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[1]) (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.

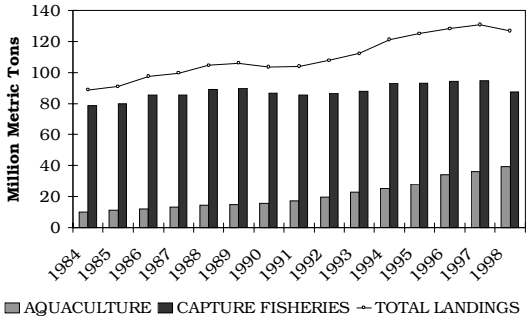

Figure 1 Contribution of aquaculture to total world fisheries production 1984-1998 (FAO, 2001)

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).

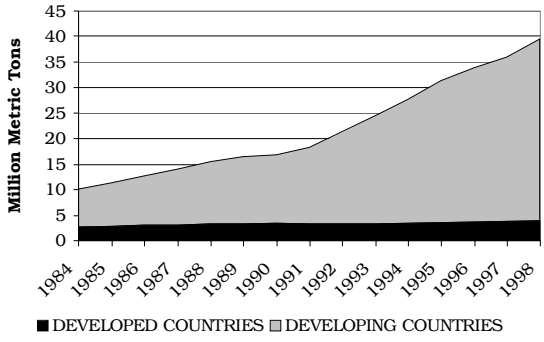

Figure 2 Aquaculture production in developed and developing countries 1984-1998 (FAO, 2001)

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 production increasing from 10.15 mmt or

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

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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