from an individual farmer analyzing and

assessing the risks associated with a potential, specific importation, to a full range IRA carried out by a multidisciplinary team.

The authority responsible for undertaking an IRA needs to be clearly identified, and the legislative background for resulting import decisions needs to be clarified or, if required, newly established.

Because of the complexities involved, the conduction of a full import risk analysis is now regarded as a distinct scientific discipline; training is essential, and learning from already conducted IRAs is highly recommended.

10.6 References

ICES. 1995. ICES Code of Practice on the Introductions and Transfers of Marine Organisms 1994. International Council for the Exploration of the Sea, Copenhagen, 12 p.

OIE. 2000. International Aquatic Animal Health Code. Third edn. Office International des Épizooties, Paris, 153 p.

11 INSTITUTIONAL DEVELOPMENT AND CAPACITY BUILDING REQUIREMENTS

11.1 Purpose

There are many differing approaches towards quarantine and related aquatic animal health procedures in the countries of Asia, related to the social, cultural, economic and ecological environment; the different status of aquaculture development; and the priorities given to aquaculture and health management. In many cases, the implementation of the *Technical Guidelines* will require further development of policies and institutional responsibilities. In some countries, and particularly Low-Income Food-Deficit Countries (LIFDCs), substantial capacity building may be required to protect investments in aquaculture and the livelihoods of people involved from the negative impacts of aquatic animal pathogens.

The implementation of the *Technical Guidelines* is dependent on having an appropriate national administrative and legal framework. Another critical aspect is having sufficient national capacity in terms of knowledgeable and skilled manpower and institutional resources for their implementation (see *Technical Guidelines*, Section 13). The purpose of this section is to provide guidance in the policy, institutional and human capacity considerations for the implementation of the *Technical Guidelines*. Reference is provided below to the health management procedure identified in the guidelines.

11.2 Legislative Frameworks

There are varying degrees of aquatic animal quarantine or health-related regulations to be found in the region, ranging from total absence to strict regulation based on precise legislation. In general terms, a legal framework concerning the health management procedure will be essential to implement the *Technical Guidelines*. There are various experiences within the region on aquatic animal health legislation, including quarantine, which can provide useful guidance.

Australia and Indonesia require quarantine of all imported live aquatic animals as mandated by the Australian *Quarantine Act 1908* and Indonesian *Law No 16/1992*, and their subordinate legislation. Countries such as the People's Republic of China and the Philippines report well-structured and comprehensive legislation for aquatic animal import/export, although regulations do not currently require mandatory quarantine or certification. Pakistan reports the existence of the necessary legislative framework giving its Quarantine Department a mandate to prevent the spread of disease both into, and out of, the country. Vietnam reports that its first regulations dealing with the introduction and transfer of aquatic animals recently came into effect.

Singapore permits import of live fish for human consumption only from countries not on their prohibited list. Ornamental fishes must be healthy and free of clinical signs of disease. An accreditation scheme for those exporting ornamental fish from Singapore also exists. Several member countries e.g., Hong Kong and Myanmar, report no legislative framework to control aquatic animal health or quarantine except for exportation, where a certification requirement is imposed by the importing country. Cambodia, Hong Kong SAR China and Nepal were among those countries with little or no live aquatic animal health and quarantine legislation.

In all cases, legislation for the import and export of live aquatic animals tends to be more comprehensive than that for the within-country movement of aquatic animals. Equally, more precise legislation dealing with the importation of live aquatics was reported in comparison to that dealing with their exportation. In terms of health, export regulations are governed predominantly by importing country requirements.

Several Asian countries also indicated the existence of environmental/conservation policy/regulations that, outside of direct animal health management procedures, impact on import/export or the internal movement of live aquatic animals. In Australia, for example, both import and export are regulated through the *Wildlife Protection (Regulation of Exports and Imports) Act 1982,* as well as by international environmental protection treaties such as the *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).* Similar legislation was also reported from Sri Lanka (*Fauna & Flora Protection Act*) although their legislation specifically excludes ornamental fish. Nepal reported that its *Aquatic Animal Conservation Act 1961* is currently under review. In general, there should be consistency between the various legislation concerning the responsible movement of live aquatic animals.

Given the significant impact of disease on regional aquaculture and fisheries, several countries have initiated processes for the development of policy and/or legislation. Bangladesh, for example, has announced an *Environmental Policy and Implementation Schedule*. In this regard, an executive committee has been formed with the brief of formulating a national quarantine system. Although Australia has one of the most developed live aquatic animal quarantine programs, recent reviews have identified some concerns. These are currently being addressed as an overall national review of aquatic animal import policy. The Republic of Korea is also in the process of considering proposals to impose quarantine requirements for imported aquatic animals, as well to control internal fish movement. Malaysia has proposed introduction of live fish quarantine and upgrading of support services, based on regional requirements. Legislative changes proposed in Thailand have focussed on exports, with a centralized pre-export holding and certification facility currently under consideration. A thorough review of current legal frameworks in relation to the health management procedures given in the *Technical Guidelines* would provide a sound basis for the identification of future needs to development of legislation.

11.3 Resources

The resources that are needed for aquatic animal disease control take many forms; the implementation of the *Technical Guidelines* will require access to institutional, laboratory and human resources.

Institutional Resources

Institutional resources comprise both those organizations responsible for policy development, and those applying and enforcing regulations. The country strategies indicate a range of existing governmental infrastructure in terms of aquatic animal trade and production. Institutions other than those holding direct legislative responsibility for aquatic animal health and live animal movement involved in this area, include government and semi-government research organizations, universities, international research institutes, extension services and private-sector companies with diagnostic capability.

In Malaysia, where the primary responsibility for aquatic animal health lies with the Ministry of Fisheries, laboratory support and expertise are provided by three major universities, as well as the Department of Veterinary Services (Ministry of Agriculture).

In Japan, certification/permits are provided by the Ministry of Agriculture, Forestry and Fisheries (MAFF) through the Japanese Fisheries Agency (JFA). Disease control efforts are supported by a network of organizations coordinated by the Fisheries Agency - Office of Fish Health Protection, which includes the Japanese Fisheries Resource Conservation Association, the National Research Institute of Aquaculture, the National Fisheries Research Institute, universities and local (prefectural) government. The certification/permits are part of an integrated aquatic animal health management system.

Extension services and integrated networks of support services, whether managed at a national or state level, are a very effective system for aquatic animal health management. They can and should provide support at the farm level. In Korea, for example, the National

Fisheries Research and Development Institute (NFRDI) imposes strict inspection and certification of imported live fish/eggs, as well as conducting export certification to comply with importing country specifications. NFRDI has subsidiary facilities in the form of three major fisheries institutes, five local fisheries laboratories and three inland fisheries laboratories. China reported on its National Fisheries Extension Centre (NFEC), which includes a national demonstration area for disease control in shrimp culture. A fisheries extension service was also reported by Cambodia.

As some of the health management procedures outlined in the *Technical Guidelines* are relatively new to some countries, substantial institutional strengthening may be required. A useful starting point may be an institutional analysis to clarify responsibilities and identify the requirements for institutional strengthening. As resources for institutional strengthening may be limited, effective use should be made of existing resources, rather than building of new structures. For example, in some countries, the use of existing veterinary institutions may be an effective means of dealing with the health management procedures in aquatic animal movements. In Lao PDR, for example, local veterinary networks are being considered for extension of aquatic animal health management advice to farmers.

Laboratory Resources

The diagnostic laboratory resources range from those whose primary purpose is non-diagnostic (e.g., general bacteriology or water quality laboratories) through general veterinary facilities to laboratories specialized in aquatic animal disease diagnosis for fisheries and/or aquaculture. Diagnostic capability in many of the participating countries was reported to be deficient, from Level I through to Level III capacity. Enhancement of laboratory facilities and increased training are frequently identified within national strategies as areas for improvement. As emphasized in the *Asia Diagnostic Guide to Aquatic Animal Diseases,* there are considerable opportunities for regional cooperation to assist countries in the region build laboratory capacity.

Among the most highly developed facilities reported in the region are the CSIRO Australian Animal Health Laboratory, the Aquatic Animal Health Researcher Institute (AAHRI, Thailand), and the National Fisheries Research and Development Institute (NFRDI, Korea), as well as the many relevant university laboratories across the region. These are potential resource centers for support to countries with lesser-developed diagnostic capacity.

Several countries reported hierarchically structured laboratory services, such as that described above for the NFRDI in Korea. For example, in Indonesia, the Centre for Agriculture Quarantine (CAQ)has seven fish quarantine service stations and five sub-stations. Similarly, in the Philippines, the Fisheries Quarantine Service (FQS) has units at relevant ports of entry with diagnostic support provided by central and satellite fish health laboratories. In general terms, the responsibilities of diagnostic laboratories and capacity building requirements should be carefully reviewed to make effective use of existing resources, before building of new facilities.

Human Resources

The level of human resources involved in aquatic animal disease control, measured both as the number of staff and as the level of expertise and formal qualifications held by individuals, varied greatly between participating countries. Human resources development at all levels – from the farmer to the level of the policy maker – will be essential to support the implementation of the *Technical Guidelines*. The numbers of staff involved in national aquatic animal health control varies from a few individuals to several hundred, such as in the case of Indonesia, which reported 300 fish inspectors employed at the CAQ under the Ministry of Agriculture. Of these inspectors, 209 have been trained in basic fish disease diagnosis and treatment, 81 in bacteriology, 24 in immunochemistry, 30 in laboratory management and 20 in histopathology.

The range of expert disciplines includes veterinary science, virology, bacteriology/mycology, parasitology, water/soil chemistry and specific aquatic animal health/pathology expertise. The qualifications of staff include doctoral (Ph.D.), master's (M.Sc.) and bachelor's (B.Sc.) degrees in biological sciences; veterinary science degrees (DVM), and other technical qualifications.

Several countries noted a lack of aquatic animal health expertise and called for greater support for training. Training at all levels must take account of educational level and language skills. The quality of training needs to be monitored to ensure effectiveness. This is particularly critical at the extension and farm levels, where many people must be trained and educational levels may be lower. This is also the first and most important level of reporting and information gathering. In general terms, considerable capacity-building in terms of knowledge and skills s required at this – the pond level – among farmers and local (government and non-government) institutions involved in working directly with farmers.

Training at the satellite, national and regional laboratory levels must ensure accuracy and standardization if it is to fulfil both the needs of farmers and of an internationally recognized reporting system. Standardization of approaches will benefit from better national and regional cooperation in human resources development. In researchers, the capacity to carry out problem-solving research must be available. This research must be demand led and serve the end user. Research products must be delivered in a timely manner, and in a form that serves both the research and farming communities. In this way, both national and regional needs will be served.

Technical and other support staff must be trained in order to relieve researchers and diagnosticians of the burden of routine work and to ensure that this work is handled rapidly.

Training and infrastructure development should be clearly matched against requirements (e.g., potential pathogen risks, economic importance). Many of the least costly activities are ultimately the most important and are likely to generate the greatest benefits, as disease awareness and reporting begins at the pond side. Analysis of cost-benefits from investments in infrastructure and training should be considered at an early stage in the development of national strategies.

There are considerable opportunities for regional-level training, particularly in those areas where advanced skills are scarce or not yet available. This may include training in such fields as epidemiology, histopathological diagnosis, immunology and molecular biology, virology, extension methodology in aquatic animal health, mycology, research methodology and design, and risk analysis and management. Training should be matched against the health management procedures given in the *Technical Guidelines*. Examples of knowledge and skills required for selected health management procedures is provided in the table below.

A rational approach to staff development requires national institutions to develop a policy that identifies their requirements and focuses on areas of need, identifying appropriate staff and providing them with the training and resources needed to develop facilities and services.

Many, if not all, skills and facilities required for staff development in this field already exist in this region. An inventory and database of personnel and institutions should be developed to assist in identifying and mobilizing them. Such an initiative was carried out by the South East Asia Aquatic Animal Disease Control Project (SEAADCP) in AAHRI and could be expanded to encompass this aim. Skilled staff, once identified, can be mobilized to provide training and technical assistance. This could be more cost effectively provided within the region, particularly in light of the current financial climate.

Level	Site	Activity	Requirement
I	Field	Observation of animal and the environment Clinical examination	Investment in training, access to information – little or no equipment required. (Site access may require boat or negotiation of cooperation with culture-site managers/employees). Investment in training and basic equipment; access to information required.
II	Lab	Parasitology Bacteriology Mycology Histopathology	Significant investment in training, equipment and running costs. Access to current information required.
III	Lab	Virology Electron microscopy Molecular biology Immunology	Considerable investment in training and equipment and considerable running costs. Access to current information required.

Source: FAO/NACA. 2000. The Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and The Beijing Consensus and Implementation Strategy. *FAO Fisheries Technical Paper* No. 402. Rome, FAO. 2000. 53p.

Financial Resources

There are significant differences among Asian countries in the budgetary allocation to aquatic animal health control. Some governments have injected considerable funds into aquatic animal health in response to the devastating impact of disease on aquaculture and fisheries in the region. Others have no specific funding earmarked for aquatic animal health-related activities, although some work is performed using general budgetary allocations for agriculture/fisheries activities.

India indicated its financial commitment to this area, reporting consecutive funding increases to the Indian Council of Agricultural Research (ICAR). Other countries reported substantial financial input toward aquatic animal health control, such as Japan (US$ 400 million), Malaysia (US$ 1.56 million) and China (US$ 1 million). Financial limitations are indicated by several countries to be at the crux of identified deficiencies in infrastructure, diagnostic facilities and relevant expertise in aquatic animal health control. As beneficiaries of improvement in the aquatic animal health status in the region, the private sector should be given consideration as a source of funds for the development of disease control strategies. However, in such a partnership approach, the private sector may want greater involvement and responsibility in policy-making processes. Such funding mechanisms need to be further explored. In general terms, the profile and importance of aquatic animal health management should be increased and arguments made for an appropriate level of resource allocation.

11.4 Harmonization with International Standards

International harmonization of aquatic animal health measures is becoming increasingly important, and all member countries should tailor development of aquatic animal health strategies to be consistent with their international trade and other obligations, such as the WTO's *Agreement on the Application of Sanitary and Phytosanitary Measures*.

11.5 Conclusions

The advent of serious disease incidents in both aquaculture and fisheries in the region over the past decade has resulted in a greater emphasis on aquatic animal health. In response,

there has been the development of improved legislative frameworks, diagnostic facilities and expertise, and an increased commitment to the goals of sustainability and minimizing ecological impacts.

It is clear from the national strategy reports that much remains to be done. Greater resources coupled with increased cooperation between member states, and a degree of harmonization of aquatic animal disease control policies and measures will facilitate meeting this goal.

The following are three specific areas that countries in the Asia Region should consider when developing aquatic animal health strategies:

- jurisdictional clarity,
- consistency with international standards and obligations, and
- greater participation of the private sector in policy making and providing financial resources.

Consistency between terrestrial and aquatic animal systems will provide increased efficiency and a larger workforce of trained staff at times of peak demand, as well as facilitate meeting international obligations.

11.6 References:

FAO/NACA. 2000. The Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and The Beijing Consensus and Implementation Strategy. *FAO Fisheries Technical Paper* No. 402. Rome, FAO. 2000. 53p.

12 NATIONAL STRATEGIES AND POLICY FRAMEWORKS

A National Strategy Framework on Aquatic Animal Health Management for the Responsible Movement of Live Aquatic Animals or 'National Strategy' was developed by the designated National Coordinators of the 21 countries/territory participating in the regional programme. The development and contents of the National Strategy was thoroughly discussed during the 2 regional workshops held in 1998 and 1999. The National Strategy contains major headings on (a) Background, (b) National Status of Quarantine and Health Certification, (c) Health Status of Aquatic Animals and Identification of Pathogens/Diseases to be Considered for Quarantine Purposes, (d) Development of the National Strategy for Health Considerations for the Responsible Transboundary Movement of Live Aquatic Animals, and (e) Implementation Strategy. Each heading contains relevant elements pertaining to health management strategies identified in the 'Technical Guidelines' and 'Manual of Procedures'. For instance, the heading on development of national strategy contains subheadings on import risk analysis, quarantine, health certification, diagnostic requirements and capacity building, zoning, national reporting and surveillance systems, contingency planning, legislation and policy frameworks and information and databases.

The development of the National Strategy also followed national level consultation with governments and related institutions. A good example is "AQUAPLAN" which contains Australia's five-year national strategic plan for aquatic animal health and was prepared through close consultation between government and industry and describes a number of national level health management initiatives ranging from border controls and import certification to enhanced veterinary education and capacity to manage aquatic animal diseases. Other countries such as Indonesia, India, Philippines, Thailand and Vietnam, for example, conducted national level consultations with relevant government agencies involved in aquatic animal health management. Other countries which already have existing national strategies, e.g., Hong Kong SAR China and Singapore, were provided the opportunity to further develop their strategies according to the various regional activities undertaken under the regional program. It is expected that the National Strategies will be fully integrated in the aquaculture development programs of participating countries, be continuously revised and updated according to the existing resources and capacities of countries and in consultation with various stakeholders and information dissemination activities will be undertaken in order to increase awareness and build consensus for effective implementation.

The National Strategies which were presented during the final workshop in Beijing in 2000 will be published as a compendium[16].

[16] FAO/NACA. 2001. Compendium of National Strategies on Aquatic Animal Health Management. (In press).

13 REGIONAL CAPACITY BUILDING

There are considerable opportunities for regional-level support to countries in the implementation of the *Technical Guidelines*. Through NACA, member countries can optimize their limited resources by working together under a common strategy for minimizing the impact of aquatic animal disease. Duplication of effort can be avoided and opportunities to promote complementarity and synergies can be promoted. The following support to implementation of the *Technical Guidelines* offers opportunities for regional cooperation that should be pursued:

Information exchange and communication. This includes the opportunities for further development of information systems (e.g. AAPQIS) to support national efforts and sharing of information on aquatic animal health management.

Regional reference laboratories in support of the diagnosis of important diseases important to the region, and to support training and emergency response in specialist areas. The identified regional laboratories could maintain reference material and verify diagnosis of diseases important to the region. Such laboratories need to be identified and their capacities reinforced. The regional disease list can be used as the basis for identification of the laboratories and skills required.

Regional cooperation to share information on diagnostic techniques, harmonization, and support diagnosis through key referral laboratories and to provide training and other support for less developed countries will be essential in implementation of these guidelines.

Regional reporting system. The further development of the regional reporting system will allow the region to more effectively monitor the status and impacts of aquatic animal diseases, and respond in a timely and effective way to serious future outbreaks. A continued close cooperation with OIE and FAO will allow the fisheries sector to learn from experiences of the livestock sector, and gain from international experience on this subject.

Regional mechanism for emergency response should be developed to provide assistance, upon request, to countries suffering serious aquatic animal disease outbreaks.

Human resources development. Regional training and education programs to assist with building national capacity, ensuring uniform and acceptable standards of diagnosis and reporting, should be further enhanced. Training is particularly needed in countries where technical skills are scarce (e.g., in epidemiology, histopathology, immunology and molecular biology, virology, extension methodology, mycology, research methodology and design, and risk analysis and management). Regional-level monitoring systems and databases should be enhanced and supported, with strong links to *the Aquatic Animal Pathogen and Quarantine Information System* (AAPQIS). This includes maintenance of the NACA/FAO and OIE *Asia-Pacific Quarterly Aquatic Animal Disease Reporting System.*

At the regional level, hands-on training is required to establish uniformity in techniques and methodology of diagnosis, reporting and health certification, among others. Regional training and education programs in support of building national capacity should be developed in response to the requirements identified in the *Technical Guidelines*.

Cooperation in aquatic animal health management in countries with shared watersheds and other trans-boundary systems, such as the Mekong river basin and Ganges River, is needed.

Finally, a regional working group, the Advisory Group on Aquatic Animal Health (AG) will be valuable in providing continued high-level support for development and implementation of the *Technical Guidelines*. Its active involvement in aquatic animal disease issues within the region should be sustained, in order to respond to new challenges and provide consistent leadership for regional developments in this field, as well as assisting in projecting the aquatic

animal health concerns of the region into international organizations dealing with global aquatic animal health issues.

14 IMPLEMENTATION STRATEGIES

The States have primary responsibilities for implementation of the *Technical Guidelines*, and the workshop recommended that the *Technical Guidelines* be integrated within national development plans, and implemented in a phased manner building on current resources. Recognising the crucial importance of implementation of the *Technical Guidelines*, a detailed implementation strategy, focussing on National Strategies and with support through regional and international cooperation has been developed and adopted. This comprehensive implementation strategy, as reflected in the Beijing Consensus (FAO/NACA 2000) is given below.

14.1 Objectives

The implementation strategies outlined for the *Technical Guidelines* emphasise national-level implementation and the role of regional and international cooperation in supporting these National Strategies. This implementation strategy, therefore, pays special attention to the requirements of Low-Income Food-Deficit Countries (LIFDCs) and to potential strategies for consideration by countries at different stages of national development. The implementation strategy, as outlined below, gives special emphasis to the concept of "*phased implementation based on national needs.*" No matter where countries are in national development, the *Technical Guidelines* provide an entry point to build capacity.

14.2 Setting of Priorities

The Asia Region has diverse economic, social and ecological conditions, within which aquaculture development occurs. With countries at different stages of development; and with access to different levels of technical, financial and institutional resources; setting of priorities and a phased approach to implementation of National Strategies are essential.

The priority setting should be based on a realistic analysis of needs and setting of strategies which target priority needs. A first priority for implementation, therefore, is to undertake an assessment of the strategy for implementation of the *Technical Guidelines* in full consultation with relevant stakeholders.

14.3 Integration into National Aquaculture Development Plans

The implementation process should consider incorporation of elements of the *Technical Guidelines* into national aquaculture development plans.

Within the context of small-scale rural aquaculture development, it is recommended that basic health management considerations (such as Level I diagnosis, basic surveillance and appropriate contingency planning) be included within rural livelihood programmes involving aquaculture.

Legislation and policy. An effective policy and legal framework is a pre-requisite for designation of responsibilities and legal enforcement of disease control measures and health management. The legal provisions may, for example, be applied to registration of farms and hatcheries, mandatory reporting of certain diseases, designation and control of disease zones, permit surveillance and to establish and enforce contingency plans. The detailed options are elaborated in the *Manual of Procedures*.

In many cases, considerable progress can be made through incorporating relevant elements within existing policy and legal frameworks. A national review of existing policy and legal frameworks is recommended to provide a basis for identifying improvements. Specific guidance may also be provided at the sub-regional and regional levels to assist countries in the development and harmonisation of legal frameworks.

National co-ordination. A competent national authority and regulatory body to oversee implementation of quarantine and health certification, in consultation with aquatic animal health expertise, is essential. National Co-ordinators have an important responsibility for the co-ordination of the implementation process at the national level. Promotion of the *Technical Guidelines* and the need for their implementation among high-level policy makers is essential.

Where participating countries have not already done so, the designation of Competent Authorities (CA) empowered with the necessary responsibilities and mandates should be given high priority.

Where not already available, a national health committee, comprising relevant responsible stakeholders, is suggested to oversee implementation of the *Technical Guidelines*.

Pathogens to be considered. An understanding of the basic aquatic animal health situation is a pre-requisite for prioritising activities, developing national policy and identifying pathogens of national importance. A high priority should be given to such assessments, as without a clear and detailed understanding of hazards and risks, it is difficult to prioritise health management actions to manage risks.

Institutional resources. The institutional responsibilities and resources required to implement the *Technical Guidelines* should be clarified, such as needs for quarantine and holding facilities, diagnosis, information management, training and education, *etc*. Official designation of laboratories, institutions, and individuals for health certification of exports is also required. States are encouraged to identify and designate national centres with responsibilities for health management support, under a comprehensive national health management strategy.

Implementation should emphasise the effective use of existing resources through co-ordination and cooperation between national fisheries agencies, veterinary authorities, research institutions and universities, supported by effective regional and sub-regional cooperation.

Institutional analyses may be carried out to help identify requirements for institutional development.

Diagnostics. The building of diagnostic capacity, where required, should be phased, driven by needs. In developing countries, emphasis should be given to widespread implementation of Level I diagnostic procedures, before considering investments in Level II or Level III diagnostics. In such cases, support to higher-level diagnostics could be provided, initially at least, through regional or sub-regional collaboration.

The establishment of an effective Level I capacity should be regarded as an essential base requirement before moving to Level II and Level III. Higher level diagnostic measures, surveillance and other components of the *Technical Guidelines* will not be successful without this Level I basis. It is strongly recommended that national priorities for capacity building should be given to development of Level I diagnostic capacity and farm-level surveillance. This approach will require close consultation with farmers, building on their experiences and development of simple keys and manuals in local languages.

The long-term objective should be to harmonise, as far as possible, national diagnostic, quarantine and health certification protocols with other national, regional and international standards to facilitate reliable information exchange and trade. Such an objective will require a continued national commitment to regional cooperation in aquatic animal health management.

Disease zoning. Disease zoning, a relatively new concept for most countries in the region, offers potential to reduce risks from spread of aquatic animal diseases and facilitate trade and development, particularly in countries sharing common watersheds. Use of sub-regional groupings (e.g., SAARC,

MRC, ASEAN, etc.) as possible channels for co-ordination of disease zoning efforts should be further explored.

As a first step, a number of sub-regional and national pilot studies on disease zoning should be undertaken. This information should be shared among countries within Asia to gain better understanding of the role and practicalities of zoning for disease control before more widespread adoption of this strategy.

Surveillance and reporting. A national disease surveillance system and means for collation of disease surveillance data (such as a national database system) are required to respond effectively to disease outbreaks, and to analyse epidemiological data.

This national surveillance system should initially be based on use of Level I diagnosis and basic surveillance, linked to Levels II and III for advanced diagnosis, where required for selected diseases. Sub-regional or regional cooperation should be used to provide access to Level II and III diagnostics capability where national facilities are not yet available.

Wherever possible, basic surveillance systems should be integrated within existing extension services, and should include establishing functional linkages between fisheries and veterinary authorities, rather than building new systems and structures.

Where not available, a national disease reporting system and an aquatic animal health information system should be developed to support the surveillance system. A detailed national-level technical document on surveillance and reporting should be prepared as an initial step to support a phased and realistic approach to implementation of national surveillance systems.

Contingency planning. The concept of contingency planning, at the state and farm level, is new for many countries in the region. The options for development of a contingency plan are provided in the *Manual of Procedures*. As limited guidance exists within the individual countries of Asia, regional cooperation to share experiences and build capacity for national contingency planning is recommended.

Import risk analysis. The concept of import risk analysis (IRA) is also new for many countries in the region. Therefore, there is an initial need to build awareness among policy makers and administrators, and capacity to understand and implement risk analysis at national and regional levels.

14.4 Capacity-building Requirements

The implementation of the *Technical Guidelines* requires people with appropriate knowledge and skills, and access to institutional and financial resources. In some countries, there is a serious shortage of trained manpower to implement the *Technical Guidelines,* and this reality has to be addressed through effective use of existing human resources and by a longer-term approach to capacity building for aquatic animal health management.

Institutional analyses and national assessments of existing capacities within countries to implement the *Technical Guidelines* (e.g., assessment of diagnostics capabilities) can be used as a first step for determining the levels of institutional strengthening required to permit effective implementation.

To support long-term capacity building within countries, it is recommended that more attention be given to curriculum development in higher educational systems, and establishing a co-ordinated approach to training and education in aquatic animal health management which will make effective use of existing institutional resources, including fisheries and veterinary authorities, as appropriate. A system of accreditation (or professionally recognised qualification) for aquatic animal health professionals, including quarantine officers, should be considered.

Epidemiological skills, in particular, are required and this need should be addressed by longer-term capacity building.

14.5 Awareness Building and Communication

A high priority should be given to raising awareness of the *Technical Guidelines* and the need for their implementation within government agencies and the private sector, including aquaculturists and NGOs. Local workshops concerning the *Technical Guidelines* and this implementation strategy and translation of the *Technical Guidelines* into local languages, as appropriate, should be given initial priority. However, awareness building and effective communication on aquatic animal disease control measures should be a continuous activity. The electronic and print media should also be effectively used in this direction

14.6 Participation of the Private Sector

The private sector has a key role to play in the implementation of the *Technical Guidelines,* and a priority should be given to awareness building in the private sector on the benefits of, and requirements for responsible movement of live aquatic animals, and active participation in implementation. The private sector – which comprises producers, fry/fingerling traders and hatchery/nursery operators, among others – should be actively involved in the development of strategies and as partners for implementation of the *Technical Guidelines*.

Special attention must be given to the development of more effective measures for self-regulation in the private sector. Incorporation of the relevant elements of the *Technical Guidelines* into industry Codes of Practice, hatchery/farm accreditation schemes and other self-regulatory measures should be given a high priority. Such activities can be supported at the regional level by creating a forum for discussion, initiating pilot-level activities and developing 'model' codes and accreditation systems.

Farmer associations and groups should be recognised as important partners for implementation of the *Technical Guidelines*, and should be consulted and involved (e.g., through a national aquatic animal health committee) in measures for their implementation.

14.7 Financial Resources

National governments should identify and allocate resources for implementation of the National Strategies. In many countries, the resources currently provided to aquatic animal health management are insufficient to deal with the problems faced, and risks posed by aquatic animal diseases to aquaculture operations, enhanced fisheries and the livelihoods of people who depend on these activities. As increased resources will be required, political will to implement the *Technical Guidelines* effectively and awareness building for policy makers and administrators are essential requirements.

National implementation will require more efficient use of financial resources and sustained investment. Consideration should be given to: (a) clear prioritisation of activities based on needs; (b) institutional linkages and collaboration, including establishing functional linkages between fisheries and veterinary authorities; (c) development of cost-recovery systems, such as for diagnostic services; and (d) effective communication and promotion of ownership among the private sector.

14.8 Monitoring and Evaluation for National Implementation

Regular monitoring by Competent Authorities to assess the extent of implementation of the *Technical Guidelines* and the effectiveness of the national response to aquatic animal disease problems is recommended.

Regular national reviews might include evaluation of the appropriateness of the national list of diseases, the system used for reporting, and mechanisms for improving the existing system(s), surveillance and diagnostic capacity and other requirements. A more detailed monitoring framework with targeted outputs should be developed to be consistent with national situations.

Regular workshops among concerned agencies can be used to review progress, and adjustments can be made to the National Strategies to respond to changing circumstances, as necessary.

Monitoring at the regional and international levels

Monitoring and evaluation at the regional and global levels can be through reports to NACA (through the Governing Council), FAO-COFI (as part of the CCRF implementation progress reports), ASEAN Fisheries Working Group and to governing bodies of other regional organizations, such as the OIE Representation for Asia and the Pacific.

The National Co-ordinators should continue to play a key role in monitoring national progress towards implementation of the *Technical Guidelines* and through regular reporting to the Advisory Group on Aquatic Animal Health (AG) (formerly the Regional Working Group (RWG)).
The AG should assist by preparing guidelines for monitoring of implementation by NCs and preparing regional summary reports on progress.

14.9 Regional Cooperation

The sharing of experiences and resources through regional and sub-regional cooperation provides essential support to national-level implementation of the *Technical Guidelines*. The important actions required at the regional level include:

- designation of aquatic animal health resource centres;
- harmonisation of national procedures for health certification, quarantine and diagnostics;
- support for capacity building;
- awareness raising, communication and information exchange;
- regional disease reporting and development of a regional emergency response mechanism; and
- joint activities for risk reduction in shared watersheds and in sub-regions.

Asia resource centres for aquatic animal health. A more cohesive networking among regional resource centres in aquatic animal health is required to provide diagnostic support and to build capacity for implementation of the *Technical Guidelines*. A network of centres in regional countries is required as Reference laboratories for OIE diseases of significance in the region. Complementary resource centres within the Asia Region to provide national agencies with assistance in the diagnosis of key regional (non-OIE) diseases on the regional disease list, to provide more generalised support, and to act as contact centres for advice and capacity building.

NACA, in close cooperation with OIE and FAO, is requested to develop a Terms of Reference and associated procedures for designation of such centres for submission to the national authorities for their consideration. National authorities may then seek designation of the resource centres through the appropriate channels of NACA and/or OIE.

Harmonisation of procedures for health certification, quarantine and diagnosis. Regional cooperation is essential to harmonise, as far as possible, quarantine procedures, diagnostic procedures, health certification and other measures with respect to aquatic animal health. NACA is requested to co-operate with other relevant bodies, including OIE, FAO and ASEAN, to assist in harmonisation of such measures.

A comprehensive regional review on the legal aspects of aquatic animal health management should be undertaken to provide a basis for supporting countries in identifying requirements to further develop and harmonise national legislation and policy for implementation of the *Technical Guidelines*.

Support to capacity building. Regional and sub-regional cooperation through the aquatic animal health resource centres should be enhanced to assist in building the skills and knowledge base required for implementation of the *Technical Guidelines*.

A special region-wide co-operative effort is required to support the general adoption of Level I diagnostic measures throughout many countries of the region. Regional support should be directed towards developing illustrated training guides specifically aimed at aquaculturists, farm managers, and workers. These should include appropriate methods of record-keeping and health management, and methods for sample collection, preservation and delivery to trained diagnosticians. The building of communication channels between farms with the view to develop farmer groups for mutual cooperation should be supported. Regional training programmes should also be developed to support capacity building for Level II and Level III disease diagnosis.

The *Technical Guidelines* also contain some concepts new to the region, and short-term regional training and workshops should be developed to build awareness and capacity on these subjects. Regional-level courses which would be of wide benefit include: (a) import risk analysis, (b) epidemiology and surveillance techniques, (c) zoning and (d) contingency planning.

In the long term, measures should be taken to ensure epidemiology, risk analysis and other higher level skills are incorporated into higher education systems. The development of regional standards and professional qualifications for personnel involved in aquatic animal health to raise professional standards among aquatic animal health workers should be explored.

Awareness raising, communication and information exchange. At the regional level, awareness should be raised within the farming sector and government administrations concerning the economic and social benefits to be gained from implementation of the *Technical Guidelines* and the necessity that a high priority be given to their implementation.

Further development of AAPQIS-Asia is recommended to provide aquatic animal health information to the region. The AAPQIS-Asia database and web site should be linked to other sources of relevant data, particularly the OIE database, to enable users to access a wide range of relevant information with relative ease.

As some of the concepts within the *Technical Guidelines* (e.g., zoning, contingency planning) are relatively new, sharing of information on country experiences in implementation of the principles within the *Technical Guidelines* is strongly encouraged.

Regional disease reporting. The regional disease reporting system should be continued and further developed, with the aim of improving the quality of the reports. In the short term, more epidemiological information, as well as indication of the level of the diagnostic method used to report a given disease (e.g., Level I, II, or III) should be incorporated.

National quarterly reports should continue to be prepared and submitted to OIE and NACA/FAO, quarterly reports disseminated by NACA/FAO and OIE, and effective feedback mechanisms at both the national and regional levels established. The annual summary report should also be continued, as this has proved most useful to countries in the region.

The proposed Advisory Group on Aquatic Animal Health (AG) should be responsible for provision of advice on the development of the regional disease list and the reporting format. It was agreed that the regional disease list would be automatically adjusted to account for new diseases listed (or deleted) by OIE.

Resource centres should be used to provide specialist assistance for confirmatory identification of pathogens and provision of standardised diagnostic reagents. Technical support for developing the

reporting system within the region, and provision of expertise and advice to further improve surveillance and reporting capabilities, should be given high priority.

With the region's aquaculture growing rapidly, there is also a need to build up information on other diseases in key aquaculture commodities, and to determine the current status and economic and social impacts of disease. At the present time, marine molluscs and marine fish, in particular, deserve increased attention, as the regional information base on diseases of these widely cultured and traded animals is still limited.

Emergency response. National and regional contingency plans need to be developed to ensure there is quick and effective response to new serious disease outbreaks.

There is some existing experience on contingency planning at the state and farm levels which should be collated and shared with other countries to help in preparing national contingency plans. OIE, FAO and NACA are requested to organise a regional workshop to share such experiences, provide guidance for development of national contingency plans, and develop a practical Asia-regional emergency response mechanism.

Joint activities for risk reduction in shared watersheds. A pilot exercise in disease zoning is needed to determine the feasibility of zoning for shared large watersheds, contiguous river systems and marine coastal areas in the Asia Region (e.g., the Mekong or Ganges river systems, the Bay of Bengal or the Sundarbans coastal area). Experiences from such pilot testing should be widely shared with countries throughout the region.

Should zoning prove practical, there is a need for a regional body to provide official international recognition of the status of zones (e.g., free zone, infected zone, surveillance zone, unknown status, etc.), and for standardisation and harmonisation of requirements (e.g., zoning criteria, sampling and testing procedures, etc.). There may also be a need to harmonise national legal frameworks between co-operating countries.

14.10Mechanisms for Regional Cooperation

The Asia Regional Aquatic Animal Health Management Programme of NACA, implemented in cooperation with FAO and with guidance from OIE, should continue to be developed to support Asia-regional countries in implementation of the *Technical Guidelines*.

Effective partnerships with SAARC, ASEAN, MRC, APEC, BIMST-EC and other concerned regional and sub-regional bodies and organizations should be developed. Regional cooperation should be extended to technical agencies and donor organizations working in the region, such as AAHRI, ACIAR, AusAID, DFID, SEAFDEC-AQD, and others, who can support countries in implementation of the *Technical Guidelines*.

The National Co-ordinators should continue to be the national contact points for the programme, and occasional meetings should be arranged to bring the NCs together to review progress and discuss issues of mutual concern.

In support of the further development of the regional programme, an Advisory Group on Aquatic Animal Health (AG) should be established and made operational under NACA. The role and membership of this regional advisory group should be such as to ensure provision of expert advice to NACA on the implementation of the *Technical Guidelines*, including:

- the review and development of the reporting list of regional aquatic animal diseases;
- development of criteria for regional monitoring of application of the *Technical Guidelines*;
- development of criteria for the designation of Regional Aquatic Animal Health Resource Centres;
- development of a process for revision of the *Technical Guidelines* and to support the *Manual of Procedures* and the *Asia Diagnostic Guide for Aquatic Animal Diseases* (ADG) as required; and

- provision of other expert advice upon request.

Initial priority should be towards development of the work plan for this group. NACA is requested to provide institutional support for the AG at the regional level, and FAO and OIE are requested to provide advice and technical support.

Finally, the workshop suggested that complementary technical guidelines for the responsible trans-boundary movement of live exotic aquatic animals be developed in due course, specifically addressing the issue of introduction and impacts of exotic aquatic animals and biodiversity.

15 ANNEX I: LIST OF NATIONAL CO-ORDINATORS

List of national co-ordinators who represented the participating countries during drafting of the manual of procedures

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17 ANNEX III: LIST OF AGENCIES AND ORGANIZATIONS

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- Australian Quarantine and Inspection Service (AQIS)
- AusVet Animal Health Services, Australia
- Bangladesh Fisheries Research Institute (BFRI)
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- Bureau of Fisheries and Aquatic Resources, Philippines (BFAR)
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18 ANNEX IV: OIE DEFINITIONS

OIE definitions of diseases notifiable to the OIE and other significant diseases.

OIE International Aquatic Animal Health Code **(3rd ed., 2000)**
SECTION 1.1. - DEFINITIONS

"*Diseases notifiable to the OIE means the list of transmissible diseases that are considered to be of socio-economic and/or public health importance within countries and that are significant in the international trade of aquatic animals and aquatic animal products. Reports are normally submitted once a year, although more frequent reporting may be necessary in some cases to comply with Articles 1.2.0.2. and 1.2.0.3. The diseases notifiable to the OIE are set out in Part 2, Section 2.1. and 2.2. of this Code. ("Diseases notifiable to the OIE", as used in this Code, were previously known as "List B diseases".)*"

"*Other significant diseases means diseases that are of current or potential international significance in aquaculture but that have not been included in the list of diseases notifiable to the OIE because they are less important than the notifiable diseases; or because their geographical distribution is limited, or it is too wide for notification to be meaningful, or it is not yet sufficiently defined; or because the aetiology of the diseases is not well enough understood; or approved diagnostic methods are not available.*"

19 ANNEX V: DISEASES LISTED BY THE OIE

Aquatic animal diseases listed by the OIE (OIE International Aquatic Animal Health Code, Third Edition, 2000).

A. Diseases Notifiable to the OIE

Diseases of fish

Epizootic haematopoietic necrosis (EHN)
Infectious haematopoietic necrosis (IHN)
Oncorhynchus masou virus disease
Spring viraemia of carp
Viral haemorrhagic septicaemia

Diseases of molluscs

Bonamiosis
Haplosporidiosis
Marteiliosis
Microcytosis
Perkinsosis

Diseases of crustaceans

Taura syndrome
White spot disease
Yellowhead disease

B. Other Significant Diseases

Diseases of fish

Channel catfish virus disease
Viral encephalopathy and retinopathy
Infectious pancreatic necrosis
Infectious salmon anaemia
Epizootic ulcerative syndrome
Bacterial kidney disease (*Renibacterium salmoninarum)*
Enteric septicaemia in catfish (*Edwardsiella ictaluri*)
Piscirickettsiosis (*Piscirickettsia salmonis*)
Gyrodactylosis (*Gyrodactylus salaris*)
Red sea bream iridoviral disease
White sturgeon iridoviral disease

Diseases of molluscs

none listed

Diseases of crustaceans

Baculoviral midgut gland necrosis
Nuclear polyhedrosis baculoviroses (*Baculovirus penaei* and *Penaeus monodon*-type baculovirus)
Infectious hypodermal and haematopoietic necrosis
Crayfish plague (*Aphanomyces astaci*)
Spawner-isolated mortality virus diseases

20 ANNEX VI: LIST OF REPORTABLE DISEASES

NACA/FAO and OIE list of reportable diseases of aquatic animals[1]

	Disease status**			**Comment**
	Month			**Numbers**
Diseases prevalent in some parts of the region				
Finfish diseases				
1. Epizootic haematopoietic necrosis *				
2. Infectious haematopoietic necrosis *				
3. *Oncorhynchus masou* virus disease *				
4. Infectious pancreatic necrosis				
5. Viral encephalopathy and retinopathy				
6. Epizootic ulcerative syndrome (EUS)				
7. Bacterial kidney disease				
Mollusc diseases				
1. Bonamiosis * (*Bonamia* sp., *B. ostreae*)				
2. Marteiliosis * (*Marteilia refringens, M. sydneyi*)				
3. Microcytosis * (*Mikrocytos mackini, M. roughleyi*)				
4. Perkinsosis * (*Perkinsus marinus, P. olseni*)				
Crustacean diseases				
1. Yellowhead disease				
2. Infectious hypodermal and haematopoietic necrosis				
3. White spot disease				
4. Baculoviral midgut gland necrosis				
5. Gill associated virus (GAV)				
6. Spawner mortality syndrome ("Midcrop mortality syndrome")				
Diseases presumed exotic to the region, but reportable to the OIE				
Finfish diseases				
1. Spring viraemia of carp *				
2. Viral haemorrhagic septicaemia *				
Mollusc diseases				
1. Haplosporidiosis (*Haplosporidium costale, H. nelsoni*) *				
Any other diseases of importance[+]				
Unknown diseases of serious nature				

+ In particular, these include the following diseases so far presumed, but not proven, to be exotic to this region:
Finfish: Channel catfish virus disease; Infectious salmon anaemia; Piscirickettsiosis; Gyrodactylosis (*Gyrodactylus salaris*); Enteric septicaemia of catfish
Molluscs: Iridovirosis (Oyster velar disease)
Crustaceans: Nuclear polyhedrosis baculovirosis (*Baculovirus penaei*); Crayfish plague (*Aphanomyces astaci*); Taura syndrome; Necrotising hepatopancreatitis

*OIE Notifiable Diseases

1 The list is based on the Second Edition of OIE International Aquatic Animal Health Code with additional diseases of significant importance to the Asia-Pacific region. This list will eventually be updated to follow OIE's Third Edition of the Code.

* - OIE notifiable diseases

** Please use the following symbols:
***No information available
000 Never reported
- Not reported but disease is known to be present
(+) Exceptional occurrence
+? Serological evidence and/or isolation of causative agent no clinical diseases
+ Low sporadic occurrence
++ Enzootic
+++ High occurrence
? Suspected by reporting officer but presence not confirmed
! Disease recognised for the first time or reappeared
( ) Occurrence limited to specific zones; this symbol should be Marked after one of the above marks e.g. ++ ( )

Prepared By:

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