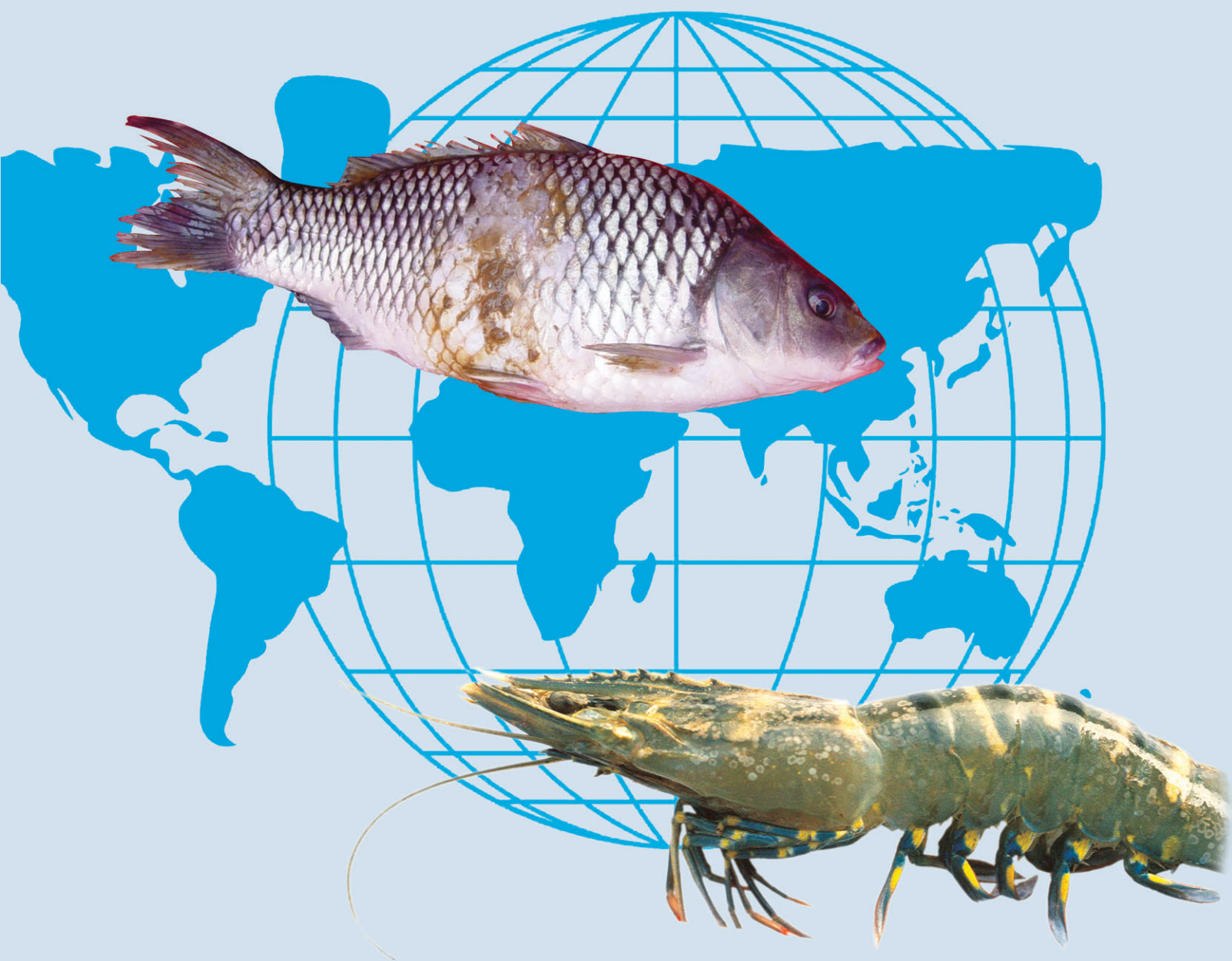


Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training



Celia R. Lavilla-Pitogo and Kazuya Nagasawa
Editors



Southeast Asian Fisheries Development Center
Aquaculture Department

Government of Japan Trust Fund

Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training

Proceedings of the Meeting on
Current Status of Transboundary Fish Diseases in Southeast Asia:
Occurrence, Surveillance, Research and Training
Manila, Philippines
23-24 June 2004

Celia R. Lavilla-Pitogo and Kazuya Nagasawa

Editors



Aquaculture Department
Southeast Asian Fisheries Development Center
Iloilo, Philippines

October 2004

October 2004

ISBN No. 971-8511-69-5

Published by:

SEAFDEC Aquaculture Department
Tigbauan 5021, Iloilo, Philippines

© *Copyright 2004*

Aquaculture Department
Southeast Asian Fisheries Development Center
Tigbauan 5021, Iloilo, Philippines

ALL RIGHTS RESERVED

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system, without the permission in writing from the publisher.

For comments and inquiries, please contact:

Training and Information Division
Southeast Asian Fisheries Development Center (SEAFDEC)
Aquaculture Department
Tigbauan 5021, Iloilo, Philippines
www.seafdec.org.ph
Fax No. (06333) 335-1008
Email: training@aqd.seafdec.org.ph

Cover Photos:

Dr. Akhmad Rukyani (carp with KHVD) and
Dr. Leobert D. de la Peña (shrimp with WSS)

This document should be cited as follows:

Lavilla-Pitogo CR, Nagasawa K. 2004. Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines. 254 p.

FOREWORD

Outbreaks of diseases attributed to microbial etiology are devastating to both cultured, and wild fish and shellfish populations. A good number of emerging diseases may trace their origin to the seemingly harmless introduction of an exotic fish or shellfish into the importing country. Unfortunately, the imported fish or shrimp eventually proved to be the vectors of a novel pathogen unknown to the indigenous and virgin fish population. The Epizootic Ulcerative Syndrome (EUS) and Koi Herpesvirus Disease (KHVD) in fish, as well as the White Spot Syndrome (WSS) and Taura Syndrome (TS) in shrimp, are salient examples of fish and shellfish infections that had moved from country to country and even between continents. Hence, this meeting on “Transboundary Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training” is highly relevant in creating and emphasizing awareness among Southeast Asian countries on the implications of the movement of fish pathogens in aquaculture. It is a proactive step towards vigilance against the transmission of the infectious organisms among economically-important aquatic animals. Focus on the positive. This complements our goal to increase food production and to sustain food security for the teeming world population.

ROLANDO R. PLATON, Ph.D.
Chief, SEAFDEC/AQD

ACKNOWLEDGMENTS

We thank the Government of Japan through the Regional Fish Disease Project for funding the Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training which was held at the Traders Hotel, Manila, Philippines on June 23-24, 2004. Many thanks to the session rapporteurs for noting down the important topics and issues discussed. We are thankful to Dr. Edgar C. Amar for collating the discussion reports and providing accuracy by listening to hours of taped sessions.

The artistic input of Ms. Ethel May C. Reyes for the cover design is very much appreciated. Dr. Agus Sunarto and Dr. Leobert D. de la Peña provided the photos on the cover. We also thank Mr. Raph Nacepo for the lay-out of the whole document.



Meeting Participants

Seated (Left to Right): S. Regidor, G. Lio-Po, J. Primavera, K. Nagasawa, J. Okamoto, Y. Oketani, J.R. Arthur, C. Tu, M. Sano, M. Phillips.
Standing (Left to Right): B. Racy, E. Alesna, A. Sunarto, N.Y. Saw, E. Catap, V.V. Kim, M. Bantaya, N.T. Nguyen, L. Hamid, S. Kanchanakhan, T. Theungphachanh, J. Somga, F. Latiff, E. Cruz-Lacierda, E. Amar, G. Pagador, K.H. Ling, C. Lavilla-Pitogo, L. de la Peña, N. Bantillo

TABLE OF CONTENTS

Foreword	iii
Acknowledgments	iv
Table of Contents	vii
I. Background and Objectives of the Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training	
Kazuya Nagasawa	3
II. Invited Papers	
Experience on Common Carp Mass Mortality in Japan	
Motohiko Sano, Takafumi Ito, Jun Kurita, Kei Yuasa, Satoshi Miwa and Takaji Iida	13
Current Status of Koi Herpesvirus Disease in Taiwan	
Chien Tu, Shih-Yuh Lin and Hwa-Tsung Sung	21
The Role of Quarantine in Preventing the Spread of Serious Pathogens of Aquatic Animals in Southeast Asia	
J. Richard Arthur	25
The Role of the Office International des Epizooties (OIE) in Health Improvement of Aquatic Animals	
Yoshiyuki Oketani	35
Research and Training on Fish Diseases at the SEAFDEC Aquaculture Department in 2000-2004: A Review	
Kazuya Nagasawa	41
AquaHealth OnLine: A New Learning Environment for Capacity Building in Aquatic Animal Health	
Celia R. Lavilla-Pitogo and Pastor L. Torres Jr.	53
Transboundary Shrimp Viral Diseases with Emphasis on White Spot Syndrome Virus (WSSV) and Taura Syndrome Virus (TSV)	
Leobert D. de la Peña	67
Summary Brief: International Symposium on Koi Herpesvirus Disease	
Gilda D. Lio-Po	71

III. Country Reports	
a. Brunei Darussalam	
Hajah Laila Haji Hamid	77
b. Cambodia	
Bun Racy	85
c. Indonesia	
Agus Sunarto, Widodo, Taukhid, Isti Koesharyani, Hambali Supriyadi, Lila Gardenia, Budi Sugianti and Djumbuh Rukmono	91
d. Lao PDR	
Thongphoun Theungphachanh	123
e. Malaysia	
Faazaz Abd. Latiff	131
f. Myanmar	
Saw New Year	159
g. Philippines	
Simeona E. Regidor, Juan D. Albaladejo and Joselito R. Somga	171
h. Singapore	199
Ling Kai Huat, Susan Kueh and Poh Yew Kwang	
i. Thailand	
Somkiat Kanchanakhan	211
j. Vietnam	
Kim Van Van	221
IV. Discussion Summary	231
V. Annexes	
1. List of Participants and Observers	247
2. Program of the Meeting	251
3. List of Acronyms	254

BACKGROUND

3

Background and Objectives of the Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training

– Kazuya Nagasawa –

Background and Objectives of the Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training

Kazuya Nagasawa

*Southeast Asian Fisheries Development Center, Aquaculture Department
Tigbauan 5021, Iloilo, Philippines*

Background of the Meeting

Status of aquaculture and transboundary disease problems in Southeast Asia

Global aquaculture production has been growing for over two decades, and a steady development of aquaculture has been well recognized in Southeast Asia with its annual yield being about 10% of the world aquaculture production. Four countries (Indonesia, Thailand, Vietnam and Philippines) in the region rank among the top ten aquaculture producers in the world. In 1999, aquaculture production in the ten ASEAN (Association of Southeast Asian Nations) countries reached a total of 2,472.6 metric tons. This indicates that increasing aquaculture production in the region has significantly contributed to global food supply as well as economic development in each country.

Despite these situations, the aquaculture sector has many constraints and problems for its sustainable growth. Disease is one of the major constraints, and infectious diseases caused by viruses, bacteria and parasites have resulted in reduction of aquaculture production in Southeast Asia. In particular, transboundary viral pathogens are known to inflict serious impacts on aquaculture production once they have been transferred to new areas.

White spot syndrome virus (WSSV) is an example of such transboundary pathogen. The disease caused by this virus was first reported in 1993 from Japan, where there were many cases of mass mortality of kuruma shrimp (*Penaeus japonicus*) and its aquaculture production was severely affected (Nakano *et al.*, 1994). WSSV was brought to Japan by importation of live kuruma shrimp larvae from China. In Southeast Asia, WSSV has been reported from Thailand, Malaysia, Vietnam, Indonesia, Philippines, Cambodia and Myanmar (based on NACA and FAO's *Quarterly Aquatic Animal Disease Report (Asia and Pacific Region)*, April-June 2003 and July-September 2003). Although it is not yet clear how this virus has spread in the region, it is most probable that WSSV was transferred from Thailand to Malaysia through the

movement of live broodstock and postlarvae. This virus causes the most devastating losses in the culture of black tiger shrimp (*P. monodon*) and has been threatening the sustainable production of shrimp culture in the region.

Activities of international organizations for transboundary diseases of aquatic animals

Some international organizations, such as the Food and Agriculture Organization of the United Nations (FAO) and the Network of Aquaculture Centers in Asia-Pacific (NACA), have been seriously concerned about aquatic animal pathogens and diseases that are transferred with transboundary movement of live aquatic animals. Since the 1990s, these organizations have held or co-convened with other organizations various workshops and published guidelines and proceedings listed below:

- Health Management in Asian Aquaculture (Subasinghe *et al.*, 1996);
- DNA-based Molecular Diagnostic Techniques: Research Needs for Standardization and Validation of the Detection of Aquatic Animals Pathogens and Diseases (Walker and Subasinghe, 2000);
- Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy (FAO/NACA, 2001a);
- Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals (FAO/NACA, 2001b);
- Asia Diagnostic Guide to Aquatic Animal Diseases (Bondad-Reantaso *et al.*, 2001); and
- Transboundary Aquatic Animal Pathogen Transfer and the Development of Harmonized Standards on Aquaculture Health Management (APEC/FAO/NACA/SEMARNAP, 2001).

NACA and FAO have jointly published the “*Quarterly Aquatic Animal Disease Report (Asia and Pacific Region)*” which contains country reports of the occurrence of specified diseases of fishes, molluscans and crustaceans from 21 countries and areas (Australia, Bangladesh, Cambodia, PR China, Hong Kong China, India, Indonesia, Iran, Japan, DPR Korea, Republic of Korea, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Vietnam).

The Office International des Épizooties (OIE) also has issued the following two publications on recommendations and protocols for prevention of international spread of specific diseases of aquatic organisms:

- International Aquatic Animal Health Code. Seventh edition (OIE, 2004); and
- Diagnostic Manual for Aquatic Animal Diseases. Fourth edition (OIE, 2003).

There have been excellent review articles on fish health management in Southeast Asia (Arthur, 1987, 1995, 1996; Arthur and Shariff, 1991) and at global level (Subasinghe *et al.*, 2001).

New transboundary fish viral diseases in Southeast Asia

Despite these efforts and publications, new transboundary viral diseases of aquatic animals have been currently reported from some parts of Southeast Asia. The diseases are Taura syndrome (TS) of Pacific white shrimp (*Litopenaeus vannamei*) cultured in Thailand (Limsuwan, 2003a, 2003b) and Indonesia (based on NACA and FAO's *Quarterly Aquatic Animal Disease Report (Asia and Pacific Region)*, July-September 2003) and koi herpesvirus (KHV) disease of common carp and koi (*Cyprinus carpio*) cultured in Indonesia (Sunarto *et al.*, 2002; Sunarto and Rukyani, 2005).

TS is a serious disease inducing high mortality of Pacific white shrimp that is originally indigenous to the Americas. In Asia, the disease resulted in big reduction of aquaculture production of Pacific white shrimp in Taiwan (Tu *et al.*, 1999; Yu and Song, 2000). Although there is no published information on the route of transfer of the disease to Thailand and Indonesia, it may be almost certain that TS virus (TSV) was brought to these countries with international movement of live Pacific white shrimp from other countries.

KHV infection was recently found also in Taiwan (Tu *et al.*, 2004) and Japan (Sano *et al.*, 2004, 2005). This disease was introduced to Indonesia with live koi imported from Hong Kong (Sunarto *et al.*, 2002). In Indonesia, there have been numerous cases of KHV-induced mass mortality of common carp and koi since March 2002. Losses were estimated to have reached more than US\$15 million as of December 2003 (Sunarto and Rukyani, 2005). There is also fragmentary information that KHV is present in Malaysia (see Table 1 in Gilad *et al.*, 2003).

Necessity to share experiences and information on fish diseases

When we combat disease threats, we need the most current information on diseases. But due to various reasons such as insufficient reporting system and research facilities to diagnose the diseases, necessary information may not be always available even among fish health management agencies and staff. It is also usual that scientific papers and reports of disease occurrences are published some one or two years after the occurrence of actual cases.

For TSV and KHV, we still have limited information. We need to learn more, especially about experiences in the countries where the diseases occur. Affected countries should share such experiences with other countries in order for them to take necessary counter-measures at national and regional-international levels. In addition, information on fish disease surveillance, quarantine, diagnosis, monitoring, research and training in each ASEAN country is also limited. For future establishment of efficient fish quarantine and surveillance in the region, we have to learn the actual status of these systems.

The Regional Fish Disease Project through the Government of Japan Trust Fund

Since the year 2000, the “Regional Fish Disease Project” has been implemented at the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) in Tigbauan, Iloilo, Philippines, funded by the Government of Japan (GOJ) Trust Fund (Inui, 2002). The first phase of the project entitled “Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds” started in 2000 and will end in 2004. A renewed, second phase of the project entitled “Development of Fish Disease Surveillance System” has been proposed by GOJ for the period from 2004 to 2008 and is about to start.

One of the major component activities under the Regional Fish Disease Project is to organize and support various international meetings. For example, using the project fund, the SEAFDEC Aquaculture Department organized with OIE the International Seminar/Workshop on Disease Control in Fish and Shrimp Aquaculture in Southeast Asia - Diagnosis and Husbandry Techniques in Iloilo City, Philippines on 4-6 December 2001. The proceedings was published in 2002 as the output of the Seminar/Workshop (Inui and Cruz-Lacierda, 2002). Also, in order to discuss various aspects of an emerging KHV disease, the International Symposium on Koi Herpesvirus Disease that was held in Yokohama, Japan on 13 March 2004 was co-organized by the Fisheries Research Agency of Japan (FRA), SEAFDEC (through the Regional Fish Disease Project), the Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF) and OIE.

Objectives of the Meeting

Under these situations and background, as part of the activities under the Regional Fish Disease Project, the SEAFDEC Aquaculture Department held the two-day meeting on “Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training” in Manila, Philippines on 23-24 June 2004 to share and collect the most current information on the occurrence of transboundary fish diseases and surveillance, quarantine, diagnosis, monitoring, research and training for aquatic animal diseases in the SEAFDEC member countries. In the meeting, three viruses, namely KHV, WSSV and TSV, were highlighted because of their high virulence and devastating impact on aquaculture in the region. This meeting was expected to be a step to prevent the spread of diseases in the region, which will be achieved efficiently in collaboration with other international organizations.

The objectives of the meeting on “Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training” are:

- To provide a forum to share the most current experiences and knowledge of transboundary fish diseases and pathogens, especially KHV, WSSV and TSV, with the SEAFDEC member countries;

- To increase our understanding of the current status of fish disease quarantine, surveillance, monitoring, diagnosis, research and training in each SEAFDEC member country;
- To integrate the most current information on various aspects of transboundary fish diseases in the SEAFDEC member countries in order to compile it as the proceedings; and
- To identify and discuss issues to be solved at national and regional-international levels.

Participants

A total of 32 participants and observers attended the meeting (*see* List of Participants). Participation in the meeting was by invitation only. With financial support from the Regional Fish Disease Project, the SEAFDEC Aquaculture Department invited 10 representatives from the SEAFDEC member countries (one person from each country: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, the Socialist Republic of Vietnam) and speakers from Japan, Taiwan, and Canada. OIE and NACA funded their respective representatives who delivered invited lectures. Representing the SEAFDEC Secretariat in Bangkok, the Deputy Secretary-General participated in the meeting. From the SEAFDEC Aquaculture Department, 10 scientists (Chief, Head of the Research Division, Fish Disease Expert, seven from the Fish Health Section) attended. The Philippines dispatched five personnel from the Bureau of Fisheries and Aquatic Resources (BFAR) as observers. The Socialist Republic of Vietnam also sent one observer to the meeting.

References

- APEC/FAO/NACA/SEMARNAP. 2001. Transboundary Aquatic Animal Pathogen Transfer and the Development of Harmonized Standards on Aquaculture Health Management. Report of the Joint APEC/FAO/NACA/SEMARNAP Workshop, Puerto Vallarta, Jalisco, Mexico, 24-28 July 2000. NACA, Bangkok. 197 p.
- Arthur JR. (ed) 1987. Fish Quarantine and Fish Diseases in South and Southeast Asia: 1986 Update. Report of the Asian Fish Health Network Workshop, Manila, 30 May 1986. Asian Fisheries Society Special Publication 1. 86 p.
- Arthur JR. 1995. Efforts to prevent the international spread of diseases of aquatic organisms, with emphasis on the Southeast Asian Region, p. 9-25. *In*: Shariff M, Arthur JR, Subansinghe RP (eds), Diseases in Asian Aquaculture II. Fish Health Section, Asian Fisheries Society, Manila.
- Arthur JR. 1996. Fish and shellfish quarantine: the reality for Asia-Pacific, p. 11-28. *In*: Subansinghe RP, Arthur JR, Shariff M (eds), Health

- Management in Asian Aquaculture. FAO Fisheries Technical Paper No. 360, FAO, Rome.
- Arthur JR, Shariff M. 1991. Towards international fish disease control in Southeast Asia. *Infodiv International* 3/91: 45-48.
- Bondad-Reantaso MG, McGladdery SE, East I, Subasinghe RP (eds). 2001. Asia Diagnostic Guide to Aquatic Animal Diseases. FAO Fisheries Technical Paper No. 402, Supplement 2. FAO, Rome. 240 p.
- FAO/NACA. 2001a. 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. FAO, Rome. 53 p.
- FAO/NACA. 2001b. Manual of Procedures for the Implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals. FAO Fisheries Technical Paper No. 402/1, Supplement 1. FAO, Rome. 106 p.
- Gilad O, Yun S, Adkison MA, Way K, Willits NH, Bercovier H, Hedrick R. 2003. Molecular comparison of isolates of an emerging fish pathogen, koi herpesvirus, and the effect of water temperature on mortality of infected koi. *J. Gen. Virol.* 84:2661-2668.
- Inui Y. 2002. Fish Disease Control Project of SEAFDEC Aquaculture Department, p. 181-185. *In: Inui Y, Cruz-Lacierda ER (eds), Disease Control in Fish and Shrimp Aquaculture in Southeast Asia - Diagnosis and Husbandry Techniques.* SEAFDEC Aquaculture Department, Iloilo, Philippines.
- Inui Y, Cruz-Lacierda ER (eds). 2002. Disease Control in Fish and Shrimp Aquaculture in Southeast Asia - Diagnosis and Husbandry Techniques. SEAFDEC Aquaculture Department, Iloilo, Philippines. 215 p.
- Limsuwan C. 2003a. Diseases of Pacific white shrimp (*Litopenaeus vannamei*) in Thailand. *The AAHRI Newsletter* 12(1):1-4.
- Limsuwan C. 2003b. The Taura syndrome virus situation of Pacific white shrimp (*Litopenaeus vannamei*) culture in Thailand. *The AAHRI Newsletter* 12(2):1-2.
- Nakano H, Koube H, Umezawa S, Momoyama K, Hiraoka M, Inoue K, Osako N. 1994. Mass mortalities of cultured kuruma shrimp, *Penaeus japonicus*, in Japan in 1993: epizootiological survey and infection trials. *Fish Pathol.* 29:135-139 (In Japanese with English abstract).
- OIE. 2003. Diagnostic Manual for Aquatic Animal Diseases. Fourth edition. OIE, Paris.
- OIE. 2004. International Aquatic Animal Health Code. Seventh edition. OIE, Paris.

- Sano M, Ito T, Kurita J, Yuasa K, Miwa S, Iida T, 2004. Experience on common carp mass mortality in Japan, p. 13-19. *In*: Lavilla-Pitogo CR, Nagasawa K (eds), *Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training*. SEAFDEC Aquaculture Department, Iloilo, Philippines.
- Sano M, Ito T, Kurita J, Miwa S, Iida T. 2005. Diagnosis of koi herpesvirus (KHV) disease in Japan. *Bull. Fish. Res. Agency*, Supplement 2 (in press).
- Subasinghe RP, Arthur JR, Shariff M (eds). 1996. *Health Management in Asian Aquaculture*. FAO Fisheries Technical Paper No. 360. FAO, Rome. 142 p.
- Subasinghe RP, Bondad-Reantaso MG, McGladdery SE. 2001. Aquaculture development, health and wealth, p. 167-191. *In*: Subasinghe RP, Bueno P, Phillips MJ, Hough C, McGladdery SE, Arthur JR (eds), *Aquaculture in the Millennium*. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, 20-25 February 2000.
- Sunarto A, Taukhid, Rukyani A, Koesharyani I, Supriyadi H, Huminto H, Agungpriyono DR, Pasaribu FH, Widodo, Herdikiawan D, Rukmono D. 2002. Field investigations on a serious disease outbreak among koi and common carp (*Cyprinus carpio*) in Indonesia. Paper presented in the 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Gold Coast, Australia.
- Sunarto A, Ryukani A. 2005. Indonesian experience on the outbreak of koi herpesvirus in koi and carp (*Cyprinus carpio*). *Bull. Fish. Res. Agency*, Supplement 2 (in press).
- Tu C, Huang H-T, Chaung S-H, Hsu J-P, Kuo S-T, Li N-J, Hsu T-L, Li M-C, Lin S-Y. 1999. Taura syndrome in Pacific white shrimp *Penaeus vannamei* cultured in Taiwan. *Dis. Aquat. Org.* 38:159-161.
- Tu C, Weng M-C, Shiau J-R, Lin S-Y. 2004. Detection of koi herpesvirus in koi *Cyprinus carpio* in Taiwan. *Fish Pathol.* 39: 109-110.
- Walker P, Subasinghe R. (eds). 2000. *DNA-based Molecular Diagnostic Techniques: Research Needs for Standardization and Validation of the Detection of Aquatic Animals Pathogens and Diseases*. FAO Fisheries Technical Paper No. 395. FAO, Rome. 93 p.
- Yu C I, Song YL. 2000. Outbreaks of Taura syndrome virus infection of cultured shrimp in Taiwan. *Fish Pathol.* 35:21-24.

13

Experience on Common Carp Mass Mortality in Japan

– Motohiko Sano, Takafumi Ito, Jun Kurita, Kei Yuasa,
Satoshi Miwa and Takaji Iida –

21

Current Status of Koi Herpesvirus Disease in Taiwan

– Chien Tu, Shih-Yuh Lin and Hwa-Tsung Sung –

25

The Role of Quarantine in Preventing the Spread of Serious Pathogens of Aquatic Animals in Southeast Asia

– J. Richard Arthur –

35

The Role of the Office International des Epizooties (OIE) in Health Improvement of Aquatic Animals

– Yoshiyuki Oketani –

41

Research and Training on Fish Diseases at the SEAFDEC Aquaculture Department in 2000-2004: A Review

– Kazuya Nagasawa –

53

AquaHealth OnLine: A New Learning Environment for Capacity Building in Aquatic Animal Health

– Celia R. Lavilla-Pitogo and Pastor L. Torres Jr. –

67

Transboundary Shrimp Viral Diseases with Emphasis on White Spot Syndrome Virus (WSSV) and Taura Syndrome Virus (TSV)

– Leobert D. de la Peña –

71

Summary Brief: International Symposium on Koi Herpesvirus Disease

– Gilda D. Lio-Po –

Experience on Common Carp Mass Mortality in Japan

**Motohiko Sano¹, Takafumi Ito¹, Jun Kurita¹, Kei Yuasa¹
Satoshi Miwa¹ and Takaji Iida²**

¹Inland Station, National Research Institute of Aquaculture, Fisheries Research Agency, Tamaki, Mie 519-0423, Japan

²National Research Institute of Aquaculture, Fisheries Research Agency, Nansei, Mie 516-0193, Japan

Abstract

The mortality rate among common carp for food reared in net pens in Lake Kasumigaura, the second largest lake in Japan, in Ibaraki Prefecture, increased from early October 2003 and koi herpesvirus (KHV) was detected in the affected fish by the National Research Institute of Aquaculture (NRIA) in late October using PCR methods of Gilad *et al.* (2002) and Gray *et al.* (2002). The Ministry of Agriculture, Forestry and Fisheries of Japan officially announced the first occurrence of KHV disease in Japan. In late October 2003, the water temperature of Lake Kasumigaura was 16-18°C and the fish losses were severe, particularly in market-sized carp. The apparent symptoms of affected fish were presence of mucus-like substance on the body surface, sunken eyes, and pale and necrotic gills, which were similar to those reported by Hedrick *et al.* (2000). Approximately 1,200 metric tons of common carp cultured in the lake were lost by mid-November. Prior to this, however, infected carp cultured in Lake Kasumigaura had already been transferred to farms, wholesalers, restaurants and game fishing facilities. Consequently, the infection spread to other areas in Japan. Independent of the outbreak in Lake Kasumigaura, a massive carp loss of over 10 thousand fish, the cause of which was initially diagnosed as columnaris disease, occurred in some rivers and a lake in Okayama Prefecture from late May to mid-July 2003. In November, the NRIA detected KHV DNA by PCR from samples of the diseased fish stored in a freezer. This demonstrated that KHV was present in Japan before late May 2003. By the end of 2003, KHV was detected in carp from 23 out of 47 prefectures in Japan. No occurrence of the disease was observed during the winter period. However, as the water temperature increased in spring of 2004, KHV reappeared in the area where the disease had been previously recorded, and also in new places. In many of the facilities that experienced KHV outbreak in 2003, the disease was not observed by June 2004 because

all carp had been removed together with other fish species and the facilities were disinfected thoroughly after the outbreaks. From January to the end of May 2004, KHV infections were reported in 24 of 47 prefectures in Japan.

Diagnostic System for Exotic Diseases and Koi Herpesvirus Disease

Some diseases are designated as “Specific Diseases” in the Japanese law. These are principally exotic diseases such as spring viremia of carp (SVC) and viral hemorrhagic septicemia (VHS) of salmonids that have the potential to devastate the aquaculture industry in Japan. For such diseases, protective guidelines have been established in Japan. The guidelines provide etiological information, diagnostic procedures, description of the symptoms and other important characteristics of the diseases. Laboratory diagnosis of the diseases must be conducted in accordance with these guidelines.

A newly isolated herpesvirus, designated as koi herpesvirus (KHV), was first reported as a causative pathogen of mass mortality that occurred among common and ornamental (koi) carp *Cyprinus carpio* cultured in Israel and the USA in 1998 (Hedrick *et al.*, 2000). A similar virus was also isolated after massive mortality of carp in Germany (Neukirch and Kunz, 2001) and Israel (Perelberg *et al.*, 2003). The virus isolated in Israel was identified as carp nephritis and gill necrosis virus (CNGV) based on the histopathological results (Ronen *et al.*, 2003). Subsequently, this viral infection has been observed in western Europe since 2000, Indonesia in the spring of 2002 and Taiwan in the fall of 2002 (Tu *et al.*, 2004), revealing that this disease is rapidly spreading worldwide in carp-trading countries. In Japan, there was no such mass mortality of carp before 2003 and KHV was not detected by a survey conducted in the Niigata Prefecture in 2001 (Amita *et al.*, 2002). As KHV is highly contagious and virulent in juvenile and adult carp (Hedrick *et al.*, 2000; Perelberg *et al.*, 2003), KHV infection was designated as a “Specific Disease” by the Japanese law amended on 30 June 2003, and an inspection procedure was established as part of the guidelines (Fig. 1). According to the procedure, Prefectural Fisheries Experimental Stations (PFESs), which

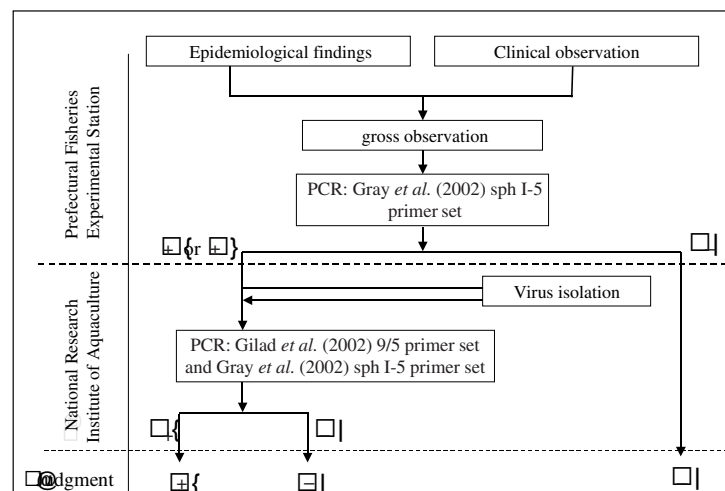


Fig. 1. Inspection procedure for KHV according to the Japanese guidelines

belong to the local government, first conduct an epizootic and routine clinical examination of diseased fish. The most important epizootiological aspect of KHV disease is that it affects only carp *Cyprinus carpio* and occurs apparently only in a limited range of water temperature from 18-28°C (Hedrick *et al.*, 2000; Gilad *et al.*, 2003). Therefore, the water temperature and susceptible fish species should be determined during a field examination. Few distinguishable external signs are usually visible, but pale and necrotic gills are frequently found. *Flexibacter columnaris* infection and some protozoan parasites, such as *Chilodonella* and *Trichodina*, are sometimes found on necrotic gill lesions, which easily lead to misdiagnosis of KHV disease. In case any doubt remains as to the presence of KHV, a polymerase chain reaction (PCR) test can be used to detect KHV DNA in the tissues of fish. The PCR method described by Gray *et al.* (2002) is adopted in the inspection procedure as the primary examination conducted by PFESs. When the PCR test is positive for KHV, the sample is sent to the National Research Institute of Aquaculture (NRIA) for further examination by PCR methods of both Gilad *et al.* (2002) and Gray *et al.* (2002) for confirmation. Virus isolation on the KF-1 cell line is also attempted using the KF-1 cell line (Hedrick *et al.*, 2000). Because of difficult isolation of KHV using the cell line, results of the isolation trial is treated as supplementary data and confirmation of KHV is solely based on the results of the PCR tests.

Occurrence of KHV Disease in Japan and Practical Diagnosis of the Disease

In Lake Kasumigaura, central Japan, the mortality among common carp cultured in net pens increased from early October 2003, when the water temperature of the lake was 16-18°C. The fish were lethargic and swam near the water surface. There were no marked external signs in most of the affected fish, but the appearance of whitish mucous-like substance on the body surface, redness of the fin and body, fin rot, and discoloration of the gill with some necrosis were sometimes observed. Mortality was over 60% in the most severe cases, especially in larger carp over 2 years old. The losses of cultured carp were estimated at 660 metric tons (MT) in early November and this reached approximately 1,200 MT by mid-November. This represents approximately one fourth of the lake's annual production.

External parasites, such as *Chilodonella*, *Trichodina*, and *Gyrodactylus*, were sometimes seen on the necrotic gill of affected fish. Marked histopathological changes were observed in the gill of diseased carp (Fig. 2). The secondary lamellae were often fused with the hyperplastic branchial epithelium where cell necrosis or infiltration of lymphocytes were often observed. Congestion and hemorrhage were sometimes observed. In some cases, the branchial tissues were severely degraded and numerous bacteria were seen in the lesions. These histopathological changes are similar to those previously reported (Hedrick *et al.*, 2000; Tu *et al.*, 2004). Unlike a previous report (Hedrick *et al.*, 2000), however, nuclear changes characterized by hypertrophy and margination of chromatin were rarely observed. No bacteria

were isolated from the kidney of affected fish using trypticase soy agar. The PCR test for KHV revealed specific bands amplified by the methods of Gray *et al.* (2002) and Gilad *et al.* (2002)(Fig. 3). The sequence of the amplicon by the primer set of Gray *et al.* (2002) was identical to the sequence deposited in the GenBank with accession no. AY568951, and that with the primer set of Gilad *et al.* (2002) showed 99% matching to AF411803.

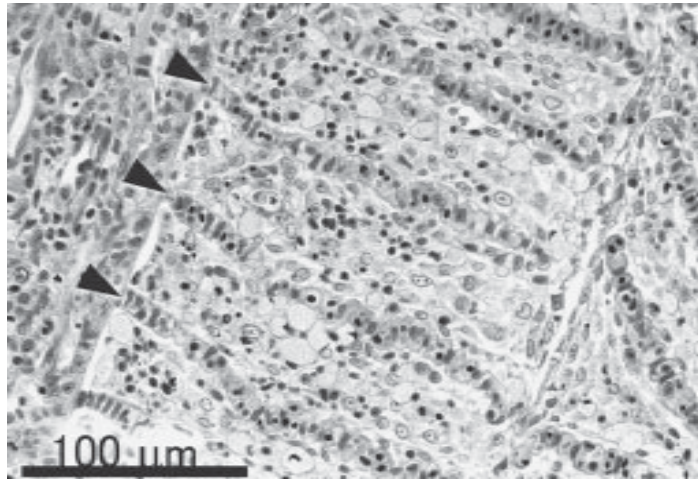


Fig. 2. A tissue section of the gill from affected common carp cultured in Lake Kasumigaura. Arrowheads indicate fused secondary lamellae with hyperplastic branchial epithelium and cell necrosis or infiltration of lymphocytes. H&E stain.

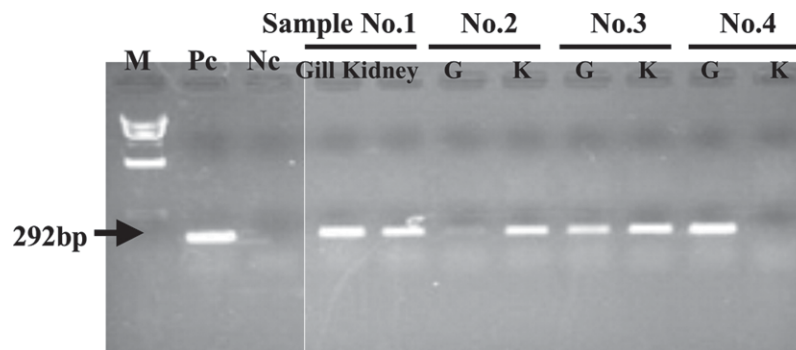


Fig. 3. Gel electrophoresis of the products (292bp) amplified with the primer set sph I-5 of Gray *et al.* (2002) from the extracted sample of gill and kidney of affected fish cultured in Lake Kasumigaura. Pc: positive control, Nc: negative control. 1% agarose gel stained with ethidium bromide.

The Ministry of Agriculture, Forestry and Fisheries of Japan officially announced the first occurrence of KHV disease in Japan on 2 November 2003. It was also reported to the Office International des Epizooties (OIE). According to the law, the Ibaraki Prefectural Governor prohibited any shipment or removal of cultured carp from the lake and ultimately ordered that all carp cultured in the lake would be destroyed by the end of March 2004.

Evidence of the Presence of KHV before the Outbreak in Lake Kasumigaura

Independent of the outbreak in Lake Kasumigaura, a massive loss exceeding 10,000 pieces of carp occurred in some rivers and a lake in Okayama Prefecture in late May to mid-July 2003. In November 2003, the NRIA detected KHV DNA by PCR in samples of diseased fish stored in a freezer. This demonstrates that KHV had been introduced into Japan before May 2003, much earlier than the Lake Kasumigaura outbreak.

The Spread of KHV in Japan

KHV-infected common carp cultured in Lake Kasumigaura were transferred to other areas in Japan before the first detection of KHV resulting in the spread of the virus. Mortalities of carp with KHV were reported in some facilities, but there were many facilities where KHV was detected in carp without mortality. This could be attributed to the fact that the water temperature was gradually decreasing at the time of investigation. By the end of 2003, the NRIA examined 529 carp in 87 cases, and KHV was found in 23 out of 47 prefectures in Japan. Half of the KHV positive cases had no obvious relations with the Lake Kasumigaura.

There was no occurrence of KHV disease during the winter period. However, as the water temperature increased in the spring of 2004, KHV reappeared in those areas where the disease was recorded in 2003, and also in new places. However, in many of the facilities that experienced KHV outbreak in 2003, the disease was not observed by June 2004. This is because in these places, all carp were removed together with other fish species, and the facilities were thoroughly disinfected after the outbreaks. There has been no occurrence of KHV disease in ornamental (koi) carp farms to date. From January to May 2004, KHV infection was reported in 24 of 47 prefectures in Japan.

Research Activity for KHV Infection at the NRIA

The NRIA and other research groups, including some universities and the Southeast Asian Fisheries Development Center (SEAFDEC), began to conduct a research project funded by the Ministry of Agriculture, Forestry and Fisheries of Japan to control KHV infection. This project will last for 3 years and consists of three major research aspects: 1) molecular virology and histopathology of KHV infection, including viral behavior in infected fish at different temperatures and at a carrier state, 2) development and evaluation of diagnostic tools such as the loop-mediated isothermal amplification (LAMP, Eiken Chemical Co.) method or immunofluorescence technique, and 3) control measures of the infection, including efficacy of disinfectants, vaccination and elevation of the rearing water temperature. The results could contribute to the control of KHV infection in both wild and cultured carp populations.

Acknowledgements

We are grateful to Prof. Dr. Ronald P. Hedrick of the University of California, Davis, USA, for his invaluable suggestions and for providing KF-1 cell line and a KHV isolate. We thank the staff of the Ibaraki Prefectural Experimental Station and Okayama Prefectural Experimental Station for providing the sample fish, and also the staff of the Aquatic Animal Health Division, National Research Institute of Aquaculture (NRIA), for running the diagnosis of KHV. This study was partially supported by a grant from the Ministry of Agriculture, Forestry and Fisheries of Japan.

References

- Amita K, Oe M, Matoyama H, Yamaguchi N, Fukuda H. 2002. A survey of koi herpesvirus and carp edema virus in colorcarp cultured in Niigata Prefecture, Japan. *Fish Pathol.* 37:197-198.
- Gilad O, Yun S, Andree KB, Adkison MA, Zlotkin A, Bercovier H, Eldar A, Hedrick RP. 2002. Initial characteristics of koi herpesvirus and development of a polymerase chain reaction assay to detect the virus in koi, *Cyprinus carpio koi*. *Dis. Aquat. Org.* 48: 101-108.
- Gilad O, Yun S, Andree KB, Adkison MA, Way K, Willits NH, Bercovier H, Hedrick RP. 2003. Molecular comparison of isolates of an emerging fish pathogen, koi herpesvirus, and the effect of water temperature on mortality of infected koi. *J. Gen. Virol.* 84: 2661-2668.
- Gray WL, Mullis L, LaPatra SE, Groff JM, Goodwin A. 2002. Detection of koi herpesvirus DNA in tissues of infected fish. *J. Fish Dis.* 25: 171-178.
- Hedrick RP, Gilad O, Yun S, Spangenberg JV, Marty GD, Nordhausen RW, Kebus MJ, Bercovier H, Eldar A. 2000. A herpesvirus associated with mass mortality of juvenile and adult koi, a strain of common carp. *J. Aquat. Anim. Health* 12: 44-57.
- Le Deuff R-M, Way K, Ecclestone L, Dixon PF, Betts AM, Stone DM, Gilad O, Hedrick RP. 2001. Development and comparison of techniques for the diagnosis of koi herpesvirus (KHV). Abstract of 10th International Conference of the European Association of Fish Pathologists. p. 257.
- Neukirch M, Kunz U. 2001. Isolation and preliminary characterization of several viruses from koi (*Cyprinus carpio*) suffering gill necrosis and mortality. *Bull. Eur. Ass. Fish Pathol.* 21: 125-135.
- Perelberg A, Smirnov M, Hutoran M, Diamant A, Bejerano Y, Kotler M. 2003. Epidemiological description of a new viral disease afflicting cultured *Cyprinus carpio* in Israel. *Israeli J. Aquat.* - Bamidgah 55: 5-12.

- Ronen A, Perelberg A, Abramowitz J, Hutoran M, Tinman S, Bejerano I, Steinitz M, Kotler M. 2003. Efficient vaccine against the virus causing a lethal disease in cultured *Cyprinus carpio*. *Vaccine* 21: 4677-4684.
- Sunarto A, Taukhid, Rukyani A, Koesharyani I, Supriyadi H, Huminto H, Agungpriyono DR, Pasaribu FH, Widodo, Herdikiawan D, Rukmono D. 2002. Field investigations on a serious disease outbreak among koi and common carp (*Cyprinus carpio*) in Indonesia. Paper presented in the 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Gold Coast, Australia. p. 106.
- Tu C, Weng M-C, Shiau J-R, Lin S-Y. 2004. Detection of koi herpesvirus in koi *Cyprinus carpio* in Taiwan. *Fish Pathol.* 39: 109-110.

Current Status of Koi Herpesvirus Disease in Taiwan

Chien Tu¹, Shih-Yuh Lin¹ and Hwa-Tsung Sung²

*¹National Animal Health Research Institute, Council of Agriculture
376 Chung-Cheng Rd., Tamsui 251, Taiwan ROC*

²Bureau of Animal and Plant Health Inspection and Quarantine, Council of Agriculture, 51 Sec. 2 Chung-Ching South Rd., Taipei 100, Taiwan ROC

Abstract

The first reported case of koi herpesvirus disease (KHVD) occurred in northern Taiwan in December 2002. Later, there were three more cases in 2003 and one outbreak of KHVD in 2004. Externally, the affected fish did not show any prominent lesions except swollen gills sometimes accompanied by bleeding. Consistent histopathological findings were in the gill tissues, where hyperplastic epithelia and eosinophilic granular cells were observed within fused secondary lamellae. Electron microscopy revealed negatively-stained icosahedral viral nucleocapsids measuring 112 ± 1 nm in diameter. Also, the koi herpesvirus was detected in the homogenate of diseased fish by PCR assay using specific primers for koi herpesvirus (KHV). The amplicon was cloned, sequenced and compared with previously published data. The sequenced data showed 99% identity with the American KHV sequence in the GenBank. The above evidence suggests that KHVD have already invaded carp culture systems in Taiwan.

The First Case of KHVD in 2002

The first outbreak of KHVD occurred in a private carp pond in Taipei County in northern Taiwan. On December 6, 2002, two 2-year-old colored carp were submitted for examination by a private hobbyist to our research facility. The owner had about 30 koi, averaging in age between 2 to 3 years, which were reared in two different ponds. He had bought several of the koi from farmers at Taoyuan County in northern Taiwan about one month before the occurrence. The water temperature in both ponds was approximately 20-22°C when the disease outbreak occurred. At first, the affected fish appeared lethargic and lacked appetite for several days before death. The owner observed a light-reddish discoloration of the pond water so that he decided to submit his fish for examination. Upon necropsy, congestion was

observed at the base of the fins and tail, and the gills were swollen. Bleeding from the gill was observed in one fish. There were no other lesions found in the internal organs. For histological examination, tissues were fixed in 10% neutral-buffered formalin for 24 hours, embedded in paraffin, sectioned and stained with hematoxylin and eosin using all routine techniques. Histopathology of the gills showed hyperplasia and fusion of the secondary lamellae in the diseased fish. Necrotic epithelial cells accompanied by some eosinophilic granular cells were noted among the hyperplastic gill epithelia. Samples for bacterial examination of the liver, spleen and kidney were obtained by stabbing the organs with a sterile loop, inoculating samples onto blood agar (5% sheep red blood cell), then incubating them at 25°C for 48 hours. No bacterial growth was obtained from these samples. For viral isolation, the tissues (spleen, kidney and gill) of two diseased fish were homogenized with 10⁷ PBS and centrifuged at 1500⁷ g for 15 min. The supernatants were filtered through a 0.45 μ pore-size filter and inoculated onto a monolayer of FHM, EPC, and BF-2 cell lines at 25°C; CHSE-24 and RTG-2 cell lines at 20°C, and observed for 14 days. There was no CPE in the inoculated cell lines after one blind passage. For electron microscopy, a herpes-like viral particle was found in the negatively-stained samples. For PCR assay, specific amplicons were produced using specific primers designed by Gilad *et al.* (2002) and Gray *et al.* (2002). The amplicons were cloned, sequenced and compared with all the data submitted to GenBank. Our sequenced result had 99% identity with that of American KHV in Genbank. KHV was diagnosed as the etiologic agent of this outbreak.

As soon as KHVD was confirmed in the National Animal Research Institute, the Taipei County Livestock Disease Control Center and the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) were notified of the results. These facilities are responsible for controlling the spread of newly emerging exotic animal diseases. Upon receiving our notice BAPHIQ sent an official document to all local County Livestock Disease Control Centers requesting the centers to investigate the current status of carp cultures in their respective counties. The public veterinarians began an investigation and discovered no new disease outbreaks among cultured carp in Taiwan. In addition, upon advise of the owner of the diseased fish, we also visited the suspected farm at Taoyuan County as the possible source of infection. Our investigation was unsuccessful because the owner of the fish farm had already closed his farm and fled the premises. Therefore, the source of the KHVD introduction to Taiwan is still unknown.

The First Case of KHVD in 2003

The first occurrence of KHVD in 2003 was at a private koi pond in Taipei. The case was transferred from the Taipei Animal Health Inspection Center to our laboratory. The total number of cultured koi in this incident was 20. Clinically, the affected fish were observed to be very sluggish and after 7-10 days, death occurred. Upon necropsy, only swelling of the gills was observed. Similar histopathological examinations and PCR assays were performed in

this case, and results obtained were the same with findings in the 2002 case. Therefore, this case was also diagnosed as KHVD. All fish were eradicated and buried. As in the previous case, the origin of infection remains unknown.

The Second Case of KHVD in 2003

The second case of KHVD also occurred in Taipei in 2003. The koi were reared in an artificial lake together with tilapia in a public park. The lake had approximately 300 koi with no recent introduction of new fish into the park ponds. The tilapia remained unaffected and had no deaths throughout the koi herpesvirus outbreak. The affected koi (2-3 years old) were lethargic and were floating near the water surface before death. Both dead and moribund fish were sent to our laboratory by the Taipei City Animal Health Inspection Center. The gross lesions were similar to those in the previous two outbreaks. The series of examinations were performed at our laboratory as previously described. Similar histopathological changes and PCR results were also obtained in this case.

Since the park is open to the public for 24 hours, it is very easy to gain access into the artificial lake. Because park officials have not introduced new koi, it was speculated that the outbreak of KHVD might have resulted from unauthorized release of diseased fish into the lake by unknown persons. All the fish in this case were destroyed.

The Third Case of KHVD in 2003

The third outbreak of KHVD in 2003 also occurred in Taipei. Seven hundred 2-3 year old koi that were reared in a lake located at a public memorial hall became infected. Similar pathological changes and PCR results were found during examinations. It was suggested that all the fish be culled to prevent further spread of the disease. Since the public has access to the pond for 24 hours, the origin of this outbreak of KHVD is probably caused by the unintentional (unexpected) introduction of diseased fish by unknown park visitors.

The First Case of KHVD in 2004

The first outbreak of KHVD in 2004 occurred in a suburban area in Taipei County. The owner is a farmer who hatches, raises and sells the koi. The farmer's koi hatchery is located in southern Taiwan. After hatching, the fries are grown to juvenile, moved to the grow-out farm, and later sold in northern Taiwan. Water for the grow-out ponds comes from a spring. The water temperature was 22-23°C when the disease outbreak occurred. The diseased fish did not show any prominent clinical signs or gross lesions during the visual examinations. The histopathological and PCR results were identical with the findings in all previous cases. All the affected fish (about 1000 pieces) were destroyed. After disinfecting the rearing water with chlorine, it was drained and the ponds were left empty for 2 months before

being re-stocked with new fish. This case may have been caused by the owner's acceptance of unhealthy koi returned by his customers.

Diagnosis and Control System of Exotic Aquatic Animal Diseases in Taiwan

The diagnostic system for aquatic animal diseases is a collaboration of the central government and the local county. In the central government, the Animal Health Research Institute (AHRI) of the Council of Agriculture is responsible for the final diagnosis of exotic aquatic animal diseases. In the AHRI, routine monitoring program for animal diseases is in place and it also receives suspected specimens submitted from all over Taiwan. In the local county, the aquatic health section of the county Livestock Disease Control Center (LDCC) is responsible for routine aquatic animal disease diagnosis and control. If a disease is suspected to be caused by a new and emerging disease agent, it will be referred to the AHRI for final confirmation. Furthermore, aside from receiving suspected specimens from local LDCC, AHRI can also accept specimens submitted directly by private individual for diagnosis.

Regarding the control system for exotic aquatic animal diseases, the BAPHIQ in the central government is in charge of the control plan, including confinement, eradication and compensation related to the exotic aquatic animal disease outbreaks. In the local county, the LDCC executes the control plan determined by BAPHIQ.

Spread of KHV in Taiwan

According to our official data, the outbreaks of KHV are found in Taipei and Taoyuan County in northern Taiwan only.

Research on KHV in Taiwan

There are on-going studies in the development of cell lines for viral isolation, development of rapid diagnostic tool, research on viral pathogenesis in the molecular level, and the development of a vaccine against KHVD at AHRI and other universities in Taiwan.

References

- Gilad O, Yun S, Andree KB, Adkison MA, Zlotkin A, Bercovier H, Eldar A, Hedrick RP. 2002. Initial characteristics of koi herpesvirus and development of a polymerase chain reaction assay to detect the virus in koi, *Cyprinus carpio koi*. Dis. Aquat. Org. 48: 101-108.
- Gray WL, Mullis L, LaPatra SE, Groff JM, Goodwin A. 2002. Detection of koi herpesvirus DNA in tissues of infected fish. J. Fish Dis. 25: 171-178.

The Role of Quarantine in Preventing the Spread of Serious Pathogens of Aquatic Animals in Southeast Asia

J. Richard Arthur

P.O. Box 1216

Barriere, British Columbia

Canada V0E 1E0

Abstract

Quarantine, in the strict sense, is the confinement of aquatic animals of unknown or questionable health status in secure facilities such that neither they nor any pathogens they may be carrying can escape into the external environment. During the period of quarantine, the animals are observed, tested, and treatment may be applied, and a decision will be made as to whether or not they should be released to the external environment.

While the concept of quarantine for aquatic animals has existed for many years, within the current framework of “national biosecurity”, quarantine is seen as one of a number of risk mitigation options that governments can apply to reduce the likelihood of serious pathogens being introduced with the importation of live aquatic animals and their products.

Although the concept of quarantine is relatively simple, its effective implementation may be complex, due to the need for specialized infrastructure, capability and expertise. Several Southeast Asian countries have considered or attempted to implement border quarantine for live aquatic animals; however, these efforts have met with little success. This has been due to a number of reasons, including failure to carefully define the scope and purpose of quarantine within a national aquatic animal health program, the diversity of forms in which trade occurs, the sheer volume of commodity traded, the lack of simple and accurate diagnostics tests for some pathogens, and the limited capital and human resources that governments are able to commit to this effort.

To improve this situation, risk analysis can be used to determine whether or not the importation of a given commodity (living aquatic animal or its product) poses an unacceptable disease risk to national biosecurity. In those cases where an unacceptably high level of risk exists, possible risk mitigation measures can then be examined to determine what actions, if any, can be applied to reduce the risk to within the country’s appropriate level of

protection (ALOP). In this way, quarantine, as one of a suite of possible risk reduction measures, can be applied effectively on a case-by-case basis to reduce the risk of introduction, establishment and spread of serious aquatic animal pathogens into new areas.

Introduction

What is Quarantine?

Quarantine has been defined in a number of ways. The *International Aquatic Animal Health Code* of the Office International des Épizooties (OIE, the World Animal Health Organization) defines the term “quarantine” as:

“Maintaining a group of aquatic animals in isolation with no direct or indirect contact with other aquatic animals, in order to undergo observation for a specified length of time and, if appropriate, testing and treatment, including proper treatment of effluent waters.” (OIE 2003).

A similar but slightly different definition was used by the Food and Agriculture Organization of the United Nations (FAO) and the Network of Aquaculture Centres in Asia-Pacific (NACA) during the recent regional Technical Cooperation Project “Assistance for the responsible movement of live aquatic animals” (FAO/NACA TCP RAS 6714(A) and 9605(A) (FAO/NACA 2000):

“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 sterilisation/disinfection of all effluent and quarantine materials.”

In contrast, in Australia, the legal basis for import biosecurity, the Quarantine Act (1908), defines “quarantine” with a wide scope, to include pre-border (e.g., health certification), border (e.g., quarantine *sensu stricto*) and post-border (e.g., monitoring and surveillance) activities. Thus the operational agency, the Australian Quarantine and Inspection Service (AQIS), uses the term “quarantine” in a very wide sense (see Bernoth 1998). Biosecurity Australia, however, generally considers the terms “biosecurity” and “quarantine” to be equivalent when quarantine is used in the sense that it has in the Quarantine Act (i.e., in the broadest sense). Thus in legal situations, Biosecurity Australia uses the word “quarantine”, while in other situations “quarantine” is avoided because it is confusing to people from outside Australia, who generally consider that it means a period of mandatory detention (Peter Beers, pers. comm.). In recent Australian risk analyses for aquatic animals, the term “quarantine measures” is used in the sense that other countries use the term “quarantine.”

In this paper, “quarantine” will be discussed using the concept of mandatory detention as applied by OIE and FAO/NACA.

The Purpose of Quarantine

The primary purpose of quarantine is to minimize the risk of introducing infectious agents (pathogens) into the national territory of the importing country and their escape and spread to susceptible species. The secondary purpose is to prevent the entry of aquatic organisms that have not been approved for introduction.

Attempts to Establish National Quarantine Programs in Southeast Asia

The international spread of serious pathogens of aquatic animals has been a concern to Southeast Asian countries for several decades (see Davy and Graham 1979, Davy and Chouinard 1983, Shariff 1987, Arthur and Shariff 1991, Arthur 1995). With the support of donor agencies such as the International Development Research Centre (Canada), the United States Agency for International Development (USAID), and the British Overseas Development Agency (ODA, now the Department for International Development (DFID)), several Southeast Asian countries began to establish quarantine and/or health certification procedures for aquatic animals in the late 1970s, and at least two (Indonesia and Malaysia) have devoted considerable national resources and effort to training quarantine officers and establishing quarantine holding facilities and supporting diagnostic laboratories.

As the current status of these national efforts will be reviewed during the individual country presentations, I will not discuss these national efforts in more detail. However, I would like to explore briefly why past quarantine efforts have not been effective in preventing the international spread of serious pathogens of aquatic animals, and how the concept of “risk” and the use of “risk analysis” can lead to the application of quarantine in more effective and cost efficient ways.

Why Have Southeast Asian Countries Had Difficulties in Implementing Quarantine?

Although the concept of quarantine is relatively simple, its effective implementation can be complex, due to the need for specialized infrastructure, capability and expertise. The efforts of countries such as Indonesia in Malaysia in attempting to implement quarantine for aquatic animals are laudable, and have certainly increased national capacity to diagnose diseases of aquatic animals and provided much basic infrastructure and expertise. However, it must be admitted that these efforts have not been as effective in preventing the entry of serious exotic diseases of fish, shellfish and molluscs as hoped. There is ample documentation of the inability of national governments of Southeast Asian countries to prevent the spread of exotic pathogens, such as epizootic ulcerative syndrome (EUS) of freshwater fish, white spot

syndrome virus (WSSV) of penaeid shrimp, and more recently, koi herpes virus (KHV) of koi and common carp and Taura syndrome virus of penaeid shrimp, which are discussed elsewhere in this volume.

The inability to prevent the entry and spread of exotic diseases has been due to a number of reasons, including:

- most importantly, the lag time between when a new disease emerges, when it is first recognized as a serious pathogen of international importance, and when accurate and reliable diagnostics tests are developed and become generally available;
- the diversity of forms in which trade occurs;
- the sheer volume of commodity traded;
- the lack of simple and accurate diagnostics tests for some pathogens (e.g., white tail disease of *Macrobrachium*); and
- the limited capital and human resources that governments are able to commit to this effort.

It must also be admitted that while various multinational and bilateral donor agencies have promoted the value of establishing quarantine programs to national governments in Southeast Asia, there has, until quite recently, been little technical guidance to assist governments in designing effective policy and approaches to aquatic animal disease control. Thus in the past, national governments have had difficulty defining the scope and purpose of quarantine within national aquatic animal health programs.

The Role of Quarantine in National and Regional Biosecurity

In the past, quarantine has often been seen as a separate activity, and as a procedure that should be applied to all imports of living aquatic animals, often with the unrealistic goal of “zero risk” of disease entry to the importing country. This thinking has changed considerably in the past 10 years, so that national governments are increasingly viewing quarantine as one component of a national aquatic animal health strategy. In Southeast Asia, the components of such a national program have been defined through a regional FAO/NACA TCP project that has the support of 21 countries in the Asia-Pacific and a number of international agencies. One of the major outputs of this program was the “Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation strategy” (FAO/NACA 2000). These guidelines, which outline an agreed-upon general approach and framework that countries in the Asia-Pacific should use in developing and implementing national programs to reduce the risk of pathogen transfers with live aquatic animals and their products, has been officially adopted as a policy document by the Association of South East Asian Nations (ASEAN). The guidelines act as a platform for greater cooperation and implementation of aquatic animal health management measures within the region and will be utilized in a wider context to support

the development of sustainable aquaculture in ASEAN (see <http://www.aseansec.org/13553.htm>).

The components of a national strategy for aquatic animal health are shown in Box 1. It can be noted that health certification and quarantine measures are key components that countries should consider when developing a national aquatic animal health strategy.

In cases where a risk assessment has determined that the level of risk associated with trade in a commodity exceeds the appropriate level of protection (ALOP) of the importing country, the importing country can then consider ways to reduce the risk to an acceptable level. The possible options for risk management will vary depending on the nature of the commodity and the individual hazard. Quarantine is one of the options that may be applied (Box 2).

Note that during the risk analysis, the management options for each hazard (pathogen) must be carefully evaluated as to their likely effectiveness, and the risk presented by the hazard reassessed based on the expected results. Figure 1 shows a summary of possible risk management steps recommended by the risk assessment for hypothetical movement of live cultured juvenile fish between two countries. In this scheme initial screening for viruses, external lesions and parasites is conducted in the exporting country. Fish that pass this initial inspection are then exported and upon arrival in the importing country, they are placed in quarantine, where they are held for further observation and tested for disease. Only batches of fish that have shown no evidence of disease are released from quarantine. It is important to note that this is a working procedure for routine importation of juvenile fish, not a procedure for the introduction of an exotic species. Previous experiences with the supplier, and a good knowledge of the history of the stock and of the capabilities of the Competent Authority in the exporting country will also increase confidence in the health status of the imported animals.

Box 1. The components of a National Strategy for Aquatic Animal Health (from FAO/NACA 2000).

- National pathogen list
- Disease diagnosis
- Health certification and quarantine measures
- Disease zoning
- Disease surveillance and reporting
- Contingency planning
- Import risk analysis
- National strategies and policy frameworks
- National and regional capacity building

Box 2. Some examples of risk management measures for importations of living aquatic animals (from Arthur *et al.* 2004).

- Sourcing from stocks of known disease status, including the use of specific pathogen free (SPF) stocks
- Importing eggs only
- Requiring quarantine and inspection in the country of origin
- Requiring quarantine and testing within the receiving country
- Using International Council for the Exploration of the Sea (ICES) protocols
- Requiring the use of specific diagnostic tests and standards
- Requiring preshipment and/or postshipment treatments

The Basic Requirements of Effective Quarantine

The basic requirements for effective quarantine include:

- Adequate physical infrastructure appropriate to the level of containment required (secure facilities, secure intake water source, etc.);
- Established operating protocols (including chain of custody); and
- Well-trained staff.

Detailed information on the requirements for setting up and operating quarantine facilities for exotic species and for routine ornamental fish trade are given by MAFF (2001), AQIS (2003) and Arthur (2003).

The necessary supporting services for quarantine include:

- Adequate legislation;
- Effective enforcement (e.g., border customs and inspection, postborder follow up);
- Knowledgeable and supportive aquaculture industry;
- Sufficient political will;
- Competent and readily available diagnostics support;
- Existence of reliable diagnostics tests for major pathogens;
- Good working relationships between importing and exporting country Competent Authorities;
- Good knowledge base of pathogens present in importing country (surveillance and monitoring, disease surveys); and
- Good information base on pathogen biology, prevention, treatment, etc.

Conclusions

Consideration of quarantine is a fundamental activity when setting up a National Aquatic Animal Health Strategy. Quarantine may be highly important to some countries having significant aquaculture, capture fisheries and/or natural biodiversity. In other cases, national situations may make quarantine a low priority or an unnecessary activity.

For most country situations, quarantine need not be applied generally. Whether or not to require quarantine should be determined based on the results of a risk analysis for each commodity or situation. In some cases, risk analysis may show that quarantine of a given commodity is not required to achieve the national ALOP, while in others, less costly and/or less restrictive measures may be equally effective.

The responsibility for establishing a quarantine facility (e.g., whether private sector or government), the place of quarantine (preborder or border) and the stringency of quarantine (level of security, duration, testing, etc.) should also be decided on a case by case basis based on the nature of the importation. Importations of exotic species for aquaculture development, because of the high likelihood of introducing serious pathogens and the extensive economic, biological and social damage such pathogens may cause,

will require more stringent quarantine measures than, for example, routine importations of strictly ornamental species.

References

- Alimon SB, Vijiarungam AF, Ming TT, Yahya MTBM, Shariff M. 1983. Country Report. Malaysia. p. 31-34. *In*: Davy FB, Chouinard A. (eds) Fish Quarantine and Fish Diseases in Southeast Asia. Report of a workshop held in Jakarta, Indonesia, 7-10 December 1982. Intern. Developm. Res. Centre Publ. IDRC-210e, Ottawa.
- AQIS. 2003. Quarantine premises criteria. 7.1 Fresh water and marine ornamental fin fish. Quarantine Premises Register, Class Criteria. Class 7.1, 22/06/2003, 6 p.
- Arthur JR (ed). 1987. Fish quarantine and fish diseases in South and Southeast Asia: 1986 update. Report of the Asian Fish Health Network Workshop held in Manila, The Philippines, 30 May 1986. Asian Fish. Soc. Spec. Publ. No. 1, 86 p.
- Arthur JR. 1995. Efforts to prevent the international spread of diseases of aquatic organisms, with emphasis on the Southeast Asian region. p. 9-25. *In*: Shariff M, Arthur JR and Subasinghe RP (eds) Diseases in Asian Aquaculture II. Asian Fish. Soc., Fish Health Sect., Manila.
- Arthur JR. 2003. Draft Aquaculture (Import and Export) Regulations and Annexures. Project TCP/NAM/0168(A) Assistance in Establishing a Legal Framework for Responsible Aquaculture Development, Food and Agriculture Organization of the United Nations, Rome, 99 p.
- Arthur JR, Bondad-Reantaso M, Baldock FC, Rodgers CJ, Edgerton BF. 2004. Manual on Risk Analysis for the Safe Movement of Aquatic Animals (FWG/01/2002). APEC/DoF/NACA/FAO, 59 p. APEC Publ. No. APEC #203-FS-03.1.
- Arthur JR, Shariff M. 1991. Towards international fish disease control in Southeast Asia. *Infofish Intern.* 3/91: 45-48.
- Bernoeth E-M. 1998. Australia. p. 10-11. *In*: First Training Workshop of the FAO/NACA/OIE. Regional Programme for the Development of Technical Guidelines on Quarantine and Health Certification, and Establishment of Information Systems, for the Responsible Movement of Live Aquatic Animals in Asia, Bangkok, Thailand, 16-20 January 1998. Food and Agriculture Organization of the United Nations, Network of Aquaculture Centres in Asia-Pacific, and Office International des Epizooties, Bangkok, TCP/RAS/6714, Field Doc. No. 1.
- Davy FB, Graham M (eds). 1979. Diseases of fish cultured for food in Southeast Asia. Report of a workshop held in Cisarua, Bogor, Indonesia,

28 November - 1 December 1978, Intern. Develop. Res. Centre Publ. IDRC-139e, 32 p.

FAO/NACA. 2000. 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 402, 53 p.

FAO/NACA. 2001. Manual of procedures for the implementation of the Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals. FAO Fisheries Technical Paper 402/1, 106 p.

MAFF. 2001. Transitional facilities for ornamental fish and marine invertebrates. MAF Biosecurity Authority, Animal Biodiversity, Standard 154.02.06, Ministry of Agriculture and Forestry, Wellington, 23 March 2001, 30 p.

OIE. 2003. International Aquatic Animal Health Code. 6th edn. Office International des Épidémiologies, Paris. (http://www.oie.int/eng/normes/fcode/a_summry.htm)

Shariff M. 1987. Current status of programs for fish health certification and quarantine systems. p. 48-52. *In*: Arthur JR (ed) Fish quarantine and fish diseases in South and Southeast Asia: 1986 update. Report of the Asian Fish Health Network Workshop held in Manila, The Philippines, 30 May 1986. Asian Fish. Soc. Spec. Publ. No. 1.

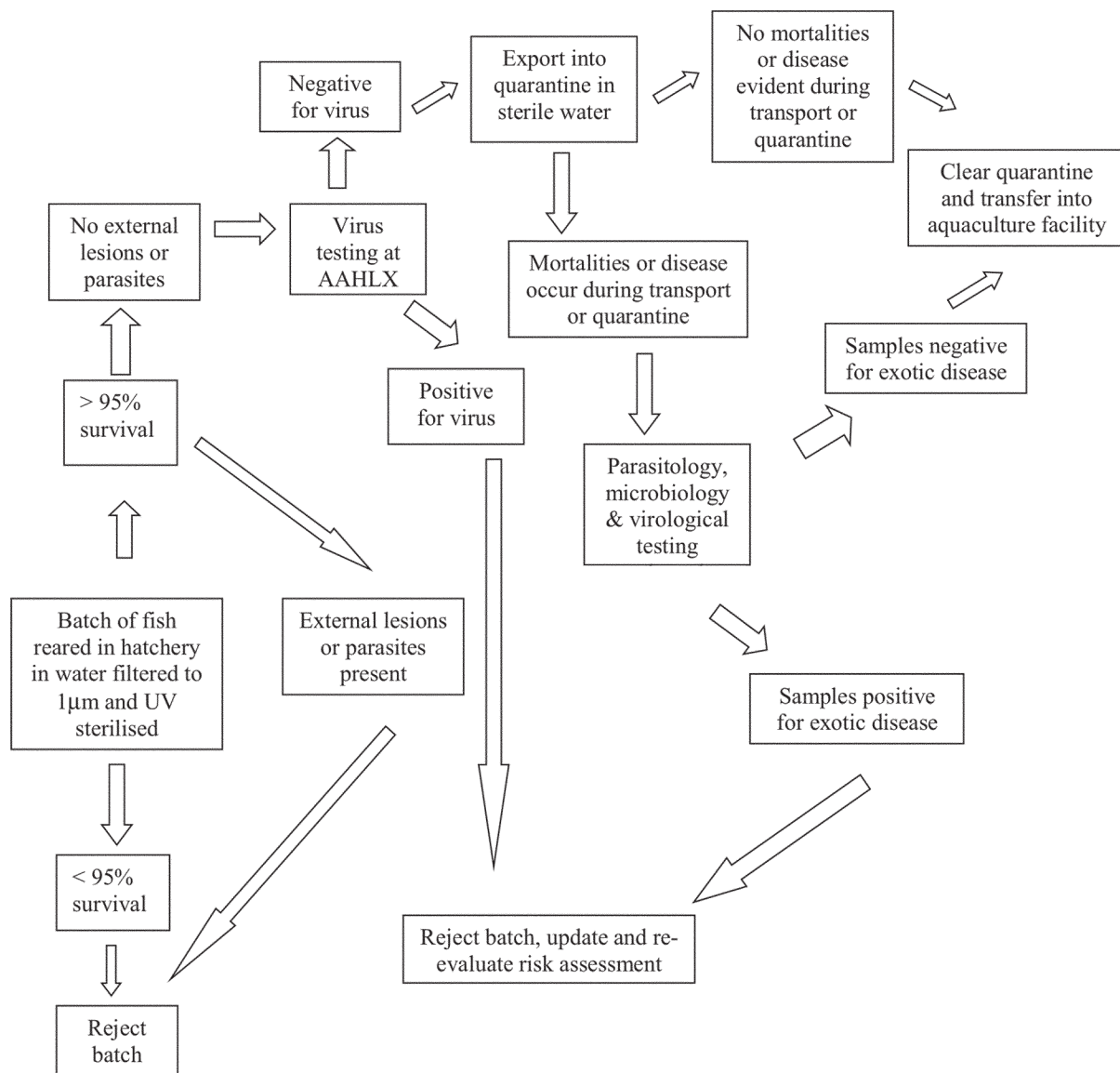


Fig. 1. Summary of the risk management steps recommended by a risk assessment for movement of live cultured juvenile fish from Country X to Country Y. (AAHLX = Aquatic Animal Health Laboratory, Country X) (from Arthur *et al.* 2004).

The Role of the Office International des Epizooties (OIE) in Health Improvement of Aquatic Animals

Yoshiyuki Oketani

*OIE Regional Representation for Asia and the Pacific
East 311, Shin Aoyama Building, 1-1-1 Minami Aoyama
Minato-ku, Tokyo 107-0062, Japan*

History of OIE in Aquatic Animal Health

The World Organisation for Animal Health (OIE) is an inter-governmental organization that was established in 1924 in order to promote world animal health. OIE missions that have become increasingly important and its mandate that has been expanded to meet requirements from the world are strongly supported by the Member Countries now reaching 167. OIE Regional Offices have been established in Tokyo, Buenos Aires, Beirut, Sofia and Bamako covering Asia and the Pacific, the Americas, the Middle East, Eastern Europe and Africa.

The main objectives of the OIE are:

- 1) To ensure transparency in the global animal disease situation;
- 2) To collect, analysis and disseminate scientific veterinary information;
- 3) To contribute expertise and encourage international solidarity in the control of animal diseases;
- 4) Within its mandate under the WTO SPS Agreement, to safeguard world trade by publishing health standards for international trade in animals and animal products;
- 5) To improve the legal framework and resources of Veterinary Services; and
- 6) To provide a better guarantee of the safety of food of animal origin and to promote animal welfare through a science-based approach.

Previously, aquatic animals were included in the category of terrestrial animals. The initial body of the current OIE Aquatic Animal Standards Commission was established in 1960 under the name of “Commission for the Study of Diseases of Fishes” and since then the Commission has organized scientific symposia regularly (in Turin in 1962, in Munich in 1965, in Stockholm in 1968, and in Paris in 1991, 1995 and 2000). The symposia

have been held under the auspices of the OIE on the most important aspects of aquatic animal health, notably on fish diseases and their control.

In 2000, OIE published for the first time the Aquatic Animal Health Code and the Manual separately from those for terrestrial animals. Diagnostic procedures for some aquatic animal diseases used to be included in the OIE International Animal Health Code starting from the 1986 edition, but it became clear that separate publications specific to Aquatic Animal Health would be needed for reasons that the conditions, problems and requirements in this field are different from those encountered in other animals, and that international trade in aquatic animals and their products has become increasingly important.

Aquatic Animal Health Standards Commission

Presently, the OIE Aquatic Animal Health Standards Commission is in operation in Paris as one of the Specialist Commissions. This Commission, which consists of five elected members (presently from Australia, the United Kingdom, Chili, France and Uganda) experienced in methods for surveillance, diagnosis, control and prevention of infectious aquatic animal diseases, meets twice yearly to address its work program. The Aquatic Animal Health Standards Commission also collaborates closely with the OIE Terrestrial Animal Health Standards Commission on issues requiring harmonized approach, and with the Biological Standards Commission and the Scientific Commission to ensure that the Aquatic Animal Health Standards Commission is using the latest scientific information in its work.

Disease Notification

Once an infectious animal disease occurs in a country, many people including producers, government officials, policy makers, exporters, importers and consumers require accurate information as quickly as possible.

The OIE has worked to secure transparency in the global animal disease situation, and collection, analysis and dissemination of scientific information. To accomplish this purpose, OIE Member Countries have obligations for disease notification, by fax or e-mail, within 24 hours, of the suspected or confirmed first occurrence or re-occurrence of the OIE list A diseases. Every Member Country of the OIE recognizes the right of the OIE to communicate directly with the Veterinary Administration of its territory.

In 2003, 61 emergency alert messages from 46 Member Countries were sent by e-mail to the Delegates of Member Countries, OIE Regional Representatives and other interested international organizations, or by fax to Member Countries without an e-mail address. This information was also disseminated via the OIE public access Web-site, the messages being systematically published in the “Alert Messages” section, and through the open access “OIE Info” mailing list.

When a serious infectious disease occurs, sometimes various rumors circulate and unconfirmed reports are accepted as facts. Therefore, people ask

for official information provided by responsible source. OIE receives official disease notification with the signature of the OIE Delegate directly from the relevant Member Country. Furthermore, OIE collects animal health information based on the active search policy, which is enhanced by exchanges of relevant information with OIE Reference Laboratories, Collaborating Centres and other international organizations. The information thus collected, including non-official information, is systematically evaluated before deciding whether to verify it with the Delegate of the relevant Member Country.

OIE information is recognized and used as official information in the world. Therefore, during the Avian Influenza crisis, more than 40,000 people visited the OIE Web-site in only one week. The OIE collaborates with the Food and Agriculture Organization of the United Nations (FAO), and the World Health Organization (WHO) with the design of a joint global early warning system. The OIE world animal health situation, lists of disease free countries, etc. are commonly used in Web-sites of these organizations as official information.

Disease Free Status

Official reporting is made by a Member Country not only when an infectious disease breaks out, but also when the disease is eradicated. If the country or a zone in the country was previously considered to be free from the particular disease, the Delegate will, with necessary documents including results of monitoring and surveillance, apply to the OIE to declare freedom from the disease.

So far, to meet the demand of the Member Countries, the OIE has been publishing the “Disease Free Country List” for Foot and Mouth Disease, Rinderpest, Bovine Pleuropneumonia, and now for Bovine Spongiform Encephalopathy (BSE).

In recent years, many Member Countries submitted formal applications for BSE free status to the Director General of the OIE. Those applications were evaluated by an ad hoc group of experts on BSE that has been set up, and also by the Scientific Commission. During the 72nd OIE General Session held in May 2004, the Director General established a list of BSE provisionally-free countries or zones in accordance with the chapters of the Terrestrial Code. The first countries listed as provisionally-free countries included Argentina, Uruguay, Iceland and Singapore.

Surveillance and Monitoring

So far, only OIE’s procedures about “disease notification” and “recognition of disease free status” using examples of some terrestrial animal diseases have been introduced. In both procedures, the official information as the result of monitoring and surveillance in accordance with the OIE Code and Manual are indispensable. Then, what kind of surveillance and monitoring are needed? According to the OIE definitions:

“Surveillance” means the continuous investigation of a given population to detect the occurrence of disease for control purposes, which may involve

testing of a part of population; and “Monitoring” constitutes on-going program directed at the detection of changes in the prevalence of disease in a given population and in its environment.

The ability of the animal health authorities to substantiate elements of the reports on the animal health situation in their country by surveillance data, results of monitoring program and details of disease history is highly relevant to the procedures of risk analysis. The science of epidemiology provides the foundation for surveillance and monitoring. A national epidemiological system should incorporate agent surveillance and monitoring, description of host population characteristics, and environmental assessment. An effective infrastructure is necessary to support this epidemiological system. Agent surveillance and monitoring may involve the clinical pathological examination of animals, the identification of pathogens, and the detection of immunological or other evidence of previous exposure of animals to pathogen.

The first step is early investigation of clinical diseases. Investigating the suspicious cases of animal diseases is one of the most important means of agent surveillance. Investigation may focus on exotic or new and emerging diseases within the country.

The next step is detection of agent and confirmation of disease prevalence. A complete epidemiological system may also require the screening of animals for OIE listed diseases having the major economic impact on trade in animals and animal products, as appropriate to the animal health situation of the country.

Now, the Asia-Pacific region is producing approximately 79% in value and 88% in volume of aquaculture worldwide. Nevertheless, the aquatic animal sector in the region is not as well provided with professional health services. It appears that, while aquaculture has been growing rapidly in many countries, there has been no matching expansion of the supporting aquatic animal health infrastructure. However, there is a relatively good coverage of aquatic animal health at international conferences, hands-on trainings, seminars and timely symposia on particular diseases organized by SEAFDEC, OIE, FAO and other organizations.

Recently, the following Conferences and Training course were held:

- OIE International Conference on Risk Analysis in Aquatic Animal Health, held in Paris in 2000;
- SEAFDEC Hands-on Training for Important Viral Diseases of Shrimps and Marine Fish, held in Iloilo, 2002 and 2003; and
- SEAFDEC/OIE/FRA/MAFF Japan International Symposium on Koi Herpesvirus Disease, held in Yokohama in 2004.

Reference Laboratory

With the aim to diagnose each OIE listed diseases, 15 fish disease institutes, 4 mollusc disease institutes and 2 crustacean disease institutes have been given the qualification as OIE Reference Laboratories in the world. The list includes 3 fish disease institutes located in the Asian region.

OIE Aquatic Code

The International Aquatic Animal Health Code contains health recommendations relative to international trade in aquatic animals and aquatic animal products. The practical application of OIE recommendations relating to international trade requires, in particular, the importing country to conduct risk analysis, preferably in liaison with the exporting country.

The aim of the Aquatic Animal Health Code is to assure the sanitary safety of international trade in aquatic animals (fish, molluscs and crustaceans) and their products. This is achieved through the detailing of health measures to be used by the Veterinary Administrations and Competent Authorities in the importing and exporting countries to avoid the transfer of agents pathogenic for animals or humans, while avoiding unjustified sanitary barriers.

The health measures in the Aquatic Code (in the form of standards, guidelines and recommendations) have been formally adopted by the OIE International Committee and the General Assembly of all Delegates of OIE Member Countries, which constitute the organization's highest decision-making body.

The development of these standards, guidelines and recommendations is the result of the continuous work of the OIE Aquatic Animal Health Standard Commission. This Commission draws upon the expertise of internationally renowned specialists to prepare draft texts for new chapters of the Aquatic Animal Health Code or revise existing chapters in light of advances in veterinary science. The views of the Delegates of Member Countries are systematically sought through the circulation of draft and revised texts. The value of the Aquatic Animal Health Code lies in the fact that measures published in it are the result of consensus among the OIE Member Countries.

OIE Aquatic Manual

The purpose of the Manual of Diagnostic Tests for Aquatic Animals is to provide a uniform approach to diagnosis of diseases listed in the OIE Aquatic Animal Health Code so that the requirements for health certification, in connection with trade in aquatic animals and their products, can be met. Also many publications exist on the diagnosis and control of aquatic animal diseases. The Aquatic Manual is a key document describing the methods that can be applied to the OIE listed diseases in aquatic animal health laboratories all over the world, thus increasing efficiency and promoting improvements in aquatic animal health worldwide.

OIE as an International Standard Setting Organization

The World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) conferred on the OIE new responsibilities under international law by specifying "the

standards, guidelines and recommendations developed under the auspices of the OIE” as the international standards for animal health and zoonoses. The SPS Agreement is aimed at establishing a multilateral framework of rules and disciplines to guide development, adoption and enforcement of sanitary measures in order to minimize their negative effects on international trade. Guidelines for conducting risk analyses are described in the Aquatic Animal Health Code. The Code thus forms an integral part of the regulatory reference system established by the WTO.

Conclusion

Effective realization of disease control needs to be based on accurate disease information resulting from well-designed surveillance and monitoring schemes. Especially with reference to trans-boundary animal diseases, a single country could not necessarily accomplish to prevent and control of such diseases. In order to carefully plan surveillance and monitoring schemes which would be acceptable worldwide, the OIE Aquatic Code and Manual should be referred to as the global standards. The OIE Regional Representation based in Tokyo will work with the Member Countries, SEAFDEC and relevant organizations for aquatic animal disease control.

Research and Training on Fish Diseases at the SEAFDEC Aquaculture Department in 2000-2004: A Review

Kazuya Nagasawa

*Southeast Asian Fisheries Development Center, Aquaculture Department
Tigbauan 5021, Iloilo, Philippines*

Abstract

This paper reviews various research and training activities on fish diseases at the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) in Iloilo, Philippines. The activities were implemented through the “Regional Fish Disease Project” of the Government of Japan Trust Fund starting in March 2000. A total of 29 research studies were conducted from 2000-2004 in the following aspects: (1) establishment and standardization of diagnostic methods; (2) biology and pathogenesis of disease pathogens; (3) disease prevention and control; (4) establishment of evaluation methods for residual chemicals in aquaculture products; and (5) epizootiology and prevention of koi herpesvirus disease. Some of these studies were conducted by scientists from the Department of Fisheries in Thailand, and from the Marine Fisheries Research Department (MFRD) of SEAFDEC in Singapore. Two sessions of hands-on training on “Important Viral Diseases of Shrimp and Marine Fish” was implemented in 2002 and 2003. Participants from the SEAFDEC member countries were funded by the project to attend the training course. The course consisted of both lecture and practical hands-on sessions. The latter focused on the use of molecular tools and other important techniques in the diagnosis of viral diseases of shrimp and marine fish. This review also provides information on publications such as proceedings, manuals, review articles, scientific papers, terminal report, annual reports, flyers, pamphlets and others as the outputs of research activities and international meetings that were organized with financial support from the project.

Introduction

Fish disease is a major constraint and threat to aquaculture production in Southeast Asia. Numerous infectious diseases have been reported from fish and shrimp cultured in this region. Currently, several new diseases have

emerged in the region. These diseases cause mass mortality of cultured species, resulting in devastating losses to the regional aquaculture production. Various chemicals including antibiotics, pesticides, disinfectants and others are often used to control fish diseases in the region. There is, however, a need to ensure that aquaculture products are safe for humans since the presence of chemical residues can negatively affect international trade of the products.

Since the year 2000, the “Regional Fish Disease Project” has been implemented at the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) in Tigbauan, Iloilo, Philippines to address various regional fish disease problems and food safety issues through the Government of Japan (GOJ) Trust Fund. The first phase of the project entitled “Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds” started in 2000 and will end in 2004. It was initially planned to end in 2003, but was extended to 2004 because of the urgent need to study an emerging viral disease of common carp and koi (*Cyprinus carpio*) (= koi herpesvirus [KHV] disease), which was reported in Indonesia and Taiwan in 2002 and Japan in 2003. After this 5-year project, the second phase of the Regional Fish Disease Project entitled “Development of Fish Disease Surveillance System” has been proposed for another 5 years duration (2004 to 2008). The project is being conducted as one of the collaborative projects of the ASEAN-SEAFDEC Fisheries Consultative Group (FCG).

This paper reviews the activities under the Regional Fish Disease Project from 2000 to 2004, focusing on research and training conducted at the SEAFDEC Aquaculture Department.

Objectives and Activities of the Regional Fish Disease Project

The Regional Fish Disease Project supported by the GOJ Trust Fund aims to: (1) assist the health development in aquaculture in Southeast Asia; (2) promote the healthy and wholesome trading of aquaculture products in the region; and (3) develop a fish disease surveillance network in the region.

To achieve these objectives, the project conducted the following activities from 2000-2004:

1. *Research.* The specific objectives of research were to (1) develop standardized diagnostic methods for major diseases affecting economically important aquaculture species in the region; (2) develop effective prevention and control measures against microbial and parasitic diseases; (3) assess the pathogenesis of newly emerging diseases; and (4) develop monitoring methods for residual chemicals in aquaculture products.
2. *Hands-on training.* This activity was specifically aimed at developing and enhancing capability in aquatic animal health diagnosis and management of technical staff working at research centers and institutions in the region.

3. *International meetings.* These were conducted to (1) discuss the status of fish disease problems in the region, the available diagnostic methods, and prevention and control measures; (2) discuss the results of research studies conducted under the project and those generated in other regions; (3) identify and discuss aquatic animal disease issues to be solved further for sustainable aquaculture growth; and (4) discuss collaboration with other international organizations such as the Office International des Épizooties (OIE).
4. *Extension.* This activity was done to disseminate research results and technology generated by the project through (1) training courses on fish diagnosis and health management; (2) production of manuals; (3) publication of primary results in international scientific journals; (4) international meetings; and (5) sampling and field visits.

To coordinate and promote the project, two Japanese fish disease experts were dispatched to the SEAFDEC Aquaculture Department as long-term experts by the Japan International Cooperation Agency (JICA). Dr. Yasuo Inui worked as the first expert from March 2000 to March 2003, and the second expert, Dr. Kazuya Nagasawa acted as the project leader from April 2003 to date.

Research during the First Phase of the Project (2000 - 2004)

Research is the main activity component of the Regional Fish Disease Project. When the project started in 2000, it was undertaken only by scientists of the SEAFDEC Aquaculture Department. Subsequently, scientists from three research institutions under the Department of Fisheries in Thailand and those of the SEAFDEC Marine Fisheries Research Department (MFRD) in Singapore joined the project in 2001 and 2002, respectively.

During the period from 2000 to 2004, a total of 29 research studies were conducted in the following five categories:

A. Establishment and Standardization of Diagnostic Methods

In Southeast Asia, various viral diseases have been reported from cultured shrimp and fish, causing devastating losses in aquaculture production. White spot syndrome (WSS) of black tiger shrimp (*Penaeus monodon*) and viral nervous necrosis (VNN) of marine fish are well known examples of such viral diseases affecting aquaculture in the region. The research in this category was undertaken to establish and standardize diagnostic techniques, such as PCR (polymerase chain reaction) methods for viral diseases, which are applicable and practical in the region. Some research studies surveyed the distribution, occurrence and prevalence of important viral diseases. There was also a study to prevent and control VNN infection in the marine finfish hatchery.

1. Standardization of diagnostic methods for viral diseases of shrimps (SEAFDEC Aquaculture Department [AQD], 2000)

2. Standardization of PCR technique as the detection method for WSSV infection in *Penaeus monodon* (SEAFDEC/AQD, 2001)
3. Development of shrimp cell culture *in vitro* (Marine Shrimp Research and Development Center [MSRDC], Thailand, 2001-2002)
4. Standardization of diagnostic methods for monodon baculovirus (MBV) and hepatopancreatic parvovirus (HPV): Establishment of monoclonal antibodies (MAbs) against MBV and HPV (SEAFDEC/AQD, 2001-2003)
5. Epizootiology of economically important viral diseases of wild *Penaeus monodon* (SEAFDEC/AQD, 2001-2003)
6. Viral diseases of cultured marine fishes in Southeast Asia
 - 6-1. Detection and identification of viral pathogens in cultured marine finfishes in the Philippines (SEAFDEC/AQD, 2000-2003)
 - 6-2. A viral survey in diseased grouper in Thailand using virus isolation and polymerase chain reaction (PCR) technique (Aquatic Animal Health Research Institute [AAHRI], Thailand, 2001-2002)
 - 6-3. Survey of iridoviral disease in freshwater fishes in Thailand (AAHRI, Thailand, 2003)
7. Establishment of preventive measures against viral nervous necrosis (VNN) in fish broodstocks: (1) grouper, (2) milkfish, (3) red snapper, and (4) sea bass (SEAFDEC/AQD, 2001-2003)

B. Biology and Pathogenesis of Disease Pathogens

Diseases caused by protozoan and metazoan parasites often cause mass mortality of cultured fish, and, like microbial agents, the parasites are important pathogens. However, there remains limited information available on fish parasites in Southeast Asia. For example, less than 10 % of more than 2,030 species of marine and freshwater fish in the Philippines have been examined for the parasites. There are only a few studies on the parasites of cultured fish in the region. The research in this category aimed to screen economically important fish for the presence of parasites, determine diagnosis and pathology of infections, and establish prevention and control methods.

1. Parasitosis in marine and freshwater fishes: diagnosis, pathology, prevention and control of infection
 - 1-1. Screening of important parasites in economically important aquaculture fish (SEAFDEC/AQD, 2000-2003)
 - 1-2. Biology and pathology of the gill monogenean parasitic to grouper (SEAFDEC/AQD, 2000-2003)
 - 1-3. Leech infestation and its associated blood parasitic protozoans (SEAFDEC/AQD, 2000-2003)
 - 1-4. Establishment/application of prevention and control methods against parasites (SEAFDEC/AQD, 2000-2003)
2. Study on parasites of groupers in Thailand (AAHRI, Thailand, 2001-2002)

3. Screening of important parasites of freshwater fish in Thailand and neighboring countries (AAHRI, Thailand, 2003)

C. Disease Prevention and Control

Luminous vibriosis caused by *Vibrio* spp., especially *V. harveyi*, is a major bacterial disease of black tiger shrimp cultured in Southeast Asia. The research studies were intended to develop husbandry techniques, such as the use of live bacteria (probiotics) and “green water” culture system, as alternatives for chemotherapy to control vibriosis. The “green water” culture system is the finfish-integrated shrimp culture system, utilizing finfish rearing water for shrimp culture. The mechanisms on how the system works to control vibriosis were analyzed.

1. Use of bacteria as biological control agent against microbial diseases in shrimp (*Penaeus monodon*) and crab (*Scylla serrata*) hatcheries (SEAFDEC/AQD, 2000-2003)
2. Screening of probiotics as biocontrol/bioremediation in the rearing of *P. monodon*. I. Tank experiment (SEAFDEC/AQD, 2001-2003)
3. Antibacterial metabolites in the microbial and phytoplankton flora of the “green water” cultured *Penaeus monodon* (SEAFDEC/AQD, 2000-2003)
4. Investigation on the mechanism of the effect of tilapia culture water on luminous bacteria (SEAFDEC/AQD, 2001-2003)
5. Screening of *Vibrio harveyi* bacteriophage for controlling luminous disease in marine shrimp hatchery (Samutsakhon Coastal Aquaculture Development Center [SCADC], Thailand, 2001-2003)
6. Development of immunological indices for monitoring health status in *P. monodon* (SEAFDEC/AQD, 2001-2003)

D. Establishment of Evaluation Methods for Residual Chemicals in Aquaculture Products

The presence of chemical residues in aquaculture products threatens human health. To ensure safe and healthy aquaculture products, a research activity addressed the development and standardization of detection methods of residual chemicals, especially pesticides and antibiotics, in aquaculture products. The usage of antibiotics in shrimp culture was also monitored.

1. Establishment and monitoring on antimicrobial usage in shrimp aquaculture (SCADC, Thailand, 2001-2003)
2. Detection of pesticide residues in aquaculture products (SEAFDEC/AQD, 2000-2003)
3. Detection of antibiotic residues in aquaculture products (SEAFDEC/MFRD, 2002-2003)

E. Epizootiology and Prevention of Koi Herpesvirus Disease

Koi herpesvirus (KHV) disease was found in common carp and koi cultured in Indonesia and Taiwan in 2002 and Japan in 2003. The disease caused mass mortality of the fish and became a new threat to freshwater aquaculture in Southeast Asia. The research studies were conducted to elucidate various aspects of KHV infection.

1. Transmission and control of koi herpesvirus (SEAFDEC/AQD, 2004)
2. Development of PCR-based detection method and phylogenetic analysis of koi herpesvirus isolated from Asian countries (SEAFDEC/AQD, 2004)
3. Histopathology of koi herpesvirus disease (SEAFDEC/AQD, 2004)
4. Hematology of carp infected with koi herpesvirus (SEAFDEC/AQD, 2004)
5. Determination of the virucidal effects of various disinfectants on koi herpesvirus (SEAFDEC/AQD, 2004)

Hands-on Training during the First Phase of the Project (2000 - 2004)

The Seminar/Workshop on “Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques” was convened by SEAFDEC and OIE in Iloilo City, Philippines on 4-6 December 2001. One of the major recommendations of the Seminar/Workshop was to conduct the international training course on diagnosis of viral diseases, which became the basis for the “SEAFDEC Hands-on Training for Important Viral Diseases of Shrimp and Marine Fish.” The implementation of the said training course was done at the SEAFDEC Aquaculture Department in collaboration with OIE and the Network of Aquaculture Centres in Asia-Pacific (NACA).

The objective of the training course was to provide executive training on the diagnosis of viral diseases to core persons from the SEAFDEC member countries and other interested participants. These persons were expected to serve as national trainers in their respective countries. The training course consisted of the first and second phases, which were held on 6-19 November 2002 and 5-21 November 2003, respectively, at the SEAFDEC Aquaculture Department. The same set of trainees was invited to attend the two phases, but there were new participants who replaced those who were unable to come for some reasons.

A total of 12 and 11 participants attended the first and second phases of the training course, respectively. The participants came from the SEAFDEC member countries (one from each country: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam) and other countries (China and India) although there was no participation from Brunei Darussalam in the second phase. All participants from the SEAFDEC member countries were funded by the Regional Fish Disease Project.

The first phase of the training course focused on the use of molecular tools and other important techniques in the diagnosis of viral diseases of

shrimp and marine fish, while the second phase was a continuation of the first phase, which then completed the two-year plan.

The 14-day course of the first phase consisted of lectures (11 hours or 15%) and practical activities (64 hours or 85%). Similarly, the 17-day course of the second phase was composed of 17 hours of lecture sessions (17.3%) and 81 hours practical activities (82.7%). Most of the lectures were done at the Research Division (RD) conference room. The practical activities were undertaken either at the Fish Health laboratory or in the Biotech laboratory. For the second phase, the participants brought shrimp and fish tissue samples from their respective countries for the laboratory activities.

The first phase of hands-on sessions included dissection and preservation of fish and shrimp samples, rapid detection methods for monodon baculovirus (MBV) and hepatopancreatic parvovirus (HPV) using hepatopancreas impression smears, histopathological analysis of viral diseases of shrimp and marine fish, extraction of nucleic acids (DNA and RNA) and detection of white spot syndrome virus (WSSV) and MBV in shrimp, and viral nervous necrosis virus (VNN) and iridovirus in grouper by one-step and nested polymerase chain reactions (PCR). The diagnostic techniques used were consistent with the standards set in the OIE's "Diagnostic Manual for Aquatic Animal Diseases" and the FAO's "Asia Diagnostic Guide to Aquatic Animal Diseases." Demonstrations on cell culture- and antibody-based detection methods for viruses were undertaken.

The second phase of the hands-on training consisted of preparation and preservation of tissue filtrates, cell culture passage, immune system parameters, histopathology, observation of virus using electron microscopy, detection of viruses by cell culture, antibody (Ab)-based detection of HPV and MBV, detection of MBV, WSSV, VNN and iridovirus using PCR. Demonstrations on histopathological slide preparation were also done.

In addition to these activities, all participants presented country reports describing the status of aquatic animal diseases and diagnostic capability in their respective countries and institutions.

Outputs

As the outputs of research and hands-on training activities and international meetings that were organized with financial support from the Regional Fish Disease Project, there are already publications available and many are in preparation for publication. These are listed under various categories below.

Proceedings

1. Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques (ed by Inui Y, Cruz-Lacierda ER), 2002, SEAFDEC Aquaculture Department, Iloilo. 215 p.
2. Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training (ed by Lavilla-Pitogo CR, Nagasawa K), 2004, SEAFDEC Aquaculture Department, Iloilo. 254 p.

Manuals

1. Borlongan I, Ng Poh Chuan J. 2004. Laboratory Manual of Standardized Methods for the Analysis of Pesticide and Antibiotic Residues in Aquaculture Products. SEAFDEC Aquaculture Department, Tigbauan, Iloilo. 46 p.
2. de la Peña LD, Lavilla-Pitogo CR. 2004. Control Measures against Important Viruses in Shrimp Hatchery with Emphasis on White Spot Syndrome Virus (WSSV). SEAFDEC Aquaculture Department, Iloilo. (in press).
3. de la Peña LD. 2004. Control Measures against Viral Nervous Necrosis (VNN) in Finfish Hatchery. SEAFDEC Aquaculture Department, Iloilo. (in press).
4. Lavilla-Pitogo CR, de la Peña LD. 2004. Health Management in Crab Hatchery System. SEAFDEC Aquaculture Department, Iloilo. (in press).
5. Nagasawa K, Cruz-Lacierda ER (eds). 2004. Diseases of Cultured Grouper. SEAFDEC Aquaculture Department, Iloilo. (in press).
6. Ruangpan L, Tendencia EA. 2004. Standardized Methods for Minimal Inhibitory Concentration Test and Determination of Antimicrobial Resistance for *Vibrio* Bacteria Isolated from Shrimp. SEAFDEC Aquaculture Department, Iloilo. (in press).

Review Articles

1. de la Peña LD. 2004. Transboundary shrimp viral diseases with emphasis on white spot syndrome virus (WSSV) and Taura syndrome virus (TSV). *In*: Lavilla-Pitogo CR, Nagasawa K (eds), Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Iloilo. p. 67-69.
2. Inui Y. 2002a. Fish disease control project of SEAFDEC Aquaculture Department. *In*: Inui Y, Cruz-Lacierda ER (eds), Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques. SEAFDEC Aquaculture Department, Iloilo, p. 181-185.
3. Inui Y. 2002b. Activities of the Fish Disease Project of SEAFDEC/AQD with relevance to shrimp disease control. *In*: Proceedings of the Third National Philippine Shrimp Industry Congress (Shrimp Congress 2002). 1-4 July 2002, Bacolod Convention Plaza Hotel, Bacolod City, Negros Occidental, Philippines. p. 60-64.
4. Lavilla-Pitogo CR, Torres PL. 2004. AquaHealth Online: A new learning environment for building capacity in aquatic animal health. *In*: Lavilla-Pitogo CR, Nagasawa K (eds), Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Iloilo. p. 53-66.
5. Lavilla-Pitogo CR, Catedral DD, Pedrajas SDG, de la Peña L. 2002. Selection of probiotics for shrimp and crab hatcheries. *In*: Inui Y, Cruz-Lacierda ER (eds), Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques. SEAFDEC Aquaculture Department, Iloilo, p. 136-150.

6. Lio-Po GD. 2004. Summary brief: International Symposium on Koi Herpesvirus Disease. *In: Lavilla-Pitogo CR, Nagasawa K (eds), Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Iloilo. p. 71-73.*
7. Lio-Po GD, Cruz-Lacierda ER, de la Peña LD, Maeno Y, Inui Y. 2002. Progress and current status of diagnostic techniques for marine fish viral diseases at the SEAFDEC Aquaculture Department. *In: Inui Y, Cruz-Lacierda ER (eds), Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques. SEAFDEC Aquaculture Department, Iloilo. p. 97-106.*
8. Lio-Po GD, Leano EM, Usero RC, Guanzon Jr. NG. 2002. *Vibrio harveyi* and the “green water culture” of *Penaeus monodon*. *In: Inui Y, Cruz-Lacierda ER (eds), Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques. SEAFDEC Aquaculture Department, Iloilo. p. 172-180.*
9. Nagasawa K. 2004. Background and objectives of the Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. *In: Lavilla-Pitogo CR, Nagasawa K (eds), Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Iloilo. p. 3-9.*
10. Nagasawa K. 2004. Research and training on fish diseases at the SEAFDEC Aquaculture Department in 2000-2004: a review. *In: Lavilla-Pitogo CR, Nagasawa K (eds), Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Iloilo. p. 41-52.*
11. Nagasawa K. 2005. Proposed activities for koi herpesvirus disease at the SEAFDEC Aquaculture Department. *Bull. Fish. Res. Agen., Supplement 2. (in press).*

Scientific Papers

1. Catap ES, Lavilla-Pitogo CR, Maeno Y, Travina RD. 2003. Occurrence, histopathology and experimental transmission of hepatopancreatic parvovirus (HPV) infections in *Penaeus monodon* postlarvae. *Diseases of Aquatic Organisms, 57: 11-17.*
2. Catap ES, Travina RD. 2004. Experimental transmission of hepatopancreatic parvovirus (HPV) infection in *Penaeus monodon* postlarvae. Proceedings of 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Queensland, Australia. (in press).
3. Cruz-Lacierda ER, Maeno Y, Pineda AJ, Matey VE. 2004. Mass mortality of hatchery-reared milkfish (*Chanos chanos*) and mangrove red snapper (*Lutjanus argentimaculatus*) caused by *Amyloodinium ocellatum* (Dinoflagellida). *Aquaculture, 236: 85-94.*
4. de la Peña LD, Lavilla-Pitogo CR, Namikoshi A, Nishizawa T, Inui Y, Muroga K. 2003. Mortality in pond-cultured shrimp *Penaeus monodon*

- in the Philippines associated with *Vibrio harveyi* and white spot syndrome virus. *Fish Pathology*, 38: 59-61.
5. Ho J-S, Kim I-H, Cruz-Lacierda ER, Nagasawa K. 2004. Sea lice (Copepoda, Caligidae) parasitic on marine fishes cultured in the Philippines. *Journal of the Fisheries Society of Taiwan*. (in press).
 6. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2002. Nodavirus infection in hatchery reared orange-spotted grouper *Epinephelus coioides*: first record of viral nervous necrosis in the Philippines. *Fish Pathology*, 37: 87-89.
 7. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2003. Development of control methods of factors suppressing sustainable production of aquaculture species: isolation of a piscine nodavirus from hatchery-reared sea bass *Lates calcarifer* in the Philippines. In: Ogawa Y, Ogata GY, Maeno Y, Shimoda T, Fujioka Y, Fukuda Y (eds), Sustainable Production Systems of Aquatic Animals in Brackish Mangrove Areas. JIRCAS Working Paper No. 35. Japan International Research Center for Agricultural Sciences (JIRCAS), Tsukuba, Japan. p. 81-87.
 8. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2003. Development of control methods of factors suppressing sustainable production of aquaculture species: experimental transmission of piscine nodavirus-induced viral nervous necrosis to the orange-spotted grouper *Epinephelus coioides*. In: Ogawa Y, Ogata GY, Maeno Y, Shimoda T, Fujioka Y, Fukuda Y (eds), Sustainable Production Systems of Aquatic Animals in Brackish Mangrove Areas. JIRCAS Working Paper No. 35. Japan International Research Center for Agricultural Sciences (JIRCAS), Tsukuba, Japan. p. 89-94.
 9. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2004. Mass mortalities associated with viral nervous necrosis in hatchery-reared sea bass *Lates calcarifer* in the Philippines. *Japan Agricultural Research Quarterly*, 38: 69-73.
 10. Moravec F, Cruz-Lacierda ER, Nagasawa K. 2004. Two *Procamallanus* spp. (Nematoda: Camallanidae) from fishes in the Philippines. *Acta Parasitologica*. (in press).
 11. Tendencia EA, de la Peña M. 2003. Investigation of some components of the greenwater system which makes it effective in the initial control of luminous bacteria. *Aquaculture*, 218: 115-119.
 12. Tendencia EA, de la Peña MR, Femin AC, Lio-Po G, Choresca, CH Jr, Inui Y. 2004. Antibacterial activity of tilapia *Tilapia hornorum* against *Vibrio harveyi*. *Aquaculture*, 232: 145-152.

Papers Presented at International and National Meetings

1. Catap ES, Travina R. 2002. Experimental transmission of hepatopancreatic parvovirus (HPV) infection in *Penaeus monodon* postlarvae. Abstracts of 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Queensland, Australia, p. 63.
2. Catap ES. 2003. Purification of monodon baculovirus (MBV) and hepatopancreatic parvovirus (HPV) virions from postlarval *Penaeus monodon*. Paper presented at the Philippine Society for Microbiology –

- Visayas Chapter 11th Annual Meeting and Regional Scientific Convention held in Cebu City, Philippines on October 23-24, 2003.
3. Cruz-Lacierda ER, Maeno Y, Pineda AJ. 2002. Occurrence and pathology of an *Amyloodinium*-like parasite on hatchery-reared milkfish (*Chanos chanos*). Abstracts of 10th International Congress of Parasitology, 4-9 August 2002, Vancouver, Canada, p. 85.
 4. Cruz-Lacierda ER, Maeno Y, Pineda AJ, Matey VE. 2003. Mass mortality of hatchery-reared milkfish (*Chanos chanos*) mangrove red snapper (*Lutjanus argentimaculatus*) caused by *Amyloodinium ocellatum* (Dinoflagellida). Paper presented at the Philippine Society for Microbiology-Visayas Chapter 11th Annual Meeting and Regional Scientific Convention held in Cebu City, Philippines on October 23-24, 2003.
 5. Erazo-Pagador G. 2002. Biology and pathogenicity of the gill monogenean (*Pseudorhabdosynochus* sp.) in grouper. Abstracts of 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Queensland, Australia, p. 113.
 6. Lavilla-Pitogo CR, Catedral DD, de la Peña LD, Inui Y. 2002. Evaluation of pathogenicity of bacterial strains in crustacean larvae by static bath: significance of monitoring bacterial counts. Abstracts of 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Queensland, Australia, p. 162.
 7. Lavilla-Pitogo CR, Catedral DD, de la Peña LD. 2003. Delivery of strain C1 probiotic bacteria through colonized *Placuna sella* shells and corrugated plastic sheets. Paper presented at the Philippine Society for Microbiology-Visayas Chapter 11th Annual Meeting and Regional Scientific Convention held in Cebu City, Philippines on October 23-24, 2003.
 8. Lio-Po GL, Peñaranda MD, Duray MN. 2002. Viral infections of hatchery-reared marine finfishes in the Philippines. Abstracts of 2nd International Symposium on Stock Enhancement and Sea Ranching, 28 January-1 February 2002, Kobe, Japan, p. 36.
 9. Lio-Po G, Franco A. 2003. Preliminary results on the comparative effects of two commercial probiotics on total bacterial counts and on luminous *Vibrio*. Paper presented at the Philippine Society for Microbiology-Visayas Chapter 11th Annual Meeting and Regional Scientific Convention held in Cebu City, Philippines on October 23-24, 2003.
 10. Maeno Y, de la Pena L, Cruz-Lacierda ER. 2002. Susceptibility of marine fish species to piscine nodavirus from orange-spotted grouper, *Epinephelus coioides* in the Philippines. Abstracts of 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Queensland, Australia, p. 46.
 11. Tendencia E. 2002. Effect of *Tilapia hornorum* on luminous bacteria *Vibrio harveyi*. Abstracts of 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Queensland, Australia, p. 172.

Terminal Report

1. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia: Terminal Report of the Regional Fish

Disease Project on “Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds” Supported by the Government of Japan Trust Fund (ed by K Nagasawa), 2005, SEAFDEC Aquaculture Department, Iloilo. (in press).

Annual Reports

1. Anonymous. 2001. Annual Report 2000 - Component: Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds. SEAFDEC Aquaculture Department, Iloilo. 64 p.
2. Anonymous. 2002. Annual Report 2001 - Component: Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds. SEAFDEC Aquaculture Department, Iloilo. 152 p.
2. Anonymous. 2002. Annual Report 2001 - Regional Fish Disease Program: Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds. SEAFDEC Aquaculture Department, Iloilo. 10 pp. (abstracted version).
4. Anonymous. 2003. Annual Report 2002: Component - Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds. SEAFDEC Aquaculture Department, Iloilo. 131 pp.
5. Anonymous. 2004. Annual Report 2003: Development of Fish Disease Inspection Methodologies for Artificially-Bred Seeds. SEAFDEC Aquaculture Department, Iloilo. 223 p.

Hands-on Training Reports

1. Cruz-Lacierda E. 2003. Terminal report on SEAFDEC hands-on training for important viral diseases of shrimp and marine fish in collaboration with OIE and NACA, 06-19 November 2002. SEAFDEC Aquaculture Department, Iloilo. 48 p.
2. Gonzales-Corre K. 2004. Terminal report on 2nd SEAFDEC hands-on training for important viral diseases of shrimp and marine fish in collaboration with OIE and NACA, 05-21 November 2003. SEAFDEC Aquaculture Department, Iloilo. 21 p.

Pamphlet

1. Sugiura S (ed). 2001. Trust Fund Highlights 2000. SEAFDEC, Bangkok. 28 pp.

Flyers

1. Anonymous. 2003. *Regional Fish Disease Project*. SEAFDEC Aquaculture Department, Iloilo.
2. Anonymous. 2003. *Living with White Spot Disease in Shrimp Farming*. SEAFDEC Aquaculture Department, Iloilo.

AquaHealth OnLine: A New Learning Environment for Capacity Building in Aquatic Animal Health

Celia R. Lavilla-Pitogo and Pastor L. Torres Jr.

Southeast Asian Fisheries Development Center

Aquaculture Department, Tigbauan 5021

Iloilo, Philippines

Abstract

Due to significant requirement of trained personnel in Fish Health Management, the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD) offered 14 sessions of face-to-face (F2F) training (1988–2002) at its station in Iloilo. However, shrinking fellowship and travel funds necessitated a shift in training paradigm. Thus, transformation of teaching materials used in F2F trainings resulted to AquaHealth Online, a team developed and electronically delivered course on Health Management in Aquaculture. The general objective of the course transformation was to train a large pool of geographically dispersed participants at minimum cost, and this paper reports on the experience earned in course development, delivery and outcome.

To enable Fish Health specialists to develop materials and skills to deliver courses for the online environment, SEAFDEC/AQD collaborated with the University of the Philippines Open University to help adapt, enhance, and reformulate materials in the F2F course for online delivery. The specialists underwent hours of training in “techno-pedagogy”, or ways of transforming teaching activities into formats that could be understood even in our absence. The primary learning resource is a CD-ROM that provides interactive information with self-assessment questions. The course covers 12 modules in 4 units: I. Introduction to Fish Health Management; II. Infectious Diseases of Fish and Crustaceans; III. Non-Infectious Diseases; and IV. Disease Diagnosis, Prevention and Control. Learning enhancement and discussion occurs through internet-based Discussion Boards (DBs) presided over by module specialists. The DBs serve as media for asynchronous discussions and makes a permanent record of lessons learned. When first offered in 2002, AquaHealth Online had 25 enrollees from

10 countries. In 2003, there were 17 participants from 8 countries. Participants were led to “just-in” relevant information and encouraged to submit assignments from internet resources. This course is an example that a state-of-the-art online course can be as effective as F2F training.

Introduction

Training on specialized subjects in aquaculture such as marine fish hatchery, freshwater aquaculture, nutrition and feed development, aquaculture management course, and many others were offered every year to participants from SEAFDEC member countries with funding for fellowships and travel from the Government of Japan. Training course delivery was through face-to-face (F2F) lectures, field trips and hands-on laboratory exercises. The Fish Health Management Training Course (FHMTTC) was offered for fourteen sessions and became one of the most sought-after and well-attended international classroom type training courses at the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD). This was due to the realization that no aquaculture venture would ever succeed without due consideration to proper health management practices and the emergence of serious infectious disease outbreaks from the late 1980s. While the demand for trained personnel in fish health management was sustained, SEAFDEC/AQD anticipated the worldwide trend of generalized reductions in the public funding of institutions, diminishing access to private and charitable donations (Abrioux, 2001) and the need to become more self-reliant in its course offerings. Thus, transformation of teaching materials used in F2F trainings resulted to a team developed and electronically delivered full course on Principles on Health Management in Aquaculture or AquaHealth Online. Elearning in the Philippines is relatively new and many requirements need to be in place to catch up with developments worldwide (Khanser, 2003).

Objectives of AquaHealth Online

AquaHealth Online is an elearning course targeting full-time working professionals. It enables learning to take place in different places, both physical and virtual. Through elearning, it is convenient and practical for a learner to acquire knowledge and skills in aquaculture health management at his own place and at his own time as long as a computer and an Internet access are made available to him to communicate with highly qualified teachers or with fellow learners. The general objective of the course was to ensure delivery of efficient training to a large pool of geographically dispersed participants at minimum cost. As with the F2F FHMTTC, AquaHealth Online’s goals remained the same wherein at the end of the course learners should be able to:

- RECOGNIZE diseased shrimps and fish;
- IDENTIFY the cause of the disease;
- EXPLAIN how a disease develops;

- APPLY preventive and control measures to lessen the risks posed by the disease;
- USE appropriate techniques for the preparation of samples for disease diagnosis.

The Course Transformation Process

The most effective learning, whether delivered as conventional F2F instruction or an elearning solution, is a result of careful planning and systematic design derived from the needs of the organization and its clients. In conceptualizing SEAFDEC/AQD's elearning courses, it was recognized that expertise in course transformation to elearning mode was generally lacking. Thus, collaboration with the University of the Philippines Open University (UPOU) and SEAFDEC/AQD was formalized through a Memorandum of Agreement whereby the former provided expertise and guidance needed in online course transformation. The project was spearheaded by the Training and Information Division with the cooperation of specialists and content experts from the Fish Health Section. An editor was assigned to see to it that course materials are expressed in a language suited for online delivery. UPOU provided expertise in instructional and graphic design. The team worked in a collaborative manner to develop the course, whereby specialists received constant support from the instructional designer to develop the course structure, create the course webpages, and package them in a CD-ROM.

A. The Fish Health Team

Twelve senior research staff of SEAFDEC/AQD contributed in the course development (Table 1). Seven have PhD degrees and majority have acted as lecturers in the F2F FHMTTC. Put together, their work experiences total 210 man-years of research and teaching in fish health and related disciplines. During the conceptualization of AquaHealth Online, many specialists were hesitant and got intimidated in delivering courses online completely. Issues on pedagogy have surfaced, but the team from the UPOU gave the necessary motivation and technical help in transforming the pedagogy of F2F instruction into online instruction materials. The specialists underwent a restructuring process with the goal of better preparing them to effectively integrate technology into their teaching and developing courses that make extensive use of Web-based technologies. This transformational process was to preserve the constructionist learning environment (Davies and Carbonaro, 2000) of the traditional course while at the same time optimizing the course delivery mode to make it more accessible to a wider audience of students.

B. Source of Course Materials

The transformation from F2F to elearning was not very difficult since basic students' references had already been transformed from loose handouts

Table 1. The specialists from SEAFDEC Aquaculture Department who comprised the AquaHealth online development team

Staff	Specialization	Highest Degree
Jesus Manolo E. Almendras	Larval Physiology of Fish, Immunology	M.Sc.
Elena S. Catap	Immunology, Fish Histopathology	Ph.D.
Romeo D. Caturao	Applied Marine Ecology	M.Sc.
Erlinda R. Cruz-Lacierda	Parasitology, Fish Histopathology	Ph.D.
Rogelio Q. Gacutan	Phycology, Plant Pathology	M.Sc.
Yasuo Inui	Fish Physiology	Ph.D.
Eduardo M. Leño	Mycology, Bacteriology	Ph.D.
Gilda D. Lio-Po	Virology, Bacteriology	Ph.D.
Gregoria E. Pagador	Histopathology	M.Sc.
Leobert D. de la Peña	Molecular Diagnostics, Bacteriology	Ph.D.
Celia R. Lavilla-Pitogo	Bacteriology, Shrimp Histopathology	Ph.D.
Eleonor A. Tendencia	Bacteriology	M.Sc.

to a well-illustrated textbook (Fig. 1) on Health Management in Aquaculture (Lio-Po, Lavilla and Cruz-Lacierda, 2001). The book has 187 pages, 11

chapters, and over 140 diagrams, tables, drawings and colored photographs to illustrate the principles. Instructional media had also been upgraded from 35 mm slides and transparencies to PowerPoint presentations and short film clips. The Fish Health Section team underwent hours of training in what we now know as “techno-pedagogy”, or ways of transforming teaching activities into multimedia formats that could be understood even in our absence. Thus, after “teacher training”, online course design, review of system’s capabilities, and provision of platform for online interaction, development of materials for AquaHealth online commenced.

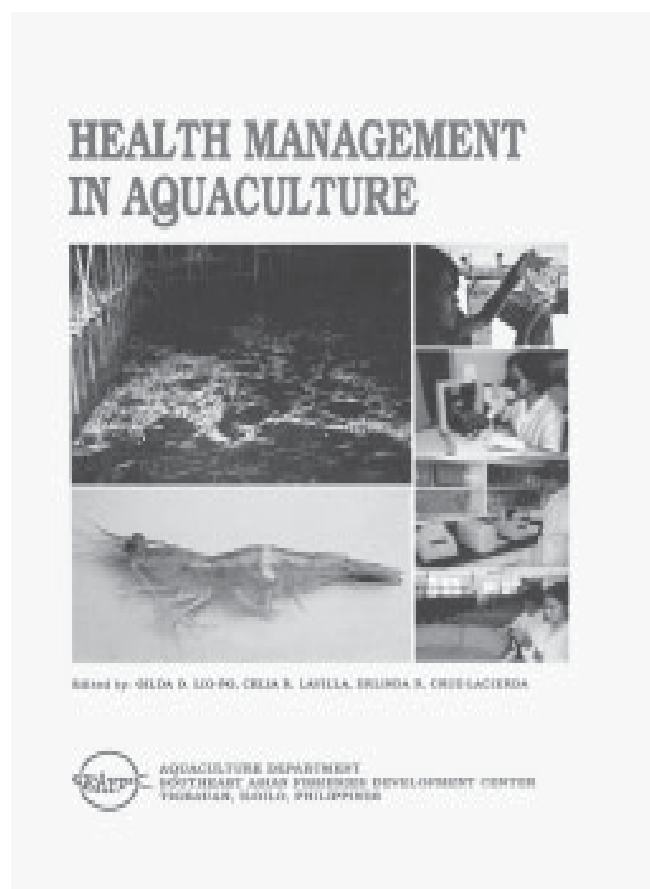


Fig. 1. The textbook on Health Management in Aquaculture edited by Lio-Po, Lavilla and Cruz-Lacierda (2001) that became the source of materials for the CD-ROM learning resource.

C. Course Design and Coverage

AquaHealth online covers up-to-date knowledge on fish and crustacean diseases, their causal organisms, and tried and tested methods of disease prevention and control. The course runs for a minimum of 16 weeks and is presented in 4 units consisting of 12 modules (Table 2). The duration of modules that deal with highly technical subjects was doubled allowing two weeks of discussion between the learners and the specialists.

The AquaHealth Online Learning Package

The advantage of an elearning package is that it not only provides a marriage of digital technology, Internet, and learning, but it also facilitates

Table 2. The units and modules of AquaHealth Online

Unit/Module	Title	Duration (weeks)
Unit 1	Introduction to Fish Health Management	
Module 1	Impact of Disease Development in Aquaculture	1
Unit 2	Infectious Diseases of Fishes and Crustaceans	
Module 2	Viral Disease	2
Module 3	Bacterial Diseases	1
Module 4	Fungal Diseases	1
Module 5	Parasitic Diseases and Pests	1
Unit 3	Non-Infectious Diseases	
Module 6	Nutritional Diseases	1
Module 7	Environmental and Other Non-Infectious Diseases	1
Module 8	Harmful and Toxic Algae	1
Unit 4	Disease Diagnosis, Prevention and Control	
Module 9	Histology as a Tool in Disease Diagnosis	1
Module 10	Serology and Molecular Techniques in Disease Diagnosis	2
Module 11	Immunity/Biological Methods of Disease Prevention/Control	2
Module 12	Physical/Chemical Methods of Disease Prevention/Control	1

learner-centered learning. The students are at the center of the teaching-learning process, and teachers act as mentors, navigators, facilitators, or “guides” to help the learners access, organize, construct, and transfer information to grasp the principles being imparted to them.

A. The AquaHealth Online CD-ROM

The FHMTTC materials that were transformed into interesting and easily learned modules were rendered by the UPOU multimedia specialists and packaged in a CD-ROM “Principles of Health Management in Aquaculture” (Fig. 2). This software provides our learners with basic interactive information. Every module contains several interactive self-assessment-questions (SAQs) that help students gauge their learning progress. Formulation of SAQs took into account design guidelines formulated by Race (1997). Each of the 12 modules was authored by at least one specialist in the field. Recognizing that the key component in an elearning approach is the students’ ability to obtain more information and research materials, online materials with hyperlinks to relevant websites were provided to encourage the learners to actively participate in the search for resources and answers to enhance their research and diagnostic skills.

B. Course Guide

A course guide (Fig. 3) was provided at the start of the course. The document provides the learner with the course basics: introduction, description, goals and objectives, outline, requirements (skills and equipment), manner of assessment (grading system), as well as activities for each chapter. Also in the document is a study schedule, instructions on navigating the CD-ROM, house rules and important contact numbers and addresses in case the learner needs technical support. Annexes are provided like Netiquette Guidelines, an introduction to the discussion platform in the Integrated Virtual Learning Environment (IVLE), starting discussions using the DBs, and submission of assignments and reports through the Workbin. The Course Guide also provides tips on how to become a successful online student and some frequently-asked-questions.



Fig. 2. The AquaHealth CD-ROM package containing the course modules that serves as offline learning resource

C. The Discussion Platform

The AquaHealth Online website used the IVLE structure hosted at the UPOU server (Fig. 4) and was accessible through links in the SEAFDEC/AQD or UPOU sites. The design of the course forum allowed discussion content to be accessible from any computer anywhere, as long as it was connected to the Internet with the user assigned account and password providing the gateway. The proposed structure consisted of a homepage with icons for establishing links to the course outline, schedule, content, email, discussion board, and technical support (Fig. 5). Interaction and exchange of ideas in each module was through the Discussions Boards (Fig. 6), each of which was mentored by at least one specialist. This set-up offered a semi-permanent record of what transpired during the module discussions. While absence in class is too conspicuous to ignore in face-to-face classrooms, an online student

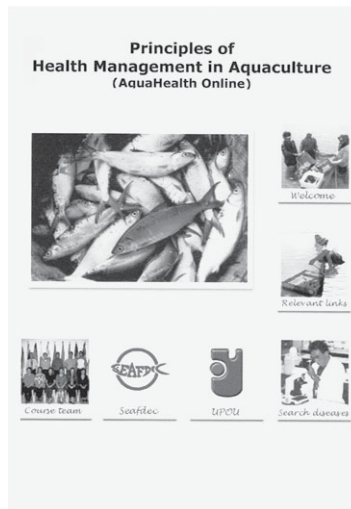


Fig. 3. The AquaHealth Online course guide

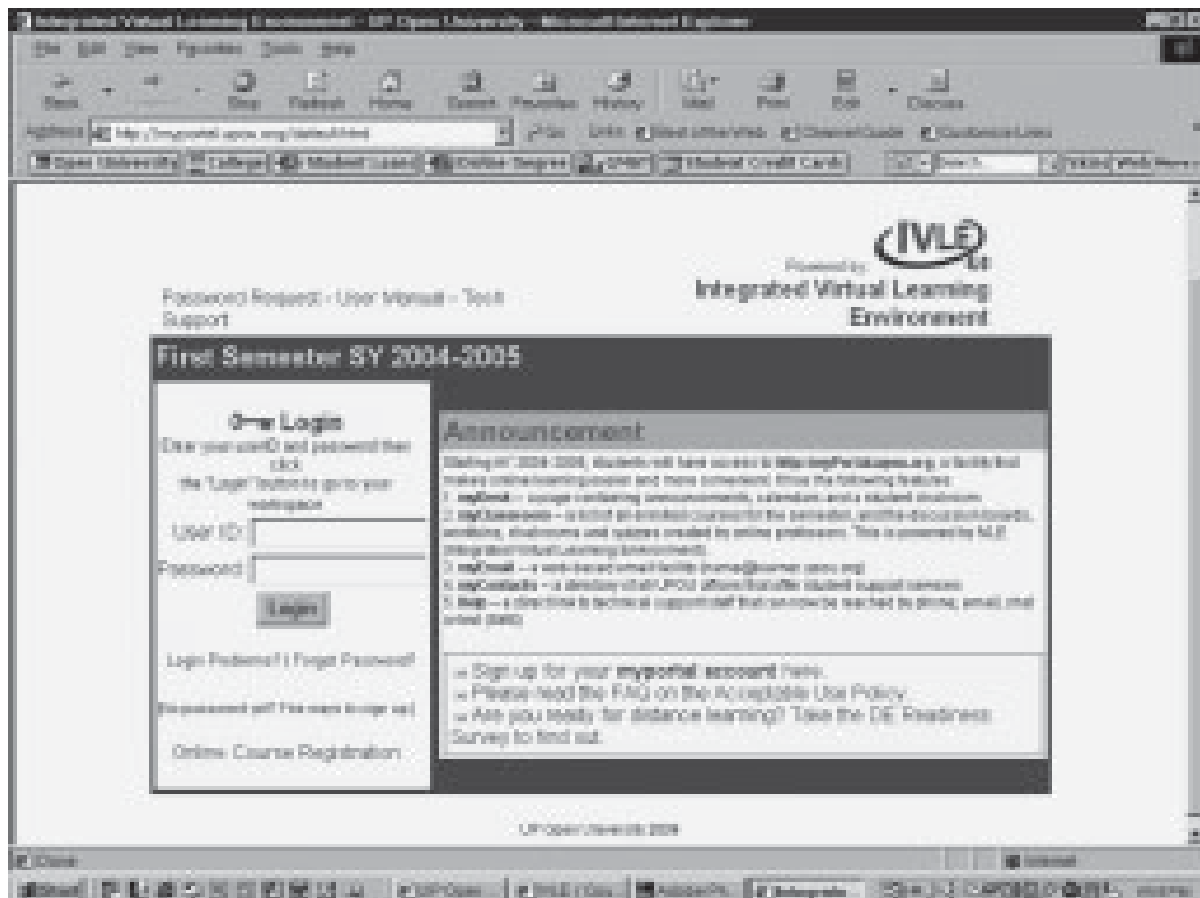


Fig. 4. The AquaHealth Online portal using the structure of the Integrated Virtual Learning Environment (IVLE)

always keeps tracks of discussion as long as the DBs remain posted. Asynchronous discussion and interaction through the DBs provide a permanent record of lessons learned as a result of interaction. Most importantly, the DB allowed for course material contents updates without necessarily revising the CD-ROM.

In addition to board postings, email was also used to inform learners about activities, grades, and reminders of upcoming deadlines and submissions. However, learners were not encouraged to use email as a platform for discussion in order not to disperse the sites where exchange of information is located. This is very important since discussion is asynchronous. class is too conspicuous to ignore in face-to-face classrooms, an online student always keeps tracks of discussion as long as the DBs remain posted. Asynchronous discussion and

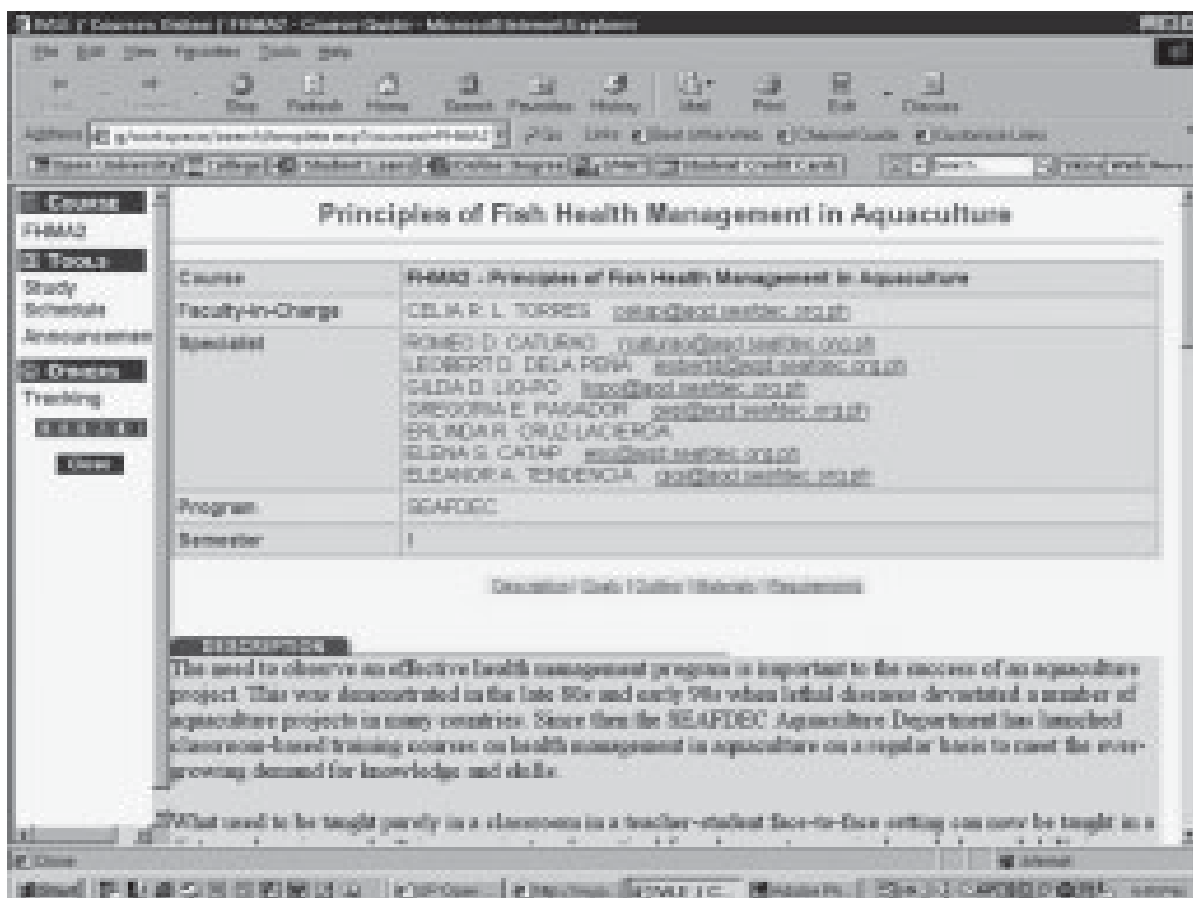


Fig. 5. The AquaHealth Online homepage

interaction through the DBs provide a permanent record of lessons learned as a result of interaction. Most importantly, the DB allowed for course material contents updates without necessarily revising the CD-ROM.

Recruitment of Trainees

When first offered in 2002, AquaHealth Online had 25 enrollees from 10 countries namely: Cambodia (2), Egypt (1), India (1), Indonesia (2), Malaysia

(2), Myanmar (2), Singapore (3), Thailand (2), Vietnam (3), and the Philippines (7). In 2003, there were 17 participants from 8 countries (Table 3). The Government of Japan provided fellowships for two participants each from 10 SEAFDEC member countries. They were nominated by their respective Directors to the SEAFDEC Council. Interestingly, 30% of

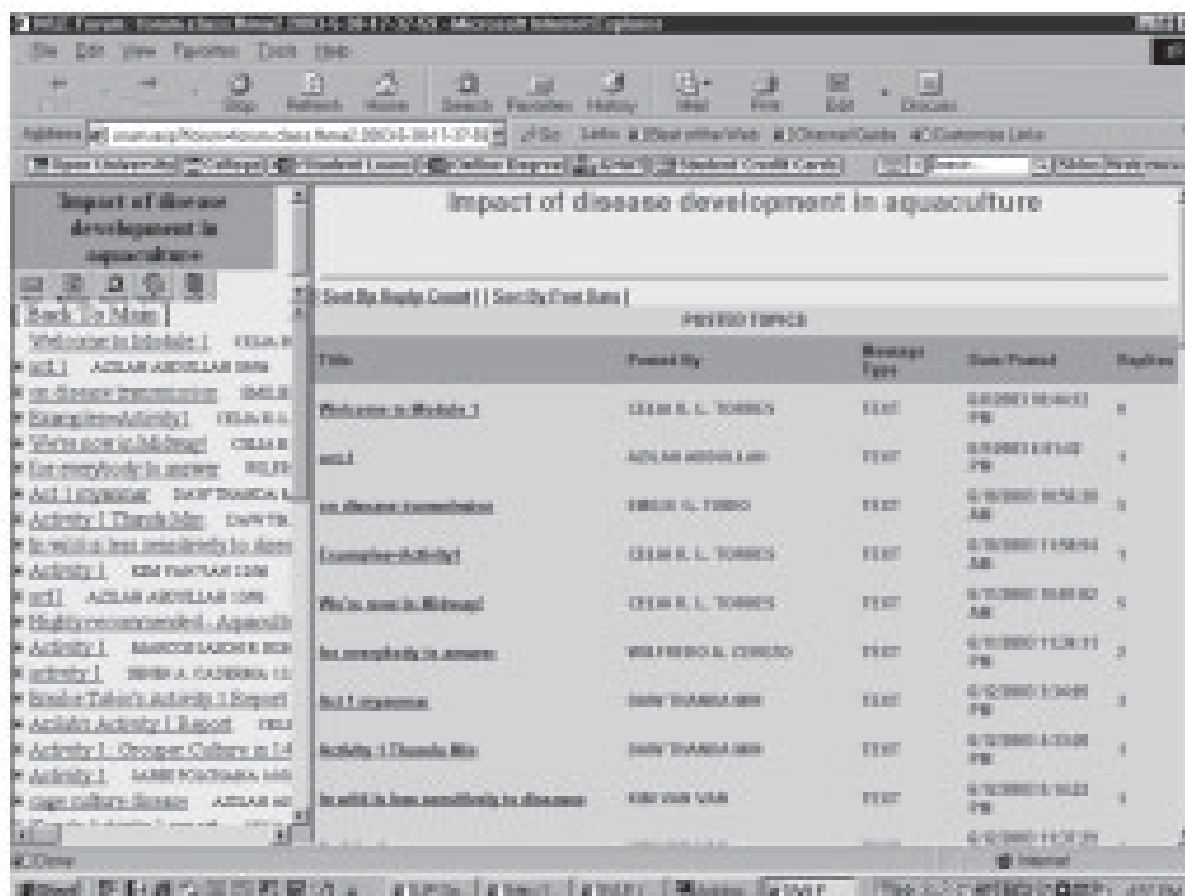


Fig. 6. The IVLE-based Discussion Board

participants in 2002 and 2003 are privately funded. The main requirement was that all learners must have taken a subject in college biology. The maximum number of learners at any time is set at 30. Overall, participants from 12 countries have participated in the course.

Conduct of the Course

Upon enrollment, learners were provided with User Identifications and Passwords that entitled them to enter the virtual classroom. Access to the virtual classroom was either through the SEAFDEC/AQD website at www.seafdec.org.ph or through UPOU's website at www.upou.org. Upon access to the course site, students "met" at the Café for Students where they introduced each other.

AquaHealth Online runs for 16 weeks where a designated specialist of a particular module encourages discussion and information exchange. A Course Officer moderates the whole process. Learners proceeded with the course as

Table 3. Profile of AquaHealth Online participants on its first two years of offering

	2002	2003
Total Number of Enrollees	25	17
GoJ* Fellowship	18	12
Private Funding	7	5
COUNTRY	Number of Participants	
Cambodia	2	0
Egypt	1	0
India	1	0
Indonesia	2	2
Malaysia	2	3
Myanmar	2	2
Oman	0	1
Philippines	7	4
Saudi Arabia	0	1
Singapore	3	0
Thailand	2	2
Vietnam	3	2
Age Range	20s to late 60s	20s to 40s
Male:Female	16:9	7:10

* Government of Japan

if they were in a classroom, except they face computer screens instead of instructors. Under the guidance of specialists, learners performed exercises individually or as a group and submitted reports of their work either through assigned workbins, by email or by posting them in the DBs for everyone's perusal. Group work was encouraged among learners from the same country to encourage F2F meetings, where possible. Most people learn better when computer-mediated lessons are combined with study groups, team exercises, and off-line events. Although computers can make aspects of learning more convenient, they do not eliminate the need for human intervention. In the first year, learners took examinations administered by proctors near the places of their work, but during last year's AquaHealth online, essay type or investigative take-home examinations were given. Of utmost importance was the unlimited interaction among learners, sharing insights and experiences, enhancing further the learning process.

Together with learning the principles of health management in aquaculture, AquaHealth learners enhanced their basic computer skills.

Learners found the interactive SAQs and tests in the CD engaging. Those who could not hold the mouse prior to the course, learned to access the IVLE website, took active part in the discussion forum, learned how to send and receive emails, type documents, attach files and submitted assignments through workbins. The links taught them how to access online dictionaries, abstracts of journals and interactive sites full of movie clips. Indirectly, the activities opened the gates to a wide array of online resources.

Out-of-“Classroom” Interaction

One problem with online learning is the perceived isolation of learners. Knowing that learning is a social experience, an Internet Café for AquaHealth learners was constructed where informal exchanges between them took place. This is where learners and specialists “meet” to learn more about each other, the nature of their work, to exchange pictures, and other personal contact that enhanced their interaction. One learner even sent a drawing depicting his interpretation of the on-going online course. While many learners and specialists keep in touch only during the course, a few remain in contact and arrange F2F meetings at every opportunity. Although “chat” was not used as a means of course delivery and discussion, it was used as a regular means of communication among learners.

Outcome of Courses

To evaluate the learners’ performance, the following assessment criteria for AquaHealth online were adopted: examination and reports (60%), discussion board participation (20%), and learning activities (20%). The total point to be accumulated was 100%, and the passing mark is 70%. All participants of AquaHealth Online were working full time and have tight work schedules, and many would have been attending to their families’ needs after work. Thus, participation and completion of requirements varied. Table 4 summarizes the performance of two batches of participants.

Learners who passed the course were awarded a “Certificate of Completion”. Those who failed to get the passing mark of 70% but participated in the discussions were awarded “Certificate of Attendance”. No recognition was given to enrollees who failed to participate significantly in the discussions and they were considered drop-outs.

Successful enrollees were those with high self-motivation. Although elearning course is accessible at learners’ work place, home, cyber café, etc. some learners are unable to cope with the demands of the course concurrently with their normal workload and personal obligations. The required repeated use of resources like computers, floppy discs, printers, Internet connections, email and discussion forums to send, retrieve, and process information actually empowered rather than intimidated learners via the development of their computing skills. Absence of computer skills was less of a deterrent to learning than having no access to it at all.

Table 4. Outcome of AquaHealth Online courses for 2002 and 2003

	2002	2003
Total number of participants	25	17
Performance:		
Passed	11 (44 %)	9 (53.0%)
Failed	11 (44%)	4 (23.5%)
Dropped	3 (12%)	4 (23.5%)

Discussion

For SEAFDEC/AQD, online delivery of courses offers many benefits because it is cost-saving and course delivery through a CD with discussion through internet-based discussion boards drastically reduced or eliminated travel cost, thus decreasing per-student training expense. Online teaching also provides higher quality of interactive and flexible training using “just-in” materials available in the internet.

The students were very positive about the elearning format of Health Management in Aquaculture with many of them seeing it as superior to conventional classroom instruction because of the added benefit of honing computer and internet navigation skills. The CD-ROM also provides readily accessible module contents that can be translated in the learners’ own language at their own pace. This positive impact on student learning is an outcome that most likely could not have been achieved through conventional training as has been observed by Oliver and Lake (1998).

Aware that attrition is a phenomenon that occurs at an alarming rate in an online learning environment, AquaHealth Online tried to provide interesting web-based links to capture the enthusiasm and interest of learners. The present state-of-the-art in online courses shows that the F2F teaching can even be surpassed by the online course pedagogy.

Looking Forward

It is a challenge to every good researcher to be able to reach an audience worldwide at a lesser cost. In ASEAN countries where many participants’ command of English may become a deterrent to effective face-to-face learning, online learning is an effective tool since the learner can study the modules through the CDs offline at his own pace. As soon as he finds the need to interact online with his classmates worldwide, the 24x7 DB is there for asynchronous discussion.

Specialists from the Fish Health Section of SEAFDEC/AQD are already experiencing the fun and benefits of online interaction in virtual classrooms. Notwithstanding the difficulty in shifting to a new teaching (mentoring) paradigm, online teaching (and learning ... yes, we do learn with our learners!) is a necessary shift that should be embraced by everyone.

The component of FHMTTC that is obviously lacking in AquaHealth Online is hands-on activity, which comprised almost 70% of the F2F training. Thus, a mixture of both online and F2F modes is being planned for the coming year. Learners who pass AquaHealth Online will be invited to SEAFDEC/AQD to undergo specialized hands-on training that will enhance their capability to perform disease diagnostic work. For more information about the course, please visit: <http://www.seafdec.org.ph/training/aquahealthonline.html>

Acknowledgements

The transformation of F2F training on Aquaculture Health Management to AquaHealth Online would not have been possible without the support of Dr. Rolando R. Platon, Chief SEAFDEC/AQD, and funding assistance from the Government of Japan that was provided to SEAFDEC/AQD. Mr. S. Ito, Deputy Chief of SEAFDEC/AQD, was instrumental in this move. We thank the team from the University of the Philippines OpenUniversity, Dr. Maria Lurenda Suplido, Prof. Patricia Arinto, and Ms. Anne Wuijts, for guiding us in the transformation through thorough instructional design and editing. Material transformation from scattered F2F audio-visual aids to online packaging was done with the expertise of Anne Wuijts, Alessandro Torres and Larry Bacabac. Course delivery was rendered smooth-sailing with assistance from the UPOU Tech-Support team, and SEAFDEC/AQD's Salvador Rex Tillo Jr. and Sharon Ann Pedrajas-Mendoza. Most of all, AquaHealth Online was made possible through earnest collaboration between the Module Specialists of the Fish Health Section (Table 1).

References

- Abrioux D. 2001. Guest Editorial. *International Review of Research in Open and Distance Learning*. 1 (2). <http://www.icaap.org/iuicode?149.1.2.10>.
- Davies JE, Carbonaro M. 2000. Developing web-mediated instruction for teaching multimedia tools in a constructionist paradigm. *Int. J. Educ. Telecomm.* 6 (3): 243-266.
- Khanser MA. 2003. *Electronic Learning in the Philippines*. Computer Times Publishing, Inc. and Khanser Publishing House, Davao City, Philippines. 156 p.
- Lio-Po GD, Lavilla CR, Cruz-Lacierda ER (eds). 2001. *Health Management in Aquaculture*. Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, Philippines. 187 p.
- Oliver R, Lake M. 1998. Training teachers for distance education programs: using authentic and meaningful contexts. *Int. J. Educ. Telecomm.* 4 (2/3): 147-170.

Race P. 1997. *The Open Learning Handbook: Promoting Quality in Designing and Delivering Flexible Learning*. Second Edition. Kogan Page Ltd., London.

Transboundary Shrimp Viral Diseases with Emphasis on White Spot Syndrome Virus (WSSV) and Taura Syndrome Virus (TSV)

Leobert D. de la Peña

Southeast Asian Fisheries Development Center

Aquaculture Department, Tigbauan 5021

Iloilo, Philippines

Crustaceans, specifically the cultured penaeid shrimp, are adversely affected by a number of diseases. Crustacean diseases that have significant social or economic impact on culture are mostly infectious in nature and many of them have no therapeutic remedies or treatments. There are currently 8 diseases of crustaceans listed by the OIE, seven of which are viral diseases of penaeid shrimp. This summary discusses two of the most important viral diseases in penaeid shrimp, white spot syndrome virus (WSSV) and Taura syndrome virus (TSV).

White Spot Syndrome Virus (WSSV)

WSSV was first described in Japan where an initial outbreak occurred in *Penaeus japonicus* in 1993 and was thought to have originated from imported stocks from China. This epizootic probably began in China around 1992 then subsequently spread to Taiwan, Japan and the rest of Asia. Infection with WSSV is characterized by white spots in the cuticle of heavily-infected shrimp and a high and rapid mortality which may reach 100% within 10 days from the onset of clinical signs. All shrimp species examined have been found to be susceptible to the virus and the host range extends widely into other marine and freshwater crustacean species, including copepods and even aquatic insect larvae. Several species of crabs and shrimp in the wild have been found infected with the virus without displaying any of the clinical signs and may act as a continual reservoir of infection. This persistence in wild crustacean species in the vicinity of shrimp farms may make the disease difficult, if not impossible, to eradicate from affected aquaculture areas. The causative agent is a double-stranded DNA virus and a member of the genus *Whispovirus* within the family *Nimaviridae*. Virions are rod-shaped to elliptical with a

trilaminar envelope and the size ranges from 80-120 × 250-380 nm. The virus was named after the gross signs of the disease which included white inclusions of various sizes embedded in the carapace at the late stages of infection. These white spots apparently represent abnormal deposits of calcium salts.

WSSV is considered as one of the most devastating viral diseases of cultured penaeid shrimp and is now widespread in Asia. Previous efforts by two research groups reported the absence of WSSV from cultured or wild *P. monodon* in the Philippines up to the late 1990s. Although WSSV came to the Philippines much later than the rest of Asia, the disease can now be easily diagnosed from samples obtained from various parts of the Philippines using polymerase chain reaction (PCR) assay. Since 1999 to early 2002, there were only few documented cases about mass mortalities associated with WSSV. However, starting in the last quarter of 2002 up to the present, mass mortalities have been frequently reported in all major shrimp producing regions in the Philippines. The outbreaks usually occurred between 60-90 days of culture. Mortality ranges from 80 to 95% in intensive culture system and 30 to 70% in extensive culture system. Also, WSSV has been detected by using PCR in 10% (dry season) and 0.3% (wet season) of the wild *P. monodon* collected from 7 sampling sites which are considered as primary sources of spawners or broodstocks in the Philippines.

Strategies that have been developed or adapted to limit the losses from this viral disease include the stocking of WSSV-free fry, use of reservoir to hold water and allow settling for at least 5 days, exclusion of potential WSSV carriers from the culture area, use of green-water culture system, nutritional supplementation with vitamins, regular application of probiotics in the rearing water, good cooperation among shrimp farmers who share the same waterways, and implementation of proactive monitoring scheme. The government, through the Bureau of Fisheries and Aquatic Resources (BFAR), strengthened existing regulations covering in-country movement of live shrimps, especially postlarvae. This includes issuance of health certificate at ports of entry and origin.

Taura Syndrome Virus (TSV)

Taura syndrome, caused by Taura syndrome virus, was first recognized in shrimp farms in Ecuador in 1992 where the disease caused catastrophic losses with a very high cumulative mortality rate of affected pond-cultured *Litopenaeus vannamei*. After its recognition as a distinct disease of cultured *L. vannamei* in Ecuador, TSV spread rapidly to virtually all of the shrimp growing regions of the Americas through shipments of infected postlarvae and broodstocks. The principal host for TSV is *L. vannamei*, although other shrimp species can be infected. Eastern hemisphere penaeids like *P. chinensis*, *P. monodon* and *P. japonicus* have been experimentally infected with TSV. Cumulative mortalities due to TSV outbreak ranged from 40% to more than 90% in cultured *L. vannamei*. Survivors of TSV infections may carry the virus for life. The virus has been demonstrated to remain infectious in the

feces of sea gulls that have ingested infected shrimp. This implicates birds as an important route of horizontal transmission of the virus. The characteristic gross pathology in *L. vannamei* include reddening of the tail fan and visible necrosis in the cuticle. The outbreak usually occurs during the first 60 days of culture. TSV was tentatively assigned under the family Picornaviridae. According to structure, the virion is 32 nm, non-enveloped, icosahedron and a single stranded RNA genome.

TSV was introduced into Asia through the importation of infected *L. vannamei* from Central and South American sources. TSV outbreaks were first reported in Taiwan where *L. vannamei* had been imported live to be used in commercial aquaculture ponds. Recently, there were confirmed reports of TSV infections in Thailand and Indonesia which also import their fry and breeders. In the Philippines, *L. vannamei* is already being cultured in Luzon area using imported postlarvae. However, due to the existence of a regulation promulgated in 1993 by BFAR under the Fisheries Administrative Order No. 189 Series of 1993, prohibiting the import of all species of live shrimp and prawns of all stages except for scientific purposes, importation of *L. vannamei* into the Philippines is considered illegal. A sample from a batch of fry that was confiscated on 8 May 2003 was tested at the National Taiwan University for the presence of TSV using the IQ2000 TSV Detection and Prevention System and was found negative for the virus. However, there is always the possibility of contamination with TSV if the illegal shipments of *L. vannamei* remain uncontrolled.

Methods to prevent and control TSV infection include total de-population of infected stocks, disinfection of the affected culture facility, and restocking with TSV-free fry that have been produced from TSV-free broodstock. In addition, active national quarantine, monitoring and surveillance systems are very valuable to help combat the spread of the virus.

Summary Brief: International Symposium on Koi Herpesvirus Disease

Gilda D. Lio-Po

*Southeast Asian Fisheries Development Center
Aquaculture Department, Tigbauan 5021
Iloilo, Philippines*

The Koi Herpesvirus Disease (KHVD) is the newest viral disease that caused mass mortalities of affected koi and common carp (*Cyprinus carpio*). The disease was initially reported in Israel and the United States in 2000. By March 2002, the first outbreak in Asia occurred in Indonesia that since then spread throughout the country. In early October 2003, KHVD outbreaks in Japan were first observed in Lake Kasumigaura and Kitaura of Ibaraki Prefecture.

With the alarming spread of KHVD in Asia, strategies for its prevention and control need to be initiated. Hence, on 13 March 2004, the Fisheries Research Agency (FRA) of Japan, the Southeast Asian Fisheries Development Center (SEAFDEC), the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan and the World Organisation for Animal Health (OIE) organized the “International Symposium on Koi Herpesvirus Disease” in Yokohama, Japan. It was a forum participated in by scientists from Japan, SEAFDEC member countries, United States, East Asia, Israel and Europe to exchange the latest information on the disease and its prevention and control.

The keynote lecture was given by Prof. Ronald P. Hedrick of the University of California, Davis, a foremost expert on KHVD. Other imminent scientists from Israel, Netherlands, Indonesia, South Korea, China, Singapore, Thailand, Japan and SEAFDEC/AQD were also invited speakers. A summary of the speakers and their presentations are as follows:

R. P. Hedrick (USA): Initial isolation and characterization of a herpes-like virus (KHV) from koi and common carp.

Ariel Ronen (Israel): Prevention of a mortal disease of carps induced by the carp interstitial nephritis and gill necrosis virus (CNGV) in Israel.

Marc Y. Engelsma (Netherlands): KHVD occurrence, diagnosis, control, research, and future in the Netherlands and Europe.

Agus Sunarto (Indonesia): Indonesian experience on the outbreak of koi herpesvirus in koi and carp.

Mi-Young Cho (Republic of Korea): The status of viral diseases of carp in Korea: its control and research development.

Min-Kuanhong (China): Viral studies on carp disease in China - with a special reference to herpesvirus on common carp.

Ling Kai Huat (Singapore): Quarantine, surveillance and monitoring of koi herpesvirus in Singapore.

Somikiat Kanchanakhan (Thailand): Thailand's current quarantine status on aquatic animal disease.

Mamoru Yoshimizu (Japan): Survivability of fish pathogenic viruses in environmental water and inactivation and disinfection of fish viruses.

Kazumasa Ikuta (Japan): The present state of carp fisheries and aquaculture in Japan.

Hiroshi Kimiya (Japan): The status of koi herpesvirus disease and its management measures in Japan.

Motohiko Sano (Japan): Diagnosis of koi herpesvirus disease in Japan.

Yoji Takashima (Japan): The status of koi herpesvirus disease in Lake Kasumigaura and Kitaura.

Kazuo Yamada (Japan): The preventive measures against koi herpesvirus disease in fancy carp in Niigata Prefecture.

Satoshi Miwa (Japan): Further research plan for koi herpesvirus disease control in Japan.

Kazuya Nagasawa (Philippines): Proposed activities for koi herpesvirus disease at the Aquaculture Department of Southeast Asian Fisheries Development Center.

In addition, a satellite meeting on "Pre-KHVD Symposium Meeting" was organized by the Government of Japan Trust Fund Fish Disease Project under the auspices of Dr. Kazuya Nagasawa at the Fisheries Research Agency, Yokohama, Japan, on 12 March 2004. Participants to this meeting were SEAFDEC AQD Chief, Dr. Rolando Platon, Dr. Kazuya Nagasawa, Dr. Gilda

Lio-Po and scientists from SEAFDEC member countries who reported on the current status of the KHVD as well as the current status of fish disease quarantine and surveillance in their respective countries. The SEAFDEC member country participants were: Mr. Srun Lim Song (Cambodia), Dr. Chintana Chanthavisouk (Lao PDR), Dr. Agus Sunarto (Indonesia), Dr. Azilah bte Abdullah (Malaysia), Ms. Daw Myat Myat Htwe (Myanmar), Dr. Joselito R. Somga (Philippines), Dr. Ling Kai Huat (Singapore) and Ms. Tran Thi Kim Chi (Vietnam).

By and large, the two meetings highlighted the significance of this emerging disease, KHVD, in Asia. Baseline information on the disease outbreaks in Indonesia and Japan were reported. Likewise, research data on recent and ongoing studies conducted in USA, Israel, Japan and Europe were presented. All these information is essential in planning for studies on KHV under the Government of Japan Trust Fund Fish Disease Project that will eventually redound to the prevention of the transboundary movement of KHVD in Southeast Asia.

77

Current Status of Transboundary Fish Diseases in Brunei Darussalam: Occurrence, Surveillance, Research and Training

– Hajah Laila Haji Hamid –

85

Current Status of Transboundary Fish Diseases in Cambodia: Occurrence, Surveillance, Research and Training

– Bun Racy –

91

Current Status of Transboundary Fish Diseases in Indonesia: Occurrence Surveillance, Research and Training

– Agus Sunarto, Widodo, Taukhid, Isti Koesharyani, Hambali Supriyadi, Lila Gardenia, Budi Sugianti and Djumbuh Rukmono –

123

Current Status of Transboundary Fish Diseases in Lao PDR: Occurrence, Surveillance, Research and Training

– Thongphoun Theungphachanh –

131

Current Status of Transboundary Fish Diseases in Malaysia: Occurrence, Surveillance, Research and Training

– Faazaz Abd. Latiff –

159

Current Status of Transboundary Fish Diseases in Myanmar: Occurrence, Surveillance, Research and Training

– Saw New Year –

171

Current Status of Transboundary Fish Diseases in the Philippines: Occurrence, Surveillance, Research and Training

– Simeona E. Regidor, Juan D. Albaladejo and Joselito R. Somga –

199

Current Status of Transboundary Fish Diseases in Singapore: Occurrence, Surveillance, Research and Training

– Ling Kai Huat, Susan Kueh and Poh Yew Kwang –

211

Current Status of Transboundary Fish Diseases in Thailand: Occurrence, Surveillance, Research and Training

– Somkiat Kanchanakhon –

221

Current Status of Transboundary Fish Diseases in Vietnam: Occurrence, Surveillance, Research and Training

– Kim Van Van –

Current Status of Transboundary Fish Diseases in Brunei Darussalam: Occurrence, Surveillance, Research and Training

Hajah Laila Haji Hamid

Department of Fisheries

3rd Floor, Ministry of Industry and Primary Resources Bldg.

Jalan Menteri Besar, Berakas BB3910

Brunei Darussalam

I. Current Status of Koi Herpesvirus (KHV) in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

Culture of common carp and koi has been established in Brunei Darussalam since the freshwater fisheries sector started. Breeding and rearing of fry and fingerlings were limited and confined to the Department of Fisheries at the beginning, but towards the early part of the 21st century breeding and rearing technology of these two varieties was transferred to the private sector successfully. Production from common carp for the last five years is in Table 1.

Common carp comprises a significant percentage (60%) of freshwater fish production by private operators in Brunei Darussalam. Other freshwater fish produced are tilapias (30%), which includes red tilapia commonly called Kromis locally, and other local and exotic species (10%). The common carp is not found in wild habitats and the source of spawners was Malaysia. At

Table 1. Production of common carp and koi from 1999-2003

Production(kg)	1999	2000	2001	2002	2003
Common carp	23,617	15, 862	17,279	31,543	53,708
Koi carp	28,225	60,000	54,000	72,040	48,700

Data source: Production data files Freshwater & Ornamental Fish Research and Development (FOFRaD)

present, there is no export of common carp and its demand locally is on the same level as other freshwater fish. The production from koi for the last five years is summarized in Table 1.

Koi is produced for two different purposes: first for ornamental purposes and second as food fish for other carnivorous species like Arowana (*Scleropages* sp.). Demand for the latter is higher and producers are more inclined towards production of koi carp for this purpose than for production as ornamental fish. Koi that are used as food fish (or “feeder koi”) are cultured for 45 days to 2 months, while ornamental koi has to be grown for 6 months to a year to get the desired coloration and patterns. The process of selection for ornamental koi takes time and yields fish that is only about 10% of the total production. The feeder koi can be harvested 5-6 times a year at lesser cost because of cheaper feeds and less maintenance.

The sources of the spawners are Malaysia, Japan and Singapore. Koi is mainly kept in ponds for landscaping purposes and the fish are mostly imported.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

Brunei Darussalam has no record of outbreaks of KHVD of common carp and koi.

II. Current Status of Viral Diseases and in the Production of Shrimps and Prawn

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

Penaeus monodon broodstock and spawners are mainly obtained from the waters of Brunei Darussalam that are caught by trawlers and almost all postlarvae are produced in local hatcheries in Brunei Darussalam. In 2001, since there was a breakthrough in blue shrimp, *Litopenaeus stylirostris*, broodstock development, the production of *P. monodon* decreased due to the lower demand by the industry from that year on. Nevertheless, grow-out culture of *P. monodon* continued, but the local hatchery did not proceed with postlarvae production. This resulted in the importation of postlarvae from East Malaysia.

The production of shrimps in the last five years is summarized in Table 2. Of the values shown in the table from year 2001 to 2003, almost 90% was contributed by *L. stylirostris* and only 10% was production of *P. monodon*. Table 3 shows the combined volume of export and value of *P. monodon* and *L. stylirostris* produced in Brunei Darussalam. The shrimps are mainly exported to the USA, Japan and other ASEAN countries. Tables 4 and 5 give the comparative production in the hatchery of *P. monodon* and *L. stylirostris*.

Table 2. The production of *Penaeus monodon* and *Litopenaeus stylirostris* from 1999-2003

Production Metric Tons (MT)	1999	2000	2001	2002	2003
Shrimps	45.0	66.0	271.0	296.0	445.18

Source: Aquaculture Research Division (AQRD)

Table 3. The export figure of marketable-size shrimps from 1999-2003

Production (MT)	1999	2000	2001	2002	2003
Shrimps	10.09	58.75	128.15	100.0	97.68
Value B\$	\$121,150.00	\$705,000.00	\$1,485,50.00	\$1,156,738.00	\$1,023,450.80

Source: Information Section

Table 4. The production record of postlarvae of *Penaeus monodon* from local hatcheries from 1999-2003

Production (million)	1999	2000	2001	2002	2003
<i>Penaeus monodon</i>	24.0	15.0	Nil	Nil	Nil

Table 5. The production record of postlarvae of *L. stylirostris* from local hatcheries from 1999-2003

Production (million)	1999	2000	2001	2002	2003
<i>Litopenaeus stylirostris</i>	Nil	Nil	18.0	28.8	41.7

b. Production of Blue Shrimp (*Litopenaeus stylirostris*)

The introduction of *L. stylirostris* revolutionized the shrimp industry of the country by increasing the productivity and sustainability of shrimp farms.

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

Spawners of freshwater prawn are mainly collected from one of the main rivers of Brunei Darussalam, the Brunei River. Hatchery production of *Macrobrachium rosenbergii* started way back in 1983, but only at a small scale. When culture of *P. monodon* started in 1988, freshwater prawn culture was completely stopped. Not until in 2001 when hatchery operations for freshwater prawn was again revived (Table 6). The demand for marketable prawn in the local market is considered still good, but the supply from the

Table 6. The production record of postlarvae of *Macrobrachium rosenbergii* from the local hatchery from 1999-2003

Production (million)	1999	2000	2001	2002	2003
Fresh water prawn fry	Nil	Nil	43,5200	45,2020	52,1250

wild is decreasing maybe due to either resource depletion or habitat disturbances.

II-2. White Spot Syndrome Virus (WSSV)

Brunei Darussalam has no recorded outbreaks of WSSV in cultured shrimps.

II-3. Taura Syndrome Virus (TSV)

Brunei Darussalam has no recorded outbreaks of TSV in cultured shrimps.

II-4. Significant and Emerging Viral Diseases of *Macrobrachium rosenbergii*

Brunei Darussalam has no record for significant and emerging viral diseases of *M. rosenbergii*.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

The responsible facility for surveillance, monitoring and diagnosis of diseases of aquaculture species is the Quality Assurance Section of the Department of Fisheries with an email contact address at fiqc@fisheries.gov.bn. Diagnosis and inspection services are being done by both Fisheries Officer and Fisheries Assistants. Surveillance and monitoring for diseases of aquatic animals are conducted once a month by taking water and fish samples from both cage and pond culture systems.

Altogether there are 33 cage culture operators, 14 shrimp pond operators, and 2 Department of Fisheries facilities with hatchery, nursery and grow-out ponds. The cages and ponds are located in three different districts in Brunei Darussalam.

There are only two Fisheries Assistants to do this surveillance and monitoring work at present. The other activities that they are doing include red tide monitoring. If there are disease outbreaks, the Quality Assurance Section also receives direct reports from cage and pond operators, as well as from concerned citizens in their respective areas. The Quality Assurance Section has prepared a standard reporting procedure for any fish mortalities, which is caused by disease outbreaks.

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

The capability and contact numbers of the Quality Assurance Laboratory are in the following box. There are no serious diseases being reported. However, in most shrimp culture runs, there are reports of soft-shelled and broken sized shrimp obtained upon harvest.

Fish health laboratory	Level I	Level II	Level III	Contact Information
Quality Assurance Laboratory (Government owned)	Ë		Ë	E-mail: fiqc@fisheries.gov.bn Tel: (673)-2-772230/ 770236 Fax: (673)-2-770237/382069

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

At present there is no quarantine or disease screening procedure for imported and exported fish in Brunei Darussalam, but a health certificate from the country of origin is required.

In Brunei Darussalam, the Quality Assurance Section of the Department of Fisheries is responsible for quarantine of aquatic animals. The quarantine area is still in the planning stage and it will be located at the nearest point of entry to the country such as the airport and at the immigration border points. The Department of Fisheries has existing facilities such as holding tanks and a fish disease laboratory to carry out quarantine.

The responsible person who will conduct quarantine and inspection services will be under the supervision of the Quarantine Officer with the assistance of two Junior Fisheries Assistants. The level of diagnosis to be used at quarantine stations will be only at Level 1.

IV-2. Procedures and Requirements for Importation

When importers want to bring live aquatic animals into Brunei Darussalam, the following requirements should be fulfilled:

Arriving Live Aquatic Animals at Port of Entry

1. The applicant submits an application form with an attached Business Registration Certificate. This is based on Section 16 and 17 of the Fisheries Operation Document issued by the Attorney General Chambers of Brunei Darussalam. A copy of the applicant's identification card is also required.
2. The applicant must be a citizen of Brunei Darussalam with a permanent resident status.
3. The applicant undergoes an interview for more data gathering.
4. The applicant's facilities and equipment will be inspected.
5. Upon endorsement, application for export permit will be issued under the following conditions:
 - Payment of Licence fee of B\$ 20.00 per consignment;
 - The importer agrees with the conditions for importing of live fish; and
 - The applicant agrees and signs the rules and regulations with regards for importing live fish.

The following activities will be done randomly upon arrival of the consignment of imported fish (mainly aquarium fishes):

1. The quarantine officer conducts a preliminary visual inspection of the shipment for any sign of abnormalities and to observe fish behavior at the port of entry. He obtains 10% of fish or a maximum of 30 fish from each shipment of live fish and brings the sample for further laboratory examinations for bacteria and parasites;
2. After inspection, the quarantine officer prepares a report and release of the fish consignment depends upon the technical findings; and
3. If the quarantine officer is not satisfied with the health status of the consignment, all the fish will be transferred to the holding tanks at the quarantine facilities for further observations. Depending on the result, the shipment or consignment can be further treated or destroyed.

The Fisheries Act Chapter 61 (Paragraph 5, Fisheries Regulations) states that anybody found guilty of violating import regulations will be given three consecutive warnings. When the offenses reach the fourth time, the applicant will be then referred to the court action and will be charged accordingly.

The above documents are required before importation of any fish, either for consumption or aquarium purposes, into the country. For importation of aquarium fishes, and shrimps broodstock and postlarvae, a health certificate is required from the country of origin. While for fishes for consumption purposes, permits are the only requirements.

IV-3. List of Quarantinable Diseases of Aquatic Animals in Brunei Darussalam

Table 7 lists the quarantinable diseases and related information on period of holding and treatment, where necessary.

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

There are no research activities, but there is a program to produce and maintain Specific Pathogen Free (SPF) broodstock for *L. stylirostris*. At present the Department of Fisheries is the only agency conducting a minor fish disease research in Brunei Darussalam.

There is only one report on the prevention and control of diseases in cage culture systems in Brunei Darussalam in English published in 1999 for the Department of Fisheries by Dr. L.K.S.W. Balasuriya, Fish Disease Pathologist from Sri Lanka.

As for training, the Quality Assurance Section of the Department of Fisheries is the only agency conducting training on Fish Diseases. At present, there is no training for quarantine, diagnosis and surveillance of aquatic animals in the country, but we do have related seminars from time to time

Table 7. Quarantinable fish diseases

Fish Diseases	Disease or Disease Agent	Quarantine Period	Treatment
a. Protozoan	<i>Piscioodinium</i> Trichodiniasis Apiosoniasis <i>Ichthyophthirius</i> Chilodonelliasis	10-14 days	Malachite green (<1 ppm) Methylene blue (5ppm) Formalin (10-15%) Salt
b. Bacterial	<i>Aeromonas</i> sp. <i>Vibrio</i> sp. Tail rot	3 consecutive treatments for 3 days	Oxytetracycline (5-25 ppm)
c. Fungal	Saprolegniasis	5-10 days	Formalin (10-15%) Malachite green (<1 ppm)
d. Parasitic	<i>Argulus</i> sp. <i>Lernaea</i> sp. Dactylogyrosis Gyrodactylogyrosis	3 days	Dipterex (0.5-3 ppm)
e. Viral	Lymphocystis	–	No treatment, but 5-10% formalin, or methylene blue (2 ppm) may be used during quarantine

conducted by outside consultants, such as from Malaysia. The recent training was done in March 2004, which involved both the Department of Fisheries Personnel and fish and shrimp operators. The topic covered was related to both cage and pond management.

The country needs training of more staff who will support the needs for surveillance, monitoring and diagnosis, especially to enhance activities in Level I, II and III diagnoses.

Reference

Balasuriya LKSW. 1999. Prevention and Control of Diseases in Cage Culture Systems in Brunei Darussalam. Department of Fisheries, Brunei Darussalam.

Current Status of Transboundary Fish Diseases in Cambodia: Occurrence, Surveillance, Research and Training

Bun Racy

*Laboratory of Inland Fisheries Research Institute
#186 Norodom Blvd.
Chamchamon, Phnom Penh, Cambodia*

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi

I-1. Production of Common Carp

Cyprinus carpio (common carp) is regarded as one of the most important freshwater fish and considered prized food in Asia. This species was introduced into Cambodia in 1982 from Vietnam for aquaculture in ponds and rice field. The fish can grow to 700-1,200 grams during the first year of culture. Common carp culture in Cambodia is small scale and products are solely for local consumption. There is no information about annual productivity of common carp in the country. Common carp are not found in natural water bodies like rivers and streams.

For cultured stocks, sources of spawners or brood stock, and fingerlings are the two hatcheries of the Department of Fisheries located at:

- Research Station, Kilometer No. 9; and
- Batié Prey Veng.

I-2. Production of Koi

Information on koi culture is not available in Cambodia.

I-3. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

There is no information KHVD in common carp and koi in Cambodia.

II. Current Status of Viral Diseases in the Production of Shrimps and Prawns

II-1. Production and Viral Diseases of Shrimps

Shrimps, *Penaeus monodon* and *P. merguensis*, are cultured in brackishwater ponds. Shrimp culture activities are conducted in two provinces: Kompot and Koh Kong. Culture methods used are traditional extensive, modern extensive and intensive systems (Table 1).

Table 1. Shrimp farming in Cambodia when it started in 1993

Farming Systems	No. of Farms	Location	Total Area (ha)	Species cultured
Traditional extensive	2	Kompot	20	<i>P. merguensis</i>
Modern extensive	2	Koh Kong	10	<i>P. monodon</i>
Intensive: Small (<5 ha)	6	Koh Kong	23	<i>P. monodon</i>
Medium (5-20 ha)	15	Koh Kong	164	<i>P. monodon</i>
Large (>20 ha)	3	Koh Kong	76	<i>P. monodon</i>

From 1993-1998, shrimp farming in Koh Kong Province increased tremendously until a total of 740 ha was developed. Table 2 shows shrimp production from 1994 to 1998. In 1999, there were problems with white spot syndrome virus (WSSV), monodon baculovirus (MBV), and yellow-head disease (YHD) causing farmers to stop culture. At present, shrimp farming is going on in extensive ponds in significantly smaller area (around 20 ha remaining in operation).

Table 2. Shrimp production record in Cambodia from 1994 to 1998

Species	Yearly Production (MT)				
	1994	1995	1996	1997	1998
<i>P. monodon</i>	560	731	600	266	197

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

The main institute that is responsible for diagnosis and inspection services of aquatic animal diseases is the Laboratory of Fish Disease of the Department of Fisheries located in the following address:

Department of Fisheries
Inland Fisheries Research Development Institute
Laboratory of Fish Disease
No. 186, Norodom Blvd., Sankat Tonle Bassac
Khan Chamcar Mon, Phnom Penh
Cambodia

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

Based on the levels of diagnosis described below, diagnostic procedures used are between Levels II and III, although only PCR method is the only Level III method that is currently available. The laboratory is starting to develop capability in virology, especially in cell line culture and maintenance.

- Level I: Diagnostic activity limited to observation of animal and the environment, and clinical examination (On site or Field Diagnosis)
- Level II: Diagnostic activity includes Parasitological, Bacteriology, Mycology, and Histopathology (Laboratory Diagnosis)
- Level III: Diagnostic activities include Virology, Electron microscopy, Molecular biology and Immunology (Laboratory Diagnosis)

The table below lists government-, private-, and university-based Fish Health laboratories and their level of diagnostic capability.

No.	Name of Laboratory	Diagnostic Level	Address
1	Department of Fisheries	II	# 186 Norodom Blvd, Chamchamon, Phnom Pen, Cambodia Tel/Fax: (855-23) 215 470 E-mail: catfish@camnet.com.kh
2	Faculty of Fishery Royal University of Agriculture	II	Royal University of Agriculture (Chamcha Daung) Cambodia Tel. (855-12) 887 864
3	Pasteur Institute	III	Monivong Blvd, Khan Toul Kok, Cambodia Tel/Fax: (855-12) 814 276

Following is the list of economically–important diseases in Cambodia, the species that are affected, and the level of diagnosis used to investigate them.

No.	Name of Diseases/Agent	Affected Animals	Level of Diagnosis
1	EUS	<i>Clarias macrocephalus</i> <i>Trichogaster pectoralis</i> <i>Anabas testudineus</i> <i>Trichogaster microlepis</i> <i>Channa striata</i>	II II II II II
2	Fungi	<i>Puntius goniotus</i>	II
3	MBV	<i>Penaeus monodon</i>	II
	WSSV	<i>Penaeus monodon</i>	II and III

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

The Department of Fisheries is responsible for quarantine of aquatic animals. When aquatic animals arrive in the country, they are quarantined at the airport until the importing company passes the quarantine standard. The Fish Health inspector will inspect the animals at the quarantine zone and samples will be taken and sent to the laboratory for pathogen detection. Inspection will be conducted by the Fish Quarantine Inspector at the point of entry or at the quarantine zone at the importing the farm.

IV-2. Procedures and Requirements for Importation

Following are steps that importers follow when they want to bring in live aquatic animals into the country:

1. Pre-arrival: file an application for animal importation.
 - a. Provide a photo or drawing to describe the species to be imported.
 - b. Describe the biological characteristics and provide data on the positive economic effect of species to be imported
2. Animal arrival at the point of entry: Fish should be accompanied by a health certificate from the exporting country
 - a. Fish will be examined for pathogens.
 - b. If quarantinable pathogens are found, treatment will be applied for those with known treatment.

IV-3. List of Quarantinable Diseases of Aquatic Animals

There is a need to improve human resource capability and laboratory facilities in order to come up with the list of Quarantinable Diseases of Aquatic Animals, and to comply with the disease reporting system in the Asian region.

Specifically, there is a need for the following:

- Diagnostic capability for viral diseases (MBV, TSV, WSSV, YHD and VNN);
- Capacity building in risk analysis, procedures for monitoring and disease surveillance;
- Establishment of a laboratory in the Department of Fisheries with modern equipment and trained manpower for disease identification;
- Strengthen the exchange of information in transboundary aquatic animal pathogens between countries; and
- Develop national reporting systems of aquatic animal diseases.

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

A training or workshop on how to conduct proper diseases surveillance, and reporting for the region is needed.

Current Status of Transboundary Fish Diseases in Indonesia: Occurrence, Surveillance, Research and Training

**Agus Sunarto¹, Widodo², Tauhid¹, Isti Koesharyani¹
Hambali Supriyadi¹, Lila Gardenia¹, Budi Sugianti³
and Djumbuh Rukmono⁴**

*¹Fish Health Research Laboratory, Agency for Marine and Fisheries Research
Ministry of Marine Affairs and Fisheries
Jl. Ragunan 20, Pasar Minggu, Jakarta, Indonesia*

*²Centre for Fish Quarantine, Secretariat General
Ministry of Marine Affairs and Fisheries
Soekarno-Hattta International Airport, Jakarta, Indonesia*

*³Centre for Fish Quarantine, Secretariat General
Ministry of Marine Affairs and Fisheries
Jl. MT Haryono Kav 52-5, Jakarta, Indonesia*

*⁴Directorate of Fish Health and Environment
Directorate General for Aquaculture
Ministry of Marine Affairs and Fisheries
Jl. Harsono RM, Building B, 4th Floor, Ragunan, Jakarta, Indonesia*

Introduction

Aquaculture industry in Indonesia has been growing rapidly in the past decade. It plays an important role in rural development, a source for export earning, and has been a leading sector in economic growth. This development is supported by a great potential of resources. The total potential area for aquaculture industry development is estimated at 27,671,778 ha, consisting of about 24,528,178 ha for marine, 913,000 ha for brackishwater ponds and 2,230,600 ha for freshwater culture (Table 1).

However, concurrent with aquaculture potential, substantial problems are being faced because they hamper the development of aquaculture. The main problem encountered along with aquaculture production in Indonesia has always been associated with disease outbreaks and environmental pollution. Substantial economic losses in Indonesian aquaculture have been mainly due to serious disease outbreaks. Recently, the National Fish Health

Table 1. Potential and utilization of aquaculture resources in Indonesia

No.	Type of Aquaculture	Potential Area (ha)	Utilization	
			(ha)	%
1	Marine	24,528,178	753	0.0000003
2	Brackishwater	913,000	438,010	48
3	Freshwater			
	Pond	526,400	85,900	16
	Cage culture	158,200	1,516	1
	Paddy field	1,546,000	150,680	10
	Total	27,671,778	676,959	2.5

Commission (NFHC) declared 4 major economically-important diseases of aquatic animals in Indonesian aquaculture: white spot syndrome virus (WSSV) in tiger shrimp (*Penaeus monodon*), Taura syndrome virus (TSV) in Pacific white shrimp (*Litopenaeus vannamei*), viral nervous necrosis (VNN) in grouper (*Cromileptes altivelis* and *Epinephelus* spp.) and seabass (*Lates calcarifer*), and koi herpesvirus (KHV) in koi and common carp (*Cyprinus carpio*). All of the diseases are associated with transboundary introduction or movement of aquatic species (Table 2).

Table 2. Chronological introduction of transboundary aquatic animal pathogens into Indonesia

No.	Transboundary aquatic animal pathogens	References
1	<i>Ichthyophthirius multifiliis</i>	Sachlan 1952
2	<i>Thelohanellus pyriformis</i>	Sachlan 1952
3	<i>Lernaea cyprinacea</i>	Djajadiredja <i>et al.</i> 1983
4	<i>Myxobolus koi</i>	Djajadiredja <i>et al.</i> 1983
5	<i>Myxosoma</i> sp.	Djajadiredja <i>et al.</i> 1983
6	<i>Aphanomyces invadans</i>	Djajadiredja <i>et al.</i> 1983
7	Yellow head virus (YHV)	Rukyani 1994
8	Iridovirus	Owens 1994
9	White spot syndrome virus (WSSV)	Sunarto 1995
10	Viral nervous necrosis (VNN)	Zafran and Yuasa 1999
11	Koi herpesvirus (KHV)	Sunarto <i>et al.</i> 2002
12	Taura syndrome virus (TSV)	Lightner 2002

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

a. Production of Common Carp

Common carp (*Cyprinus carpio*) is the main freshwater fish cultured in Indonesia. Annual production of cultured common carp in the last five years follows 56,546 metric tons (MT)(1998), 57,278 MT (1999), 75,322 MT

(2000), 76,475 MT (2001), and 83,885 MT (2002)(DGA, 2003). Fifty percent of this annual production is contributed in West Java. In addition to the cultured common carp, the fish are also found in wild habitats such as rivers, lakes and reservoirs. However, there are no available data of carp production in the wild.

There are 13 local strains of common carp in Indonesia: namely Majalaya, Rajadanu, Sutisna Kuningan, Sianjur Wildan, Aki Ending Cianjur, Cangkringan, Samin Sumbar, Kancra Domas, Karper Kaca, Sinyonya, Punten, Merah Sumbar and Bali. Spawners, broodstock or fingerlings are locally available. Indonesia does not import or export common carp. The broodstock are usually kept in earthen ponds or concrete tanks and the seeds are produced either by provincial breeding centres (Balai Benih Ikan, BBI) or by farmers. The eggs and juveniles are produced using combination of hatchery and outdoor pond facilities. Hatched larvae obtained through egg stripping are kept inside the hatchery until they start swimming few days after hatching. The major food for the larvae are *Daphnia* or *Moina*, rotifers, and artificial diet. The larvae are then raised into fingerlings in nursery ponds, prior to stocking into growout ponds or cages. The annual production of common carp seeds is around 10 billion/year.

There are three types of common carp culture systems: floating netcage culture in lakes or reservoirs, running water system (raceway) in rivers or streams, and in earthen ponds. The floating net-cages apply a double cage culture system whereby the upper cage measures 7 × 7 m with 2.5 m water depth and used for common carp, and the lower layer is for Nile tilapia. Running water culture systems are situated in the bank of a river and measures 7 × 2.5 m with 1.5 m water depth. Earthen pond extensive culture system has low stocking density and located in a shallow water pond. This system has less water exchange, and poor quality of feed and other management measures.

The production of common carp in Indonesia is hampered by the shortage of good quality broodstocks and seeds, and, recently, by mass mortality due to koi herpesvirus (KHV). The government promotes selective breeding program to ensure the quality of broodstock and seeds. However, there are no effective management measures to control the KHV outbreak.

b. Production of Koi

Koi (*Cyprinus carpio*) is an important freshwater ornamental fish cultured in Indonesia. However, there is lack of information on its annual production. Koi is cultured in various systems as shown in Table 3.

Indonesia mainly imports high quality koi broodstock from China, Japan and Singapore. The quality of color of koi mostly depends on its genetic make-up (70%), water quality (20%) and other factors (10%). The optimum water quality for cultured koi includes pH of 7.2-7.4, low level of iron, chlorine and sulfur, high dissolved oxygen and temperature range of 25-30°C.

Table 3. Stocking density of koi based on size of fish and water depth

Age of koi (year)	Length of koi (cm)	Pond water depth (m)	Number of koi per m ²
1	15	20-30	40
2	30	30	10
3-5	40	30-45	2-5

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

a. History, Geographic Distribution and Clinical Signs

The first episode of mass mortalities of cultured koi was recorded in March 2002 in Blitar, East Java. It occurred after heavy rains among fishes newly introduced from Surabaya, the capital city of East Java. The fish were imported from China through Hong Kong in December 2001 and January 2002. The outbreak occurred in koi of all ages causing mortality of up to 80-95%. The diseased fish showed a blister-like lesion on the skin, called 'penyakit melepuh' in Indonesian language. Although gill damage was also observed in the diseased fish, not much attention was given to that clinical sign. Blitar is well known as the centre for koi production in the country. The koi, including the infected fish batch, were distributed all over the country, with Central Java, West Java and Jakarta as the main market (Sunarto *et al.*, 2002).

The second disease outbreak occurred in cultured common carp at the end of April of 2002 in Subang regency, West Java. Due to immediate harvest, there was an over supply of fish in the region. Therefore, farmers sold the infected fish at very low price (Rp 3,000/kg; normal price Rp 7,000/kg). After this, the outbreaks spread to neighboring provinces mainly through fish movements. The third episode of the outbreak occurred in May to early June 2002 in cultured common carp in floating net-cages in the Citarum river system. The system is composed of the Saguling reservoir in the upper reaches, Cirata in the middle, and Jatiluhur down stream. There are 4,425, 33,000, and 2,000 units of floating net-cages, mostly with common carp, in Saguling, Cirata and Jatiluhur reservoirs, respectively. Weeks before the outbreak, farmers introduced common carp from the Subang region to this system due to the low price of fish.

The fourth episode of the outbreak occurred in cultured common carp during in February 2003 in Lubuk Lingau regency, South Sumatera. The gross signs of the diseased common carp were extremely similar with that observed previously in koi and common carp in Java islands. Common carp farms at Lubuk Lingau were infected with the disease coming from Cirata reservoir, West Java through fish transfer by traders. The outbreak then spread to neighbouring districts and provinces including Bengkulu in the south and Jambi in the west.

b. Species Affected

Although the disease was observed as being highly contagious and extremely virulent, morbidity and mortality were restricted to koi and common carp populations. Several other species stocked within the same ponds or cages remained completely asymptomatic to the disease. However, it is not known

yet whether these fish harbor the virus and act as carriers. Screening of other cultured and wild fishes collected from the same cage, pond or canal of surrounding farm showed PCR negative results against KHV. The fish include Nile tilapia, giant gouramy, native catfish and Siam catfish.

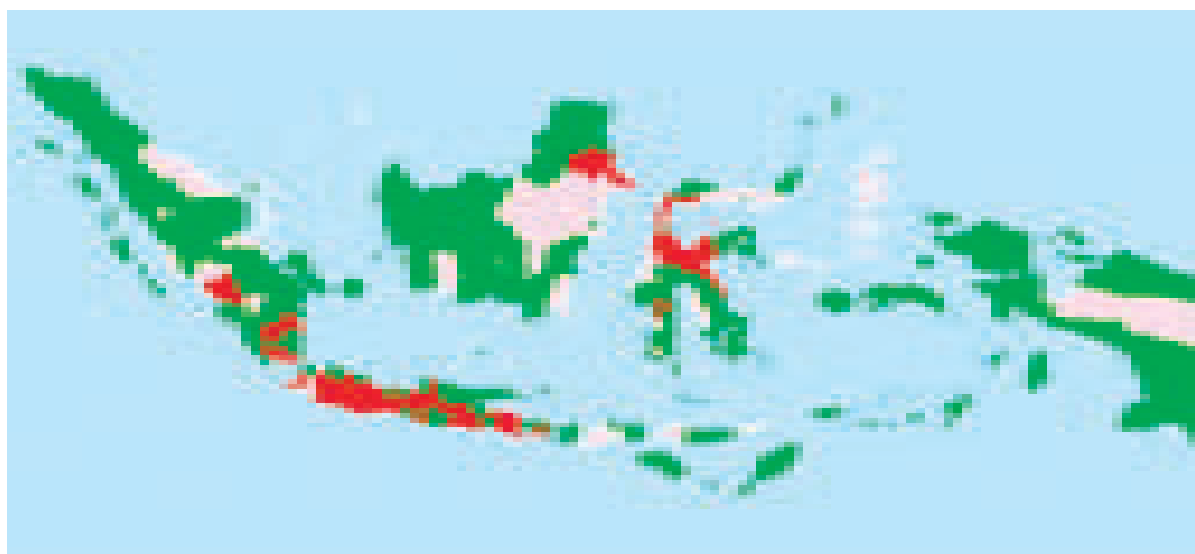


Fig. 1. Geographical distribution of reported KHV in Indonesia. Pink areas indicate no data. Green areas indicate no reported KHV, red areas have reported KHV in either common carp or koi (Cameron, 2003)

c. Diagnosis

A case definition was established as an important step in the disease investigation in order to determine whether an individual fish, pond or tank is suffering from KHV disease or not. The case definition was used to minimize mis-diagnosis. The case definition included high mortality in koi or common carp, in which the fish shows gill damage, with or without other skin lesions. The only consistent clinical sign found during the outbreak was severe gill necrosis. Therefore, this pathognomonic clinical signs was used to establish a presumptive diagnosis against KHV (Level I diagnosis). Although KHV histopathological changes (Level II diagnosis) were not obviously observed in most of the diseased fish, some of diseased fish showed consistent findings with various lesions. These include intranuclear amphophilic inclusion bodies with peripheral chromatin margination within the gill epithelium. Similar inclusions were also observed within the kidney tubular epithelium accompanied by nephrocalcinosis. PCR detection (Level III diagnosis) of KHV was carried out using specific primers set developed by Gray *et al.* (2002) and Gilad *et al.* (2002).

d. Socio-economic Impact

The first report regarding the economic losses due to the outbreak was made by the head of the Association of Ornamental Fish Culture of Blitar regency, East Java. They reported that in Blitar alone, the outbreak destroyed high quality koi belonging to 5,000 fish farmers with economic losses of more than Rp5 billion (US\$ 0.5 millions) within the first 3-months of the outbreak.

As of July 2002, the Task Force estimated that the loss of revenue in the sector and the socio-economic impact to the rural farming communities was in the region of US\$5 million. As the outbreaks continued to spread to new areas, the socio-economic impact due to the diseases escalated. The Directorate of Fish Health and Environment (DFHE) estimated that as of December 2002 and 2003, losses due to the outbreak were US\$10 million and US\$15 million, respectively.

II. Current Status of Viral Diseases in the Production of Shrimps

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

Culture of black tiger shrimp (*P. monodon*) is the most important aquaculture industry in Indonesia. It is notable that Indonesia has a large potential area of approximately 4 million ha of mangrove tidal swamps for shrimp culture, plus generations of experience in shrimp pond aquaculture. The government has given high priority to shrimp aquaculture. Since the government launched the programme on shrimp pond intensification in 1984, referred to as 'program intensifikasi tambak' in the Indonesian language, shrimp pond culture has rapidly expanded. This programme has been successful in increasing shrimp production from 15,400 MT in 1986 to 159,597 MT in 2002 (DGA, 2004) (Table 4).

Table 4. Production of shrimp from Indonesian aquaculture

No.	Species	Production				
		1998	1999	2000	2001	2002
1	Giant tiger shrimp (<i>Penaeus monodon</i>)	78,824	92,726	93,756	103,603	112,840
2	Banana shrimp (<i>Penaeus merguensis</i>)	22,589	28,872	28,965	25,862	24,708
3	Metapenaeus shrimp (<i>Metapenaeus ensis</i>)	20,434	19,255	20,453	19,093	21,634
4	Mysids	264	93	544	610	415

Source: DGA (2004)

b. Production of Pacific White Shrimp (*Litopenaeus vannamei*)

The Government of Indonesia released a permit that allowed importation of Pacific white shrimp (*L. vannamei*) on 10 October 2000 for research purposes only. The exotic shrimp was imported from Taiwan, Hawaii and America (Table 5). Based on Ministerial Decree No. 4/2001 dated 14 July 2001, the government allowed importation of Pacific white shrimp for culture purpose. Since then, the shrimp has been cultured in 15 out of 30 provinces in Indonesia, namely North Sumatera, West Sumatera, South Sumatera, Riau, Bengkulu, Lampung, Banten, West Java, Central Java, Jogjakarta, East Java, Bali, West Nusa Tenggara, South Kalimantan and West Kalimantan. Up to July 2002, the production of the shrimp was 27,000 MT (Sugama, 2002). The broodstocks were imported from Taiwan, Hawaii and USA. The seeds are either imported or produced by local hatcheries.

Local hatcheries in Lampung, West Java, Central Java, East Java and Bali produced 5-30 million seeds/cycle.

Table 5. Records of first importation of *Litopenaeus vannamei* into Indonesia

No.	Species	Country of Origin	No. of Shrimp	Permit/ Recommendation Letter
1	<i>Litopenaeus vannamei</i>	Taiwan & Hawaii	5,000,000 seeds 2,000 spawners	Degree of DGA No. IK.530/D3.9389/X/00K dated 10 October 2000
2	<i>Litopenaeus vannamei</i>	USA	300,000 seeds	Degree of DGA No. IK.530/D3.9390/X/00K dated 10 October 2000

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

Freshwater prawn (*M. rosenbergii*) was mainly cultured in Java and Bali. The average annual production of freshwater prawn is 400 MT per year. The seeds are produced by either private or governmental breeding units (Table 6).

Table 6. Seed production of freshwater prawn

No.	Province	Number of breeding units	Production per year
1	West Java	1	300,000
2	Central Java	7	11,809,000
3	East Java	3	Not operated
4	Bali	9	7,786,000
	Total	20	19,995,000

Source: Hadie *et al.*, 2001

Freshwater prawn is cultured in earthen ponds or rice fields. The minimum size of the pond is 1000 m². There are at least four types of freshwater pond culture systems; monoculture, polyculture with freshwater finfish, integrated with paddy field, and integrated with poultry culture. No importation of freshwater prawn has been recorded.

II-2. White Spot Syndrome Virus (WSSV)

The disease occurred in on-growing juvenile shrimp of all ages and sizes. Moribund shrimp displayed red discoloration and white spots on the inside surface of carapace, body shell and appendages. The spots ranged from 0.5 to 3.0 mm in diameter. The lymphoid organ of the diseased shrimp was swollen and shrunken.

a. Species Affected

The disease affected both cultured and wild penaeid shrimps. The major cultured shrimp species in Indonesia are black tiger shrimp (*Penaeus monodon*) and white shrimp (*P. merguensis*). Infection with WSSV was also found in wild shrimp, *Metapenaeus ensis*. Recently, Pacific white shrimp (*L. vannamei*) was also affected by the disease, but WSSV infection has not yet been reported in *L. stylirostris*.

b. Epidemiology

Since the middle of 1994, a disease that caused cumulative mortality of up to 100% was reported in numerous shrimp farms in northern coast of East, Central and West Java, Indonesia. The new disease, in which the pathognomonic characteristic sign was the presence of white spots on the cuticle, referred to as white spot syndrome ('penyakit bercak putih' in the Indonesian language), was the most threatening disease that had ever occurred in Indonesian shrimp farms. The two earlier viral diseases of shrimp, i.e. monodon baculovirus (MBV) and yellow head virus (YHV) were less pathogenic than the newly emerged white spot syndrome virus (WSSV), the causative agent of white spot syndrome (WSS).

The economic impact of WSSV in Indonesian shrimp industry is difficult to determine. It is estimated that in 1999 only 20% of shrimp ponds were in operation. Many of the ponds remained un-operated, with some being converted to milkfish ponds. This phenomenon may be associated with environment deterioration and disease outbreaks, particularly WSSV.

c. Geographic Distribution and Transmission Issues

Outbreak of WSSV was first reported to occur in black tiger shrimp in Probolinggo, East Java and later in Tangerang, Serang and Karawang, West Java. The disease, causing severe losses, has spread to Bali, Nusa Tenggara, Sulawesi, Kalimantan and Sumatera. Virtually, the disease has spread throughout the country. The disease is vertically transmitted from infected broodstock to its offspring and horizontally transmitted from infected carriers and contaminated environment.

d. Availability of Diagnostics (Levels I, II and III)

At the farmer-level and district laboratories, WSSV may be diagnosed based on its pathognomonic clinical signs, i.e. the appearance of white spots in the carapace and body surface (diagnostic Level I). Histopathological changes (diagnostic Level II) and molecular-based methods (diagnostic Level III) are also used as a confirmative diagnosis for the disease. Almost all major fish disease laboratories are equipped with PCR units and capable for detection of WSSV.

e. Preventive and Control Methods

Managing WSSV should be done in all levels of shrimp production starting from shrimp hatchery up to the grow-out ponds. In hatcheries, PCR technique is used for screening broodstock before spawning. Only broodstocks that are free from WSSV are used as spawners. The postlarvae (PLs) should also be

screened for WSSV. If infected, the whole tank should be disinfected with 20 ppm chlorine and then discarded.

The combination of PCR technique and formalin treatment has been proven as the best strategy for managing WSSV in grow-out ponds. The benefit of PCR screening combined with formalin treatment is to maintain low-intensity of WSSV infections in shrimp, hence significantly reducing the disease outbreak in ponds. We adopted the technique developed by Chanratchakool and Limsuwan (1994). WSSV-free PLs are bathed in 150 ppm formalin for 30 minutes to separate the weak and unhealthy individuals. Only the healthy PLs, which actively swimming against the water current, are then stocked into the ponds. WSSV status during the rearing periods is monitored through regular PCR checking at day 25 and day 55. Semi-quantitative PCR technique allows us to distinguished light and severe infection of WSSV. If the WSSV infection is light, the culture may be continued with improvement of culture condition. However, when the WSSV infection is severe, immediate harvest is the only way to reduce more economic losses on the part of the farmer.

To maintain low level of WSSV infection, bio-security concept should be applied. Closed system with zero or minimum water exchange might be the best solution to have consistent and environmentally sound shrimp production. The key component of closed system is the application of bioremediator (probiotic) and vigorous aeration.

Managing WSSV outbreak in grow-out shrimp may also be achieved through enhancement of shrimp defence mechanism using immunostimulants such as fucoidan, peptidoglycan, and lipopolysaccharide. Combination of prophylactic measures such as screening of PLs using PCR, use of specific-pathogen-free broodstock and PLs, application of immunostimulants, and good management practices will be helpful in controlling WSSV outbreak in Indonesian shrimp farms.

II-3. Taura Syndrome Virus (TSV)

The Government of Indonesia officially released a permit that allowed importation of Pacific white shrimp (*Litopenaeus vannamei*) in 1999. The exotic shrimps should only be imported from Taura syndrome-free country. However, since November 2002, Taura Syndrome caused by Taura syndrome virus (TSV), an RNA virus, has been reported in *L. vannamei* in East Java.

a. Clinical Signs

TSV mostly caused mortality in 1-2 months old *L. vannamei* reared in intensive culture systems at the stocking density of 120 PLs/m². Affected shrimp show reddish discoloration on the tail and multifocal necrosis shown as black spots on the body.

b. Economic Losses

The disease caused up to 75% mortality, but there are no data on the economic impact of TSV to the Indonesian shrimp industry. It is suspected that the disease came to Indonesia due to illegal importation of broodstock and PL from sources with unreliable health status.

c. Epidemiology and Geographic Distribution

In response to Dr. Lightner's letter dated 4 November 2002 to the OIE pertaining to the 'confirmation of TSV in Indonesia', the Government of Indonesia conducted active surveillance in the islands of Java (East, Central and West Java) and Sumatera (Lampung province). TSV was first reported to occur in *L. vannamei* in 2002. Despite active surveillance in *L. vannamei*, TSV infection was not found in West Java and Banten provinces. However, most *L. vannamei* originating from East Java (Banyuwangi, Situbondo, Pasuruan, Bangil, Sidoarjo, Malang) were TSV positive. It is suspected that TSV first occurred in Banyuwangi and Situbondo before it spread to other districts in East Java through movement of infected post larvae. Banyuwangi and Situbondo are important production centers for *P. monodon* and *L. vannamei*, producing both PLs and marketable shrimps. Samples of *P. monodon* originating from Brebes (Central Java), Situbondo (East Java) and Bali islands were also PCR positive for TSV. The virus has also been found in *L. vannamei* from Maros (Sulawesi Islands) and Sumbawa Islands.

d. Diagnostic Methods

Capability to diagnose shrimp viruses at all levels of diagnosis (Level I, II or III) is available in the country. However, PCR technique using both commercial kits and primers based on the OIE Manual were used as confirmatory diagnosis for the disease.

e. Prevention and Control Methods

To prevent the introduction of TSV to their farms, most of shrimp farmers use specific-pathogen-free (SPF) and specific-pathogen-resistant (SPR) postlarvae, which are imported from Hawaii and Florida. The shrimp are then cultured in ponds that strictly apply bio-secure concepts similar with those for prevention of WSSV.

II-4. Significant and Emerging Viral Diseases of *Macrobrachium rosenbergii*

No significant emerging viral disease of freshwater prawn has been recorded. This may be due to lack of intensive research on diseases affecting freshwater prawn.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

Since the Directorate General of Fisheries was promoted to become the Ministry of Marine Affairs and Fisheries in 2001, three principal institutions have been created with mandates related to fish health management including surveillance, monitoring and diagnosis. These institutions are the **Directorate for Fish Health and the Environment (DFHE)** under the Directorate General

for Aquaculture, the **Center for Fish Quarantine (CFQ)** under the Secretariat General, and the **Central Research Institute for Aquaculture (CRIA)** under the Agency for Marine and Fisheries Research (AMFR) (Appendix 1). Arthur (2003) advised that coordination and cooperation between the three principal government agencies involved in fish health management should be further developed and strengthened through interagency consultative and working groups (Appendix 2). There are also various commissions and committees, universities, professional associations, private sector representatives and other stakeholders who are concerned with the status of fish health management in the country.

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

a. Fish Health Laboratories

Although Indonesia has a long history of work on fish diseases, there is very limited expertise and laboratory facilities within the country (Appendix 3). Most laboratories in Indonesia fall under Level I and Level II categories, capable of conducting fish disease diagnosis based on clinical signs and observation of environmental changes (Level I), and microbiology and histopathology (Level II). Viral diseases are becoming increasingly important to Indonesian aquaculture, and the country currently has little expertise or facilities to conduct research in this area. Specifically, there is lack of laboratory facilities and expertise for fish virology. A national laboratory for fish virology is being set up. However, staff expertise needs to be further developed. Despite the constraints, research activities related to virology have been initiated at the Fish Health Research Laboratory in Jakarta, Gondol Research Station for Coastal Fisheries in Bali, and Brackishwater Aquaculture Development Centre in Jepara.

b. Economically-Important Diseases of Aquatic Animals

The 4 major economically-important diseases of aquatic animals in Indonesian aquaculture declared by the National Fish Health Commission (NFHC) are shown in Table 7.

Table 7. Four major economically-important diseases of aquatic animals in Indonesia

No.	Name of Disease	Affected animals	Level of Diagnosis
1	White spot syndrome virus (WSSV)	Penaeid shrimp	III (PCR)
2	Taura syndrome virus (TSV)	Mainly Pacific white shrimp (<i>Litopenaeus vannamei</i>)	III (PCR)
3	Koi herpesvirus disease (KHVD)	Koi and common carp (<i>Cyprinus carpio</i>)	III (PCR)
4	Viral nervous necrosis (VNN)	Groupers (<i>Cromileptes altivelis</i> and <i>Epinephelus</i> spp.) and seabass (<i>Lates calcarifer</i>)	III (PCR)

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

The Center for Fish Quarantine (CFQ) of the Ministry of Marine Affairs and Fisheries (MMAF) located in Jakarta manages fish quarantine in Indonesia. The Director of the Centre is under the supervision of the Secretary General of MMAF. The Director of the center supervises 41 Fish Quarantine Implementing Units consisting of 2 Fish Quarantine Regional Offices, 12 Fish Quarantine Stations and 27 Fish Quarantine Sub-Stations that are located all over the country.

IV-2. Procedure/Requirements for Imported/Arriving Live Fish/ Crustaceans at Port of Entry

According to the regulations on importation of fish, all importation of live fish, dead fish, and fish product is subject to the following conditions:

- a. Importation must be made through designated points of entry;
- b. It should be accompanied by a Fish Health Certificate; and
- c. It should be notified and submitted to a Fish Quarantine Inspector upon arrival of the consignment.

In addition to the conditions mentioned above, importation of live fish must be covered by an Import Permit, which may require additional conditions for the said importation. The additional conditions will be determined on case-by-case basis by the Director General of Fish Culture depending on the risk involved.

a. Import Permit

The application for import permit shall be made in writing to the Director General of Fish Culture prior to importation of the fish. Copies of the application shall be sent to the Center for Fish Quarantine. Any applicant who has obtained a fish import permit shall contact the Center for Fish Quarantine so that technical requirements for proper handling of the imported fish during the quarantine period can be prepared.

b. Quarantine Actions

1. Inspection

- a) Inspection of documents
Inspection of documents is performed to determine the presence of required documents, such as import permit and Fish Health Certificate. If the required documents are present, the consignment is subjected to health inspection.
- b) Inspection of consignment
When the required documents are fulfilled, the inspection of consignment is performed to detect the presence of quarantinable diseases. Inspection of consignment may be done on board or after it has been unloaded from the means of conveyance.

2. Detention

If after inspection it becomes evident that required documents have been fully complied with, carriers of pest and diseases may be detained for observation at a fish quarantine establishment.

3. Isolation and Observation

For further detection of certain quarantinable pests and diseases, which due to their nature, requires a definitely long period, special facilities, and controlled environmental conditions, carriers of pest and diseases that have been inspected may be isolated for observation. According to the MOA Decree No. 265 of 1990, isolation and observation in certain cases can be conducted at an approved private fish quarantine establishment.

4. Treatment

Treatment shall be performed if after observation it becomes evident that:

- a) The carrier is infested or infected, or suspected being infested by quarantinable pest and diseases, or
- b) The carrier is not free or suspected of being not free from quarantinable pest and diseases.

5. Refusal of Entry

Carriers of quarantinable pest and diseases shall be refused entry if it becomes evident that:

- a) After inspection on board, the carrier is infested by certain quarantinable pest and diseases designated by the Government, or in a decaying condition or damage, or belong to species prohibited to be imported.
- b) The required quarantine documents have not yet been complied with, or
- c) After treatment on board, the carrier cannot be freed from inspection of quarantine pest and diseases.

6. Destruction

Carriers of quarantinable pest and diseases shall be destroyed if it become evident that:

- a) After discharge from conveyance and subsequent inspection, the carrier is infested by quarantinable pest and diseases, or is in decaying condition, damage, or belong to those species prohibited to be imported.
- b) After refusal of entry, the carrier is not moved out (re-export) of the territory of the Republic of Indonesia by its owner within the stipulated period of time, or
- c) After observation in isolation, the carrier is not free from quarantinable pest and diseases, or
- d) After discharge from the conveyance and subsequent treatment, the carrier cannot be freed from quarantine pest and diseases.

7. Release

Carrier of quarantine pest and diseases shall be released if it becomes evident that:

- a) After inspection, the carrier is free from quarantinable pest and diseases, or
- b) After observation in isolation, the carrier is free from quarantinable pest and diseases, or
- c) After treatment, the carrier can be freed from quarantine pest and diseases, or
- d) After detention, the required documents have been fully complied with.

c. Rules and Regulations

Basic and fundamental to fish quarantine measures in Indonesia is Law No. 16 of 1992 concerning Animal, Fish and Plant Quarantine, which was published and came into effect on 8 June 1992. In general, with the issuance of this law, all regulations issued before it became invalid. However, all existing executive regulations, as long as they are not in contradiction with this law, remain in force pending the issuance of new executive regulations under this law. Furthermore, by the enactment of Government Regulation No. 15 of 2002 concerning Fish Quarantine, basic legal conditions required for the implementation of fish quarantine actions became stronger. Law No. 16 of 1992 and Government Regulation No. 15 of 2002 put into order, among others, basic provision on quarantine requirement, quarantine actions, quarantine area, kinds of pests and their carrier, places of entry and export, development of quarantine mindedness, investigation and penalty. As already mentioned earlier, existing executive regulations remain in force as long as they are not in contradiction with Law No. 16 of 1992. A comprehensive list of legislations related to fish quarantine and legislation, and on the restriction of movement of certain fish species are in Appendix 4 and 5, respectively.

d. Facilities, Standard Methods and Manpower

Diagnostic methods for aquatic animal diseases that have already been set up and recommended by the OIE will be adopted. By using that method, accurate results will be achieved and the risk on the introduction of dangerous pathogens can be mitigated or eliminated. Most developed countries have already set up complex conditions and requirements that should be met by their trading partners. To fulfill those requirements, countries need to develop capability to adopt the standard and code recommended by the OIE, such as setting up of facilities and laboratories for fish disease diagnosis. On the other hand, there is also a need to improve fish health status by upgrading culture methods and sanitation system in fish production facilities.

As already mentioned, standards and codes on aquatic animal health recommended by the OIE have to be adopted by WTO member countries. The Government of Indonesia is aware that technical capability of quarantine inspectors on virus detection is very limited. It is, therefore, recommended that ASEAN will organize a training in order to strengthen capability in protecting the region from introduced viral diseases of common concern. Recognizing this situation, Indonesia recently conducted trainings on disease diagnostics using histopathology and PCR technology. These trainings were conducted in collaboration with universities and research institutes. Standardized training on

aquatic animal diseases organized by the ASEAN will be more effective to properly improve technical capability of fish quarantine inspectors in the region.

IV-3. List of Quarantinable/Notifiable Fish/Crustacean Diseases in Indonesia

Based on Ministerial Decree No. 17/2003, there are 51 quarantinable fish diseases in Indonesia. Of these, 18 are viral, 11 bacterial, 5 mycotic and 17 are parasitic diseases.

A. Viral Diseases

1. Channel catfish virus disease (CCVD)
2. Spring viraemia of carp (SVC) & Swimbladder inflammation (SBI)
3. Infectious pancreatic necrosis (IPN)
4. Infectious haematopoietic necrosis (IHN)
5. Lymphocystis
6. Infectious hypodermal and haematopoietic necrosis virus (IHHNV)
7. Baculovirus penaei (BP)
8. Monodon baculovirus (MBV)
9. Baculovirus midgut gland necrosis (BMGN)
10. Yellow head disease (YHD)
11. Hepatopancreatic parvovirus (HPV)
12. Taura syndrome virus (TSV)
13. White spot syndrome virus (WSSV)
14. Golden eye disease (GED) or Sleepy grouper disease (SGD)
15. Lymphoid parvovirus
16. Type C baculovirus (TCBV)
17. Viral nervous necrosis (VNN)
18. Epithelioma papillosum (*Herpesvirus cyprini*)

B. Bacterial Diseases

1. Furunculosis (*Aeromonas salmonicida*)
2. Bacterial kidney disease (BKD) (*Renibacterium salmoninarum*)
3. Fish mycobacteriosis (*Mycobacterium marinum*, *M. fortuitum*, *M. chelonae*)
4. Nocardiosis (*Nocardia* sp.)
5. Edwarsiellosis (*Edwardsiella tarda*)
6. Enteric septicaemia of catfish (*Edwardsiella ictaluri*)
7. Streptococcosis (*Streptococcus* sp.)
8. Pasteurellosis (*Pasteurella piscicida*)
9. Enteritic red mouth disease (*Yersinia ruckeri*)
10. Gaffkemia (*Aeromonas invadans* var. *homari*)
11. Red spot disease (*Pseudomonas anguilliseptica*)

C. Mycotic Diseases

1. Sand paper disease/Swinging disease/Ichthyoporosis (*Ichthyophonus hoferi*)

2. Branchiomycosis (*Branchiomyces sanguinis*)
3. Branchiomycosis (*Branchiomyces demigrane*)
4. Aphanomycosis (*Aphanomyces astaci*)
5. Epizootic ulcerative syndrome (*Aphanomyces invadans*)

D. Parasitic Diseases

1. Whirling disease (*Myxobolus/Myxosoma cerebralis*)
2. Pleistophorosis (*Pleisthopora hyphessobrycon*)
3. Pleistophorosis (*Pleisthopora anguillarum*)
4. Ceratomyxosis (*Ceratomyxa shasta*)
5. Henneguyan disease (*Henneguya exiilis*)
6. Cotton shrimp disease (*Thelohania duorara*)
7. Cotton shrimp disease (*Thelohania penaei*)
8. Bonamiosis (*Bonamia ostreae*)
9. Haplosporidiosis (*Haplosporidium nelsonii*)
10. Haplosporidiosis (*Haplosporidium costale*)
11. Marteiosis (*Marteilia refrigens*)
12. Marteiosis (*Marteilia sydneyii*)
13. Perkinsiosis (*Perkinsus marinus*)
14. Ergasiliosis (*Ergasilus sieboldi*)
15. White tumor in siam catfish (*Nosema* sp.)
16. Lytoceatosis (*Lytoceatus parvulus*)
17. Paragonimiasis (*Paragonimus pulmonalis*)

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

Current research activities are mainly focused on the four major fish diseases: WSSV, TSV, VNN and KHV and conducted at the Fish Health Research Laboratory, Research Institute for Freshwater Fisheries in Bogor, West Java. Research is also going on at the Research Institute for Brackishwater Fisheries in Maros, South Sulawesi and at the Research Institute for Coastal Fisheries in Gondol, Bali.

There are also various implementing units under Directorate General of Aquaculture where research is conducted to some extent. These are the:

1. Brackishwater Aquaculture Development Centre (BBBAP, Jepara)
2. Brackishwater Aquaculture Development Centre (BBAP, Situbondo)
3. Marine Aquaculture Development Centre (BBL, Lampung)
4. Freshwater Aquaculture Development Centre (BBAT, Sukabumi)
5. Freshwater Aquaculture Development Centre (BBAT, Jambi)
6. Brackishwater Aquaculture Development Centre (BBAP, Takalar)
7. Marine Aquaculture Development Centre (LBL, Batam)
8. Marine Aquaculture Development Centre (LBL, Ujung Bate)
9. Marine Aquaculture Development Centre (LBL, Lombok)
10. Freshwater Aquaculture Development Centre (LBAT, Mandiangin)
11. Marine Aquaculture Development Centre (LBL, Ambon)
12. Freshwater Aquaculture Development Centre (LBAT, Tatelu)

In addition, there are other implementing units under the Provincial Fisheries Service:

13. Marine and Brackishwater Aquaculture Development Centre (UPBAPL Karawang, West Java)
14. Brackishwater Aquaculture Development Centre (UPBAP Bangil, East Java)
15. Brackishwater Aquaculture Development Centre (BBAP Pangkep, South Sulawesi)

University-based research is being conducted at:

16. Faculty of Veterinary Medicine, Bogor Agricultural University, West Java
17. Faculty of Fisheries, Bogor Agricultural University, West Java
18. Faculty of Fisheries, Diponegoro University, Central Java
19. Faculty of Fisheries, Gajah Mada University, Jogjakarta
20. Faculty of Fisheries, Airlangga University, East Java
21. Faculty of Fisheries, Brawijaya University, East Java

As for training, the courses that provide necessary skills to conduct quarantine, diagnosis and inspection of aquatic animals include the following:

1. Basic training on fish health management
2. Advanced training on fish health management, including parasitology, mycology, bacteriology, histopathology, immunology and molecular biology
3. Use of rapid diagnostic techniques
4. PCR methodology
5. Fish medicine

For surveillance activities, the skills required are more advanced since the activity entails more expertise and training in the following aspects are necessary:

1. Histopathology (long term training)
2. Epidemiology (short and long term training)
3. Virology (short and long term training)
4. Rapid diagnostics
5. Developing program on surveillance and monitoring

References

- Arthur JR. 2003. Fish Health Management for Indonesia. A consultancy report of Project TCP/INS/2905 (A): Health Management in Freshwater Aquaculture. FAO, Rome, 25 p.
- Bastiawan D, Taukhid, Rukyani A. 1997. Culture and specimen preservation techniques of mycotic disease group. Paper presented in a Seminar on Evaluation of Fish Quarantine Diseases, Cipanas, West Java. 9 p.

- Callinan RB, Paclibare JO, Reantaso MB, Lumanlan-Mayo SC, Fraser GC, Sammut J. 1995. EUS outbreaks in estuarine fish in Australia and the Philippines: Association with acid sulfate soils, rainfall, and *Aphanomyces*, p. 291-298. *In*: Shariff M, Arthur JR and Subasinghe RP (eds). Diseases in Asian Aquaculture II. Fish Health Section, Asian Fisheries Society, Manila, Philippines.
- Cameron A. 2003. Report of International Consultant in Epidemiology. Health Management in Freshwater Aquaculture. TCP/INS/2905(A). FAO, Rome, 25 p.
- Chanratchakool P, Limsuwan C. 1998. Application of PCR and formalin treatment to prevent white spot disease in shrimp, p. 287-290. *In*: Flegel TW (ed) Advances in Shrimp Biotechnology. National Centre for Genetic Engineering and Biotechnology, Bangkok.
- Directorate General for Aquaculture (DGA). 2003. Indonesian Aquaculture Statistics. Directorate General for Aquaculture. Jakarta. 127 p.
- Djajadiredja R, Panjaitan TH, Rukyani A, Saron A, Satyani D, Supriyadi H. 1983. Country Report. Indonesia, p. 19-30. *In*: FB Davy and A Chouinard (eds.) Fish Quarantine and Fish Diseases in Southeast Asia. Report of a Workshop held in Jakarta, Indonesia, 7-10 December 1982. International Development Research Centre of Canada (IDRC-210e) Ottawa, Canada, 72 p.
- Gilad SO, Yun S, Andree KB, Adkison MA, Zlotkin A, Bercovier H, Eldar A, Hedrick RP. 2002. Initial characteristics of koi herpesvirus and development of a polymerase chain reaction assay to detect the virus in koi, *Cyprinus carpio koi*. *Dis. Aquat. Org.* 48: 101-108.
- Gray WL, Mullis L, LaPatra SE, Groff JM, Goodwin A. 2002. Detection of koi herpesvirus DNA in tissues of infected fish. *J. Fish Dis.* 25: 171-178.
- Hadie LE, Hadie W, Hikmayani Y, Gunadi B, Wakhid A. 2001. Opportunity and prospect of freshwater shrimp (*Macrobrachium rosenbergii*) culture. Paper presented in 'Release of new strain and business meeting of freshwater shrimp', 24 July 2002, West Java, Indonesia. 20 p. (in Indonesian).
- Mangunwiryo H. 1997. Country Paper: Indonesia, p. 51-64. *In*: Humphrey J, Arthur JR, Subasinghe RP and Phillips MJ (eds). Aquatic Animal Quarantine and Health Certification in Asia, FAO Fisheries Technical Paper No. 373.
- Owens L. 1994. Sleepy grouper disease in Indonesia. A report prepared by the Department of Biomedical and Tropical Veterinary Sciences, James Cook University of North Queensland, Townsville, Australia.
- Rukyani A. 2001. Control strategy of viral diseases in grouper culture, p. 27-34. *In*: Sudradjat A, Heruwati ES, Poernomo A, Rukyani A, Widodo J, Danakusumah E (eds). Proceedings of the Marine Culture Technology and Development of Sea Farming in Indonesia (in Indonesian).

- Rukyani A. 1993. The status of aquaculture and fish disease problems in Indonesia. Paper presented at the International Workshop and Training Course on Quick Diagnostic Methods and Bio-ecological Control of Fish and Shrimp Diseases. 29 July-7 August 1993, Vietnam.
- Rukyani A. 1994. Yellow head disease in shrimp. *Trubus*, March, 1994. p. 293 (in Indonesian).
- Rukyani A. 2002. Koi Herpesvirus in Indonesia. Report of KHV epidemic to OIE by the Directorate of Fish Health and Environment, DGA, Jakarta.
- Rukyani A, Sunarto A. 1998. Non-specific pathogen resistant (NsPR) *Penaeus monodon*: a complementary SPF broodstock development. Paper presented in the Workshop on the Development of *Penaeus monodon* Disease Free Broodstock in ASEAN Country held on 23-24 March, Jakarta, Indonesia. 15 p.
- Sachlan M. 1952. Notes on parasites of freshwater fishes in Indonesia. *Central Inland Fisheries Research Station* 2:1-59.
- Sugama K. 2003. Culture status of introduced shrimp and the prospects for its development in freshwater ponds. *Warta Perikanan* p.19-22 (in Indonesian).
- Sunarto A. 1995. Watch out for white spot disease in shrimp. *INFOVET*, April 1995, p.30-31 (in Indonesian with abstract in English).
- Sunarto A, Taukhid, Rukyani A, Koesharyani I, Supriyadi H, Huminto H, Agungpriyono DR, Pasaribu FH, Widodo, Herdikiawan D, Rukmono D. 2002. Field investigations on a serious disease outbreak among koi and common carp (*Cyprinus carpio*) in Indonesia. Paper presented in the 5th Symposium on Diseases in Asian Aquaculture, 24-28 November 2002, Gold Cost, Australia.
- Surahmat and Suparno. 1995. What is Pest Risk Analysis (PRA). Paper presented at the Seminar on Fish Quarantine held on 24-26 January 1995 at the Center for Agricultural Quarantine, Jakarta, Indonesia.
- Sutanto H. 2003. Koi. *PT Penebar Swadaya*. p.78.
- Zafran and Yuasa K. 1999. History of VNN disease in Indonesia. *Lolitkanta News Letter*, 15: 3-4 (in Indonesian).

Appendix 1. Summary of Current Mandates of Governmental Departments and other Agencies Concerned with Fish Health Management (Arthur, 2003)

Ministry of Marine Affairs and Fisheries (MMAF)

Directorate General for Aquaculture

Directorate for Fish Health and the Environment

- Develops policy and legislation related to fish quarantine (shared)
- Responsible for disease control and prevention in aquaculture
- Responsible for conducting import risk analysis (IRA)
- Controls introduction of fish into inland waters
- Responsible for disease monitoring and surveillance activities
- Submits reports on national disease status to FAO/NACA
- Responsible for extension activities for fish disease

National Commission on Introductions and Transfers (Proposed)

- Reports to the Director General for Aquaculture

Universities

- Provide ad hoc diagnostic expertise and advice
- Training
- Applied research

Ministry of Trade

- Concerned with fees for quarantine services

Ministry of Health

- Concerns related to zoonotic diseases (i.e., those transmitted from aquatic animals and their products to man)

Ministry of Forestry

- Enforces CITES
- Concerns about impacts of exotic diseases on biodiversity

National Commission on Fish Health (and other committees)

- Reports to the Director General for Aquaculture
- Provides advice on fish health issues

Other Agencies with Related Concerns

Research Agency for Marine Affairs and Fisheries

Central Research Institute for Aquaculture

- Conducts research on diseases of fish

Secretariat General

Center for Fish Quarantine

- Develops regulations, technical guidance and standards for fish quarantine
- Implements quarantine for both international and domestic movements of live fish, including: issuance of health certificates, border inspections, laboratory diagnostics, quarantine of shipments
- Develops technical cooperation with other institutions, both nationally and internationally

Bureau of Law

- Evaluation of laws
- Stakeholder consultation process

Ministry of Agriculture

Chief Veterinary Officer

- Official reporting to OIE (However, fish disease reporting is done by MMAF via FAO/NACA)

Appendix 2. Interrelationships for Governmental Department and other Agencies Concerned with Fish Health Management (Arthur, 2003)

Ministry of Marine Affairs and Fisheries

Secretariat General

(6 agencies including quarantine)

Research Agency for Marine Affairs and Fisheries

Directorate General of Aquaculture

Center for Fish Quarantine

National Fish Health Committee

National Committee on Introductions & Transfers (Proposed)

Five Sub-Directorates

- Fish Disease Monitoring & Evaluation
- Fish Disease Control & Eradication
- Quality Control & Fish Medicine Certification
- Environmental Monitoring & Evaluation
- Aquaculture Environmental Protection

Three Sub-Directorates

- Technical Services
- Administration
- Program for Overseas Collaboration

Directorate for Fish Health & Environment

Others with Potential Involvement

- Universities (4 with fish health expertise)
- Private aquaculturists (farmer's organizations)
- Ornamental fish importers
- Sportsfishermen
- International agencies
- International experts/universities

Fish Quarantine Offices, Stations and Checkpoints

- Fish Quarantine Regional Offices (2)
- Class I Fish Quarantine Stations (7)
- Class II Fish Quarantine Stations (5)
- Fish Quarantine Substations (27)
- Domestic Checkpoints (more than 300)

Research Centers

- Research Center for Aquaculture, Fish Health Research Laboratory
- Four other centers with no activities related to fish health (Marine Technology; Capture Fisheries; Marine Territory and Non-biotic Resources; Fish Processing; and Social Economics of Marine Affairs and Fisheries)

Other Agencies with Related Concerns (Liaison Required) :

Ministry of Health

- Concerns related to zoonotic disease

Ministry of Trade

- Liaison concerning fees for quarantine services

Ministry of Health

- Concerns related to zoonotic diseases

Ministry of Forestry

- Protection of endangered species (CITES)

Ministry of Agriculture

- Chief Veterinary Officer (OIE reporting)

Appendix 3. List of fish health laboratories in Indonesia

No.	Province	Name of Laboratory or Institution	Contact Person	Diagnostic Capability	Address	Diagnostic Level
1	Nangro Aceh Darussalam	Loka BAP Ujung Batee, Banda Aceh	Endah Sutanti	Clinical signs, parasitology, bacteriology	JL. Krueng Raya KM 16 PO BOX 46 Banda Aceh Telp/ Fax (0651) 24686	Level 1 + PCR
		Pos Karantina Ikan ST Iskandar Muda, Banda Aceh	Dra. Erita	Clinical signs, parasitology, bacteriology	JL. Cendana Utama No.7 Jeulingke. Banda Aceh. Telp.(0651) 53705	Level 1
2.	R i a u	Loka Budidaya Laut Batam	Sri Agustati, S. Pi	Clinical signs, parasitology, bacteriology	Jl. KHA. Dahlan Sekupang PO BOX 60 Batam Telp. (0778) 381042	Level 1 + PCR
		BBI Sentral Sei Tibun	Haerudin, A. Md	Clinical signs	Jl. Bangkinang Km.43 Kab. Kampar Telp.(0761) 22921-34685 Fax. (0761) 23191	Level 1
		Pos Karantina Ikan Sultan Syarif Kasim II, Pekanbaru	Tatang	Clinical signs	Gedung Terminal Sultan Syarif Kasim II Telp. (0761) 674626	Level 1
		Pos Karantina Ikan Tanjung Pinang	Ir. Elfahmi	Clinical signs, parasitology, bacteriology	d/a Pos K. Tumbuhan Pinang, Jl. Sumatera No. 163 Tanjung Pinang Telp. (0771) 313316	Level 1
		Pos Karantina Ikan Pangkal Pinang (Bandara Depati amir)	Ir. Hendri Novianto	Clinical signs, parasitology, bacteriology	Jl. Koba Pangkal Baru Telp. (0717) 434756	Level 1
		Universitas Riau Fakultas Perikanan, Pekanbaru.	Ir. Teten Suparmi, M.Sc	Clinical signs, parasitology, bacteriology	Jl. Raya Bangkinang, Pekanbaru Telp. (0761) 63266	Level 1
		Satuan Kerja Karantina Ikan Pelabuhan Dumai	Jhon Edward Reski Paningotan, S.Pi	Clinical signs, parasitology, bacteriology	Jl. Datuk Laksamana, Telp. (0765) 438906	Level 1
3.	Sumatera Utara	Stasiun Karantina Ikan Bandara Polonia, Medan.	Barita Sriwaty Aritonang	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Padang Golf Polonia Medan Telp/Fax (061) 4572181 Email : Fish-Quarantine@Yahoo.com	Level 1 + PCR
		Dinas Perikanan Propinsi	Ir. Erna Dewi	Clinical signs	Jl. Sel Batu Gingging 6 Medan Telp. (061) 552881, 568819 Fax.21508	Level 1
		PT. Central Windu Sejati, Medan.	Edi	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Desa Karang Gading, Secanggang, Kab Langkat, Telp. (061) 7867678	Level 1
4.	Sumatera Barat	Stasiun Karantina Ikan Tabing, Padang.	Ir. Nuraini Umrainita	Clinical signs	Jl. Prof. Hamka Gd. Terminal Bandara Tabing Padang Telp. (0751) 57561	Level 1
5	Jambi	BBAT Seigelam, Jambi	Edi Barkat Kholidin, S.Pi	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Jen.Sudirman No.16 C The Tok, Kab. Muaro Jambi Telp.(0741) 33508	Level 2 + PCR
		BBI Sentral Kerinci	Sukirman, A.Md	Clinical signs	Jl. Desa Pendung Hilir, Kec. Air Hangat Kab. Kerinci, Telp (0748) 353038	Level 1

Appendix 3 (continuation)

No.	Province	Name of Laboratory or Institution	Contact Person	Diagnostic Capability	Address	Diagnostic Level
6	Bengkulu	Pos Karantina Ikan ST Thaha, Jambi	Guntur K Darmanto	Clinical signs	Jl. Sersan UD Syawal Palmerah Baru, Jambi 36139 Telp.(0741) 572474	Level 1
		Pos Karantina Ikan Bengkulu	MW. Giri P,S.Pi	Clinical signs	Jl. Ir. Rustandi Sugianto Km.13,8 Kandang Telp.(0736) 53017	Level 1
		UPTD - BPBAT	Ir. Sri Hartati, M.MA	Clinical signs	Desa Marga Sakti Kec. Lais Kab. Bengkulu Utara Telp.(0736) 21477	Level 1
7	Sumatera Selatan	BBI Sentral Air Satan	Ir. Teti Hutapea	Clinical signs	Desa Air Satan Kec. Muara Beliti Kab. Musi Rawas,Telp. (0711) 352528, Fax.351394	Level 1
		Stasiun Karantina Ikan Sultan Mahmud Badaruddin II Palembang	Leonard Tambunan, S.Pi	Clinical signs	Jl. Adi Sucipta Telp/Fax. (0741) 414184	Level 1
8	Lampung	BBL Lampung	Drs. Philipus Hartono	Clinical signs, parasitology, bacteriology	Desa Hanura Kec. Padang Cermin Kec. Lampung Selatan Telp. (0721) 471379 - 471380, Fax. (0721) 471379	Level 2 + PCR
		PT. Biru Laut Khatulistiwa, Lampung.	Hery Saria	Clinical signs, parasitology,	Jl. Raya Trans Sumatera PO Box.1, Desa Merak Belantung, Lampung SelatanTelp (0721) 351310	Level 1
		Pos Karantina Ikan Pel Laut Panjang	Suharyanto, A.Pi	Clinical signs, parasitology, bacteriology	Jl. Jawa No.5 Pelabuhan Panjang Bandar Lampung Telp (0721) 32487	Level 1
		PT. Prospek Karyatama	Alfian	Clinical signs, parasitology, bacteriology, rapid test for virus	Jl. Ir. Sutami Km 15, Tanjung Bintang - Lampung, Telp. (0721) 351310	Level 1
		PT. Charoen Pokphan Bahari/Bratasena	Januar	Pathology, clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Desa Teladas, Kec. Menggala Kab Tulang Bawang, Lampung, Telp. (0725) 556222	Level 1
9	DKI Jakarta	Laboratorium Riset Kesehatan Ikan, Pasar Minggu - Jakarta	Ir. Taukhid, MSc	Pathology, parasitology, mycology, bacteriology, histopathology, imunology, virology (PCR),	Jl. Ragunan No 20 PO Box 7220, Pasar Minggu. Telp. (021) 7805052 Fax 7815101	Level 2 + PCR
		PT. Charoen Pokphand Jaya Farm, Aquatic Animal Health Laboratory, Jakarta.	Ir.Heni Budi Utari, MS	Pathology, clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jln. Parang TritisV No. 6 Ancol, Jakarta Utara Telp. (021) 6922646, Fax (021) 6914462	Level 2 + PCR
		Pos Karantina Ikan Tanjung Priok, Jakarta	Hary Maryadi	Clinical signs, parasitology	d/a Raya Pelabuhan 6-8 Tanjung Priok, Jakarta.Telp. (021) 491549	Level 1

Appendix 3 (continuation)

No.	Province	Name of Laboratory or Institution	Contact Person	Diagnostic Capability	Address	Diagnostic Level
10	Banten	Balai Karantina Ikan Soekarno Hatta, Cengkareng	Ir. Rini Widoyati	Clinical signs, parasitology, mycology, bacteriology,	Gedung Karantina Pertanian Bandara Soekarno Hatta Telp. (021) 5507932 Fax. 5506738	Level 2
11	Jawa Barat	BBAT Sukabumi	Ir. Endang Mujiutami	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Selabintana No.17 Sukabumi Telp. (0266) 225211-225240 Fax.221762	Level 2 + PCR
		Fakultas Perikanan, Institut Pertanian Bogor (IPB), Bogor	Drs. Alifuddin, MS	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Fakultas Perikanan dan Ilmu Kelautan Jl.Rasamala Dermaga Bogor. Telp.(0251) 628755 Fax. 622941	Level 2 + PCR
		Universitas Padjadjaran, Bandung	Ike Rustikawati	Clinical signs, parasitology, mycology, bacteriology,	Jl. Dipati ukur No. 35 Bandung Telp. (022) 7797763	Level 1
		Balai Pengembangan Budidaya Perikanan Laut, Tawar dan Payau, Kerawang	Sam Prihata, A.Md	Clinical signs, parasitology, mycology, bacteriology,	Jl. Pusaka Jaya Utara Kec. Pedas Kerawang Telp. (0267) 409887	Level 1
		Dinas Perikanan Kabupaten Indramayu	Sri Supriatinah, S.Pi	Clinical sign, virology (PCR)	Jl. Pabean Udik No.1 Indramayu Telp. (0234) 272767	Level 1 + PCR
12	Jawa Tengah	Balai Besar Pengembangan Budidaya Air Payau Jepara	Drs. Arief Taslihan, M.Si	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Pemandian Kartini PO BOX No1 Jepara Telp.(0291)591125, Fax. 591724	Level 2 + PCR
		Universitas Diponegoro, Semarang.	Ir. Desrina, MSc	Clinical signs, parasitology, mycology, bacteriology,	Fak. Perikanan Jl. Prof. Sudarto Tembalang Telp.(0291) 7474698	Level 2
		Balai Pengembangan Budidaya Air Payau Tegal	Ir. Pratiwi	Clinical signs, parasitology, mycology, bacteriology,	Jl. Raya Beringin Maribaya Tegal.Telp. (0283) 323230	Level 1
		Pos Karantina Ikan Tanjung Emas, Semarang.	Ir. Eka Perdana	Clinical signs, parasitology,	Jl. Ampena No.4 Semarang Telp. (024) 541769	Level 1
		PT. Charoen Pokphan Prima Lab, Tegal.	Ir. Nurhabana	Clinical signs, parasitology, mycology, bacteriology,	Jl. Cimanuk 1A Tegal, Telp. (0283) 351375	Level 1
		Satker Karantina Ikan Adi Sumarno, Solo	Ir. Woro Nur Endang Satriati	Clinical signs, parasitology	Jl. Amarta Gedong Baru Ngabean Kartosuro PO Box.800 Suarakarta. Telp.(0271) 790715 Pes 232 Fax (0271) 780058	Level 1
13	Jawa Timur	BBAP Situbondo	Ir. Yani Lestari Nuraini	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Pecaron PO BOX. 5 Panarukan Situbondo Telp.(338) 0673328	Level 2 + PCR

Appendix 3 (continuation)

No.	Province	Name of Laboratory or Institution	Contact Person	Diagnostic Capability	Address	Diagnostic Level
		PT.Tirta Mutiara Makmur	Rubyanto, MBA	Clinical signs, parasitology, virology (PCR)	Jl. Raya Tampora Km.5 PO.Box 14 Telp, (0338) 891286, Fax.(0338) 891679	Level 1 +PCR
		Univ. Airlangga, Surabaya.	Drh.Usni Anwar	Clinical signs, parasitology, mycology, bacteriology,	Jl. Airlangga No.4 Surabaya Telp. (031) 5020348	Level 2 + PCR
		Univ. Brawijaya, Malang.	Ir. Syamsudin Dalimunte	Clinical signs, parasitology, mycology, bacteriology,	Jl. Mayjen Haryono No.161 Malang Telp/Fax (0341) 553512	Level 2
		Stasiun Karantina Ikan Bandara Juanda, Surabaya.	Sri Diyah Purnamasar, A.Pi	Clinical signs, parasitology, mycology, bacteriology,	Jl. Pangesongan II/58 A Jambangan Surabaya. Telp. (031) 8286357 - 8678471	Level 2
		Balai Pengembangan Budidaya Air Payau Bangil	Dra. Ninik	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Perikanan Kalianyar PO Box.6 746 Bangil. Telp. (0343) 741654	Lever 1 + PCR
		Akademi Perikanan Sidoarjo	Ir. Insani Gunawati	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Raya Buncitan PO BOX 1 Sidoarjo Telp. (0318) 911380	Level 1 + PCR
		PT. Suryawindu Pertiwi, Probolinggo.	Yulianto	Clinical signs, parasitology, E45bacteriology	Desa Jabungsisir, Paiton - Probolinggo, Telp. (0335) 771193	Level 1
		Pos Karantina Ikan Tanjung Perak, Surabaya.	Ir. Dwi raharjo, S.Pi	Clinical signs, parasitology, mycology, bacteriology	Jl. Kalimas Baru No.86 Surabaya. (031) 3283886	Level 1
		Petani	Ahmad Munajad	Clinical signs, parasitology	Jl. KS Tubun No.24 Bantarsoka Purwokerto Barat. Telp. (0281) 631468	Level 1
14	DIY Yogyakarta	Univ. Gajah Mada, Yogyakarta.	Dr. Ir. Trianto, M.Sc	Clinical signs, parasitology, mycology, bacteriology	Fak. Perikanan Jl. Bulak Sumur Telp. (0274) 551218	Level 2
		Pos Karantina Ikan Adi Sucipto, Yogyakarta	Drs. Sumargono	Clinical signs, parasitology, mycology, bacteriology	Bandara Adi SuciptoTelp. (0274) 583632	Level 2
15	Bali	Balai Besar Riset Perikanan Laut Gondol	Ir. Zafran	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Desa Penyambungan Kec. Gerokjak Kab. Buleleng PO BOX 140 Singaraja. Telp (0362) 92278 - 92272	Level 2 + PCR
		Stasiun Karantina Ikan Ngurah Rai	Gatot Perdana A.Pi	Clinical signs, parasitology, bacteriology	Jl. I Gusti Ngurah Rai Tuban Denpasar Telp. (0361) 75695 Fax.756951	Level 2
		Wilayah Kerja Karantina Ikan Gilimanuk	Slamet Eko Priyono, A.Pi HP. 08118432312	Clinical signs, parasitology	Jl. Pel Penyebangan Gilimanuk, Jembrana.	Level 1

Appendix 3 (continuation)

No.	Province	Name of Laboratory or Institution	Contact Person	Diagnostic Capability	Address	Diagnostic Level
16	Nusa Tenggara Barat	Loka Budidaya Laut Lombok	Ir. IBM. Made Suastika, MS	Clinical signs, parasitology	Jl. Jend. Sudirman No.21 PO BOX 128 Praya Lombok Tengah Telp./Fax. (0370) 653795-654898	Level 1
		Stasiun Karantina Ikan Selaparang, Mataram	Drs. Nurhaidin, S.Pi	Clinical signs, parasitology	Jl. Adi Sucipto Bandara Salaparang Mataram Telp. (0370) 635425	Level 1
		Pos Karantina Ikan Bandara M. Salahuddin, Bima	M. Farchan, S.Pi	Clinical signs, parasitology	Jl. St. Salahuddin Polibelo Bima Telp. (0374) 6472562	Level 1
		Satker Karantina Ikan Pelabuhan Laut Lembar	I Putu Panca Yasa, S.Pi HP.08123782820	Clinical signs, parasitology	Jl. Raya Pel Laut Lembar, Lombok Barat	Level 1
17	Nusa Tenggara Timur	Pos Karantina Ikan Bandara El Tari, Kupang	Ir. Putu Sumardiana	Clinical signs, parasitology	Jl. Terminal Bandara El Tari, Kupang. Telp. (0380) 832600	Level 1
18	Kalimantan Selatan	Loka Budidaya Air Tawar Mandiangin	Ir. Sarifin	Clinical signs, parasitology, bacteriology	Jln. Tahura Sultan Adam Km 14 Banjar Baru Telp/ Fax. (0511) 780758	Level 1
		Fak. Perikanan, Univ. Lambung Mangkurat, Banjarmasin.	Ir. Ririn Kartika	Clinical signs, parasitology, mycology, bacteriology	Jl. Hasan Basri Ahmad Yani KM. 36 Banjarmasin, Telp. (0511) 777897- 772124	Level 1
19	Kalimantan Barat	Balai Benih Ikan Sentral Anjungan	Ir. Anang Napiri	Clinical signs, parasitology	Desa Kepayang, Kec. Sei Pinyuh, Kab. Pontianak, Telp.(0561) 227926	Level 1
		Stasiun Karantina Ikan Bandara Supadio, Pontianak.	Ir. Suhermanto	Clinical signs, parasitology	Bandara Supadio, Pontianak. Telp/Fax. (0561) 691126	Level 1
		PT. Charoen Pokphan Prima Mempawah, Pontianak.	Diana	Clinical signs, parasitology	Bandara Supadio, Pontianak. Telp/Fax. (0561) 691126	Level 1
20	Kalimantan Timur	Stasiun Karantina Ikan Sepinggan, Balikpapan.	Nafi Mubarak, S.Pi	Clinical signs	Jl. Kol. Syarifuddin Yoes, Balikpapan. Telp/Fax. (0542) 876348	Level 1
		Dinas Perikanan Propinsi, Samarinda	Ir. Esti Wahyuni	Clinical signs	Jl. Kesuma Bangsa No. 1 Samarinda Telp. (0541) 206938	Level 1
		Satker Karantina Ikan Juata, Tarakan	Sachrurozi, S.Pi	Clinical signs, parasitology,	d/a Bandara Juata, Tarakan, Telp. (0551) 35803	Level 1
21	Sulawesi Utara	Loka Balai Air Tawar, Tatelu	Ir. Frederik Lantang	Clinical signs, parasitology, bacteriology	Jl. Penilih, Kec. Dimembe, Kab. Minahasa Telp. (0431) 823697	Level 1
		Stasiun Karantina Ikan Bandara Sam Ratulangi, Manado.	Ir. Sunarti Ahmad	Clinical signs, parasitology	Jl. Bandara Samratulangi, Manado Telp. (0431) 64688, Fax. 811688	Level 1
		Wilayah Kerja Karantina Ikan Bitung	I Nyoman Suardana, S.Pi	Clinical signs, parasitology	Komp. Pelabuhan Laut Bitung Jl. Ir Soekarno No.23 Telp. (0438) 34386	Level 1

Appendix 3 (continuation)

No.	Province	Name of Laboratory or Institution	Contact Person	Diagnostic Capability	Address	Diagnostic Level
22	Sulawesi Tengah	Pos Karantina Ikan Muitiara, Palu	Suardi, S.Pi	Clinical signs, parasitology	Jl. AR. Rahman Saleh No.15 Birobuli - Palu, Telp.(0451) 482131	Level 1
23	Sulawesi Tenggara	Stasiun Karantina Ikan Wolter Mongonsidi, Kendari.	Ir. St. Narwiyani	Clinical signs, parasitology	Jl. Balai Kota No. 4 Kendari Telp. (0401) 3244848	Level 1
		Satker Karantina Ikan Kolaka	Hamzah, S.Pi	Clinical signs, parasitology	Jl. Banteng No. 76, Komp Pelabukan Kolaka	Level 1
24	Sulawesi Selatan	Balai Riset Perikanan Pantai Maros	Ir. Munimah	Clinical signs, parasitology, mycology, bacteriology	Jl. Makmur. DG Sitaka, Maros. Sulawesi selatan Telp. (0416) 371544. Fax 371545	Level 2
		Balai Karantina Ikan Hasanuddin, Makassar.	Ir. Siti Chadijah	Clinical signs, parasitology, mycology, bacteriology	Jl. Landak Baru No. 47 Telp. (0411) 874793. Fax 855766	Level 2
		Univ. Hasanuddin, Makassar.	Ir. Alex Rantetondok	Clinical signs, parasitology, mycology, bacteriology	Jl. Perintis Kemerdekaan Km.10, Makassar Telp. (0411) 586200	Level 1
		Balai Budidaya Air Payau Takala	Drs. Habson	Clinical signs, parasitology, mycology, bacteriology	Desa Bontole, Kec. Galesong, Kab. Takalar Telp. (0411) 320730. Fax 866936	Level 1
		Unit Pembinaan Budidaya Air Payau Pangkep/Barru	Ir.Andi Farida HP. 08124239707	Clinical signs, parasitology, mycology, bacteriology, virology (PCR)	Jl. Poros Pangkep Baru, Kec. Mandale Kab. Pangkep Telp. (0411) 864720	Level 1+ PCR
		PT. Charoen Pokphand Prima, Makassar.	Nathalia	Clinical signs, parasitology, bacteriology	Jl. Gatot Subroto 23 Makassar, Telp. (0411) 438189	Level 1
25	Maluku	Loka Budidaya Laut Ambon	Evri Nurbeti	Clinical signs, parasitology, bacteriology	Jl. Laksda Leo Wattimena, Weiheru Telp (0911) 361616	Level 1
		Pos Karantina Ikan Ambon	Komaruddin, S.Pi	Clinical signs, parasitology	Jl. Laksda Leo Wattimena, Weiheru.Ambon, Telp/Fax (0911) 362047	Level 1
		Pos Karantina Ikan Ternate	Ramli, S.Pi	Clinical signs, parasitology	Komp. Bandar Sultan Babullah, Ternate	Level 1
26	Papua	Stasiun Karantina Ikan Sentani, Jayapura.	Muchlin, S.Pi	Clinical signs, parasitology	Komp. Bandara Sentani PO BOX 234 Jayapura Telp. (0967) 592203	Level 1
		Pos Kerja Karantina Ikan Bandara Mopah, Merauke	Ashari Syarief, S.Pi	Clinical signs, parasitology	Jl. Peternakan Mopah Lama PO BOX 263, Telp (0971) 323749	Level 1
		Pos Karantina Ikan Bandara Jefman, Sorong	Rd. Ferry Ichwan Priatna, A.Pi	Clinical signs, parasitology	Jl.Jend A. Yani No.2 Sorong Telp/Fax (0951) 32671	Level 1
		Satker Karantina Ikan Bandara Timika	Dede Rosmana, A.pi	Clinical signs, parasitology	Jl. Yos sudarso, Timika,Telp. (0901) 322709	Level 1
		Satker Karantina Ikan Bandara Frans Kaisiepo, Biak.	Yesse Danny Huwae, A.Pi	Clinical signs, parasitology	Jl. Prof. Muh. Yamin No. 73 Biak, Papua, Telp. (0981) 23054	Level 1

Appendix 4. List of legislations related to fish quarantine

No.	Decree Number	Level and Effective Date	Note
1.	Act. No. 16/1992	Law of the Republic of Indonesia Effective date (ED): 8 June 1992	This is the main legislation for Quarantine in Indonesia. It includes animal, plant and fish quarantine. This act explains about the health certification, requirement for domestic and international fish movement.
2.	Decree no. 15/2002	The Ministry of Marine Affairs and Fisheries (MMAF) ED: 23 April 2002	Further explanation of the Fish Quarantine act. No. 16/1992. It contains definition, requirement for fish quarantine, quarantine action, quarantine zone, quarantine pest and disease categories, entry and exit point, quarantine personals, retribution and collaboration among the countries.
3.	Decree no. 819/1980	The Ministry of Agriculture ED: 15 Nov 1980 <i>Not valid</i>	Importation procedure of live fish into Republic of Indonesia Permit issued by Directorate General of Fisheries, entry point only Jakarta International Airport
4.	Decree no. 265/1986	The Ministry of Agriculture ED: 6 May 1986 <i>Not valid</i>	The requirements (procedure, document, and criteria) for importation of live fish
5.	Decree no. 245/1990	The Ministry of Agriculture Effective date: April 1990A. <i>Not valid</i>	Quarantine measures, and actions against live fish intended for exportation. Annex. List of exporting points
6.	Decree no. 169/1990	The Ministry of Agriculture ED: March 1990B. <i>Not valid</i>	Specifies ports of entry for live fish airport of Sukarno hatta (Jakarta), regional quarantine service, Polonia Airport (Medan, FQS), Ngurah Rai Airport (Bali, FQS), and Biak Airport (Papua, FQS)
7.	Decree No.405/1996	The Ministry of Agriculture ED: 27 May 1996C. <i>Not valid</i>	Renewal of the Decree no. 88/1994 Revision on entry and exit points for carriers of quarantine pests and diseases of fish
8.	Decree no. 213/2001	The Ministry of Agriculture ED: April 2001D. <i>Not valid</i>	Renewal of the decree no. 245/1990 and 405/1996. Updates the list of entry, exit and domestic checkpoints for live fish transport.
9.	Decree no. 470/2002	The Ministry of Agriculture ED: 31 August 2002	Renewal of the decree no. 213/2001. Updates the list at the appendix.
10.	Decree no. 16/2003	MMAF ED: 9 June 2003	Renewal of the decree no. 470/2002. Updates the list of entry, exit and domestic checkpoints at the appendix.
11.	Decree no. 809/1990	The Ministry of Agriculture ED: 30 October 1990	Fish Quarantine fees for importation, exportation, and inter-island movement of live fish
12.	Decree no. 18/2003	MMAF ED: 9 June 2003	Renewal of the decree no. 405/ Update list of international, and domestic exit and entry points for live fish (airports, seaports, river ports, inland ports, and other intra-national checkpoints)
13.	Instruction letter no. 429/1998	The Center for Fish Quarantine ED: 1 April 1998	Technical guidance on the standard diagnosis and monitoring of quarantine fish pest and disease, as well as the trial for vaccine, disinfections, and medicine.
14.	Decree no. 520/1993	The Ministry of Agriculture ED: 5 August 1993	List of quarantine pest and diseases of fish and their carriers.
15.	Decree no. 841/1999	The Ministry of Agriculture ED: 22 July 1999	Updates of the decree no. 520/1993 concerning list of quarantine fish disease.
16.	Decree no. 17/2003	MMAF ED: 9 June 2003	Updates of the decree no. 841/1993 concerning list of quarantine fish disease. (detailed list is enclosed)
17.	Decree no. 363/1990 Decree no. 248/1990 Decree no. 143/1990	The Ministry of Agriculture The Ministry of Health The Ministry of Trade ED: May 1990	Collaboration ministerial decree on the quality control technical guidance for the exported fresh and frozen fish. A simplification procedure <i>Not directly related to fish quarantine</i>
18.	Decree No.34/2003	MMAF ED: 17 Sept 2003	Legal documents required for fish quarantine with standard form examples
19.	Decree no.15/2003	MMAF ED: 9 June 2003	Requirement and procedures for neither individual nor government institution to qualify as a Quarantine unit.

Appendix 5. Legislations on the restriction of movement of certain fish species

1.	Decree no. 214/1973	The Ministry of Agriculture ED: 7 May 1973	Prohibition of exporting live fish (<i>Anguilla</i> , milkfish fry, <i>Botia</i> broodstock, and freshwater shrimp)
2.	Decree no. 179/1982	The Ministry of Agriculture ED: 22 March 1982	Importation prohibition of some high-risk fish to Indonesia. The species prohibited was: Piranha, Vampire catfish, Aligator, <i>Silurus alanis</i> , <i>Esex masoinongy</i> , <i>Electronhorus electricus</i> , <i>Tetraodon spp.</i>
3.	Decree no. 382/1987	The Ministry of Agriculture ED: 20 June 1987	Prohibition of exporting wild milkfish fry from sea around Java, Madura, Lampung, South Kalimantan, East Kalimantan, South Sulawesi, and Southeast Sulawesi.
4.	Decree no. 700/1989	The Ministry of Agriculture ED: 6 October 1989	Agreement for exporting Penaeid shrimp from Indonesia except brood stock and their candidates. Quarantine was not necessarily applied unless stated by the destination country
5.	Decree no. 94/1995	The Ministry of Trade ED: May 1995	Prohibition of exporting Napoleon wrasse (<i>Cheilinus undulatus</i>)
6.	Decree no. 375/1995	The Ministry of Agriculture ED: 24 May 1995	Prohibition for Napoleon wrasse fishing activities, except for traditional fish farmers at certain size, location and number.
7.	Decree no. 34/1996	The Directorate General of Forest Protection and Sustainable Natural Resources ED: June 1996	Prohibition of trading wild Arowana. Permits of Trading of Arowana (<i>Scleropages formosus</i>) only from registered culture farm with certificate of origin and microchip number.
8.	Decree no. 28/2002	MMAFED: June 2002	The decree officially declared that Java Island as an isolated area of the disease and moving carp and koi from Java Island to other islands are strictly prohibited. In addition, importation of common carp and koi into this country was temporarily not permitted.
9.	Decree no. 40/2002	MMAFED: October 2002	Three months after the Ministerial Decree no 28/2002, through Ministerial Decree No.40/2002 Java and Bali is pronounced as infected area and movement of live-fish from the Islands to another within the country should follow quarantine check for KHV. Importing koi and common carp is permitted only from free KHV country.
10.	Circulation letter No. 4999/2002	The Directorate General of Aquaculture ED: 15 Nov 2002	Technical guidance and procedure transporting common carp out the Java island.

Current Status of Transboundary Fish Diseases in Lao PDR: Occurrence, Surveillance, Research and Training

Thongphoun Theungphachanh

*Animal Production Quality Control
Department of Livestock and Fisheries
National Animal Health Centre
P.O. Box 811
Lao Peoples Democratic Republic*

Introduction

Lao PDR is a landlocked country with no direct access to the sea. Fisheries resources are derived purely from fresh water resources (Tables 1 and 2). The resources originate from the Mekong River, reservoirs and its tributaries (40%), pond, swamps, wetlands, flood plains (26%), rice field (32%) and cage culture (2%). Food production of Lao PDR is dominated by subsistence agriculture, which accounts for about 65% (for fish 7%) of GDP and it is estimated that 85% of the population rely on farming practices. The predominant crop is rice, which takes up more than 80% of the cultivated area. Other foods locally produced include: beef, chicken, pork, eggs, and a wide range of fruits and vegetables. Fishes produced in the country are mainly consumed locally, especially because fish products in Lao PDR are not exported yet. Most fish are marketed in fresh form. Processing of fish is by drying, fermentation, and smoking. The domestic fish marketing system starts with the middle trader who collects the fish from the fishermen (fish pond, reservoirs, Mekong River, etc.) and bring them to the landing market in the village. In some cases, another trader will buy the fish from the first trader and sends them to town market for retail. Since villages have no cold storage facilities for the fish products, the fish is marketing in fresh form. This lack of cold storage facility system leads to unstable fish price. For instance, during peak harvest season, the fish price is very low, but it easily goes up in the dry season when fish production is very low.

The industrial sector is small, contributing about 14% of GDP which ranged from medium-sized manufacturing plants to small operations producing at residential properties. Based on the annual statistics in 1999-2000, there are about 800 food manufacturing plants in Lao PDR located

mostly in big towns. Food and fishery products include baked goods, noodles, milk, salt, fish sauces, fermented fish, ice, canned beverages and agricultural processed products. Presently, there is little fish processing in Lao PDR, hence the trend towards increased in fish manufacturing. Post-harvest management and practices have been traditionally done by women, and this has become a very important consideration in gender issues and programs. There is no available information on production of koi carp.

Table 1. Species of fish produced in different fish production systems, or caught in reservoirs and natural water bodies

	Lao name	English name	Scientific name
Pond culture	Pa nin	Tilapia	<i>Oreochromis</i> sp.
	Pa nai	Common carp	<i>Cyprinus carpio</i>
	Pa marican	Indian carp	<i>Cirrhinar mrigala</i>
	Pa paak	Javanese carp	<i>Puntius gonionotus</i>
	Pa hua nyai	Bighead carp	<i>Aristithys nobilis</i>
	Pa kedleab	Silver carp	<i>Hypophthalmichthys molitrix</i>
	Pa rohu	Rohu	<i>Labeo rohita</i>
	Pa salid	Snakeskin gourami	<i>Trichogaster pectoralis</i>
Rice fish culture	Pa nin	Tilapia	<i>Oreochromis</i> sp.
	Pa nai	Common carp	<i>Cyprinus carpio</i>
State hatchery	Pa nin	Tilapia	<i>Oreochromis</i> sp.
	Pa nai	Common carp	<i>Cyprinus carpio</i>
	Pa marican	Indian carp	<i>Cirrhinar mrigala</i>
	Pa paak	Javanese carp	<i>Puntius gonionotus</i>
	Pa hua nyai	Bighead carp	<i>Aristithys nobilis</i>
	Pa kedleab	Silver carp	<i>Hypophthalmichthys molitrix</i>
	Pa rohu	Rohu	<i>Labeo rohita</i>
	Pa duc	Catfish	<i>Clarias</i> spp.
Private hatchery	Pa nin	Tilapia	<i>Oreochromis</i> sp.
	Pa nai	Common carp	<i>Cyprinus carpio</i>
	Pa paak	Javanese carp	<i>Puntius gonionotus</i>
	Pa hua nyai	Bighead carp	<i>Aristithys nobilis</i>
Community pond	Pa nin	Tilapia	<i>Oreochromis</i> sp.
	Pa nai	Common carp	<i>Cyprinus carpio</i>
	Pa marican	Indian carp	<i>Cirrhinar mrigala</i>
	Pa paak	Javanese carp	<i>Puntius gonionotus</i>
	Pa hua nyai	Bighead carp	<i>Aristithys nobilis</i>
	Pa kedleab	Silver carp	<i>Hypophthalmichthys molitrix</i>
	Pa rohu	Rohu	<i>Labeo rohita</i>

Table 1 (continuation)

	Lao name	English name	Scientific name
Reservoir	Pa nin	Tilapia	<i>Oreochromis</i> sp.
	Pa nai	Common carp	<i>Cyprinus carpio</i>
	Pa marican	Indian carp	<i>Cirrhinar mrigala</i>
	Pa paak	Javanese carp	<i>Puntius gonionotus</i>
	Pa hua nyai	Bighead carp	<i>Aristihthys nobilis</i>
	Pa kedleab	Silver carp	<i>Hypophthalmichthys molitrix</i>
Nursery	Pa rohu	Rohu	<i>Labeo rohita</i>
	Pa pok	Barb	<i>Puntius orphoides</i>
	Pa Sieu		<i>Esomus goddardi</i> (Cyprinidae)
Capture Fisheries	Pa nai	Common carp	<i>Cyprinus carpio</i>
	Pa paak	Javanese carp	<i>Puntius gonionotus</i>
	Pa hua nyai	Bighead carp	<i>Aristihthys nobilis</i>
	Pa paak	Javanese carp	<i>Puntius gonionotus</i>
	Pa salid	Snakeskin gourami	<i>Trichogaster pectoralis</i>
	Pa duk	Catfish	<i>Clarias</i> spp.
	Pa lot	na	na
	Pa kho	na	na
	Pa soud	na	na
	Pa pok	na	na
	Pa kheng	na	na
	Pa tong	na	na
	Eel	na	na
	Pa kabok	na	na
	Pa kun	na	na
	Pa kuilan	na	na
	Pa dok ngiew	na	na
	Pa kot	na	<i>Mystus numerus</i>
	Pa Kha nyaeng	na	<i>Mystus carvasius</i>
	Pa seuam	na	na
Pa lon	na	<i>Cirrhinus microlepis</i>	
Pa Khao	na	<i>Wallagonia attu</i>	
Pa siew	na	na	

na: not available

Table 2. Fish Production in Lao PDR, from 1998 to 2002

Year	Fish Caught (MT)			Total Production (MT)
	C ¹	I ²	A ³	
1998	2,940	2,520	36,540	42,000
1999	3,020	2,416	54,967	60,403
2000	17,790 3,421	5,169 2,870	10,300	71,316
			475	
			23,850	
			7,441	
2001	17,790 3,421	5,169 2,870	12,081	73,135
			513	
			23,850	
			7,441	
2002	19,061 4,847	3,791 5,791	28,458	93,156
			900	
			23,858	
			6,500	

Sources of information: DLF, Remark: FISHSTAT

1 = Capture Fisheries Resources, 2 = Inland Fisheries, 3 = Aquaculture Fish Pond

I. Fish Diseases in Lao PDR

I-1. Current Status of Fish Diseases

Fish is an important food for Lao people, both for subsistence and to generate income. Therefore, fish disease occurrence can affect fish production.

In Lao PDR, fish disease so far has not been a serious problem compared to another countries in South East Asia. However, some fish diseases have been observed in the remote and cool part of northern and southern Lao PDR. These diseases include *Learnea* sp., *Dactylogyrus* sp., *Gyrodactylus* sp., *Ichthyophthirius multifiliis*, *Trichodina* sp., *Cryptocaryon* sp., *Epistylis* sp., *Oodinium* sp., and the bacterium, *Edwardsiella tarda*. More information is provided in Table 3. The Lao Government is very concerned about issues on fish diseases and tries to find the solution. Particularly, the Department of Livestock and Living Aquatic Resources Research Center (LARReC) is the agency in charge of this aspect. In this agency, fish diseases have been considered as a very important research activity since 1999.

Table 3. Ranking of the different disease, production-related problems and number of respondents reporting for each production systems

Disease and production-related problems	Total number respondents (families, community pond enterprise)	Production Systems							
		A	B	C	D	E	F	G	H
Death no signs	67 families	21					21		25
Ped erosion (EUS-like)	59 families, 2 communities 60 ponds (204 families)	3		2 (204 families)			21		35
Predation by snake fish and crab	58 families, 1 state hatchery	47	11		1				
Overstocking	37 families								
Not enough food	36 families								
Lack of experience technical knowledge	31 families	31							
Red spots with skin intact	21 families						21		
Fry too small	20 families	20							
Weeds and polluted	16 families						16		
Flood	15 families	15							
Lack of oxygen cylinders	6 families					5		1	
Lack of nursery pond	6 families					6			
Low hatching rate	6 families					6			
Damaged eggs	6 families					6			
Poor selection of broodstock	6 families					6			
Red patches	5 families	3	2						
<i>Lernaea</i> infection	4 families, 1 state hatchery	3	1		1				
Death - white spot	5 families					5			
Not enough water	4 families	4							
Not enough hapa net	3 private hatcheries					2		1	
Difficulty in water management	2 private hatcheries					2			
Inadequate distribution of water	1 state hatchery				1				
Predation by insects	1 state hatchery				1				
Poor genetics	1 state hatchery				1				
Erosion of dikes	1 state hatchery				1				

A: pond culture; **B:** rice fish culture; **C:** community pond; **D:** state hatchery; **E:** private hatchery; **F:** reservoir; **G :** nursery; and **H :** capture fisheries

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi Carp

Unfortunately no information is available on KHVD. However, clinical signs of KHVD have been observed in some places in a lake and in pond culture systems.

II. Current Status of Viral Diseases in the Production of Shrimps

II-1. Production of Shrimps

There is no shrimp culture pond activity to support consumption in the country. Because of this, the Government of Lao PDR has a policy of allowing the importation of seafood into the country for consumption. The yearly average total amount of imported seafood is about 1200-1300 metric tons. The price of shrimp is about 80000 kip per kilogram (US\$8.00). Each importing company must be registered and pays an import tax to the Department of Taxation.

Quality control of imported seafood is the responsibility of government officials, specifically veterinarians, at the border check points. This work is under the supervision of the Department of Livestock and Fisheries. The importation document must specify the quantity, types of processing and packaging, and the means of transport. In some cases, a sample is taken for laboratory analysis in order to examine for animal diseases.

II-2. Viral Diseases of Shrimps

Unfortunately, there is no information available on the occurrence of WSSV and TSV in shrimps.

III. Surveillance, Monitoring and Diagnosis of Aquatic Animals

The Department of Livestock and Fishery's Living Aquatic Resource Research Centre is responsible for monitoring occurrences of diseases. The Department is under the Ministry of Agriculture and Forestry with the following address and contact numbers:

Ministry of Agriculture and Forestry
Department of Livestock and Fisheries
National Animal Health Centre
P.O. Box 811 Vientiane, Lao PDR
Tel: 856-21 416 932 or 856-21 241 581, Fax: 856-21 415 674

Surveillance and monitoring for diseases of aquatic animals are conducted periodically by the Living Aquatic Resource Research Centre in order to prevent diseases. Observations on environmental conditions, water quality and water color are part of the monitoring.

The laboratory has the capacity to perform bacterial, fungal and parasitological analysis, but not for the examination of virus infections. The bacteriology laboratory has the ability to isolate and identify most bacterial species. Examination for protozoan and metazoan parasites, blood parasites, and external and internal parasites of livestock are regularly undertaken. The laboratories are capable of disease diagnosis at Levels I and II.

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

The following are the requirements to support shipment of fishery products:

- Brood for live and aquarium fishes = Health certificates from exporting country are required;
- Frozen fish requires an importation document or a permit specifying the quantity, type, processing method, packaging and the means of transport;
- In some cases a sample is taken for aquatic animal disease; and
- Quality control certification of imported products is the responsibility of the government officials at the border checkpoint.

The inspection aims to minimize transmission of animal diseases to humans. For the Harmonization of Certificate and testing at the National and Regional level, we need to improve the Diagnostic Capacity of our laboratory to meet the requirement of International Standard. At present, we do not have enough trained staff and facilities to achieve it because we do not have enough financial support from the Government and also from international organizations. The current constraint for the implementation of this inspection is a lack of funding to support the work of officials at the border checkpoints. In addition, the officials have little training or experience in the inspection of shrimp and other seafood types. Likewise, the veterinary law to enforce these preventive measures is not in place but we hope to remedy this in the near future.

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

There are significant opportunities to gain synergetic benefits from cooperation between the different divisions of Department of Livestock and Fisheries (DLF) in key areas, specifically laboratory system, surveillance and information management. An integrated surveillance system should be established for aquatic animals and livestock using active and passive surveillance techniques established during previous and current livestock health ACIAR project. An integrated information system should be established to meet the needs of the Department of Livestock and Fisheries based on existing system, and utilizing the district-level record keeping system

developed under the Regional Development Committee (RDC) for Livestock and Fisheries Development in Southern Laos. Parallel to the DLF is the recently created National Agriculture and Forestry Research Institute (NAFRI), and a sub-section, the Lao Animal Research Institute with functions yet to be clarified.

The agencies that conduct training on Fish Diseases are LARReC, DLF and NAHC all under the Ministry of Agriculture and Forestry. The laboratory for livestock has the capacity to perform bacterial, fungal and parasitic analysis, but not for the examination of virus infections. The bacteriology laboratory has the ability to isolate and identify most bacterial species. Fish disease capability can be developed from collaborative activities with existing laboratories. Given that, there remain numerous requirements to support activities for surveillance, monitoring and diagnosis such as:

- Training of staff on diagnosis of bacterial and viral diseases;
- Prevention and treatment methods for bacterial, viral and parasitic diseases;
- Active surveillance technique for livestock and aquaculture;
- Manual for veterinary and clinical parasitology, bacteriology and virology for aquatic animals; and
- A color atlas of clinical parasitology, bacteriology and virology for aquatic animals.

Current Status of Transboundary Fish Diseases in Malaysia: Occurrence, Surveillance, Research and Training

Faazaz Abd. Latiff

National Fish Health Research Centre

Fisheries Research Institute

11960 Batu Maung, Penang, Malaysia

Introduction

Malaysia lies within 100° and 119° East longitudes, and 7° North latitude (Fig. 1). Neighbouring countries are Thailand to the north and Singapore to the south. The country consists of two land masses with a total area of 330,434 square kilometres: Peninsular Malaysia is located south of Thailand, while East Malaysia, comprising the states of Sabah and Sarawak, stretches along



Fig. 1. Map of Malaysia (Peninsular and East Malaysia)

the northern part of Borneo. The two land masses are separated by the South China Sea. Malaysia has a total coastline of 4,675 km, with 2,068 km for the Peninsula and about 2,607 km for East Malaysia. It is on a strategic location along Straits of Malacca and southern South China Sea.

The fisheries sector plays an important role in providing fish as a source of food and protein. It contributes about 1.54% of the GDP and provides direct employment to 84,496 fishermen and 22,108 fish culturists. Over the years, the industry has succeeded in achieving a steady production from its marine inshore fisheries amounting to an average of 1.06 million tons (Annual Fisheries Statistics, 1998, 1999, 2000, 2001).

In 2001, the fisheries sector produced RM 5.45 billion (Euro 1.25 billion) consisting of 1,408,308 metric tons (MT) of fish valued at RM 5.37 billion, and 338 million pieces of ornamental fish valued at RM 81 million. Statistically, the sector recorded an overall decrease in production by 3.12%, but an increased value of 0.06% compared to 2000 figures.

Production from marine capture fisheries yielded 1,231,289 MT with a value of RM 4.17 billion. Within the sector, the coastal fisheries remained the major contributor with a production of 1,063,363 MT valued at RM 3.66 billion. The aquaculture sector recorded a production of 177,019 MT, which constituted 12.6% of the total fish production valued at RM 1,206.59 million. The inland fisheries sector remained insignificant producing only 3,446 MT or 0.24% of the total fish production (Annual Fisheries Statistics, 1998, 1999, 2000, 2001). The lists of aquatic animal species traded live for food and other purposes are given in Appendices 1A-1F.

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

Malaysia has been the largest producer for ornamental fish. Almost 90 percent of these fish and aquatic plants have been exported to Singapore and Hong Kong, France, Germany, United Kingdom, Thailand, Indonesia, Holland, United States of America and the Philippines (Fisheries News, April 2002). At the same time Malaysia is importing koi carp from Japan, Indonesia, Singapore, Thailand, Hong Kong and Taiwan with shipments through the Kuala Lumpur International Airport (KLIA)(Tables 1a-1b). Besides koi, Malaysia has also other carps and the production for the major species are tabulated in Appendices 2-5. Appendix 6 shows carp fry production from government hatcheries. Table 1c shows the number of koi that had been exported through the Bayan Lepas International Airport (BLIA) in Penang. There are 14 big koi fish producers in Malaysia.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

Among the koi diseases reported in Malaysia was cyprinid herpesvirus (CHV) in the early 1990s reported by the University Putra Malaysia (UPM) in Serdang, Selangor. The gross pathology observed were non-necrotizing, benign neoplasm on the skin with whitish, soft, warty lesions, epidermal echymotic haemorrhages and lordosis (Hassan *et al.*, 1995). The virus was able to multiply in BF-2 and BB cell lines. Monoclonal antibody and structural analyses were performed on this virus (Abdullah, 2004).

The Department of Fisheries (DOF) Malaysia had been alarmed by the koi herpesvirus disease (KHVD) which was reported in Indonesia in 2002. The government took immediate action to ban the importation of koi especially from Indonesia. Tables 1a-1b show there was no koi importation from Indonesia in 2003. Until today, there is no outbreak of koi herpesvirus (KHV) in Malaysia.

To confirm the matter, a survey was started in 2002 by UPM to screen for this virus with funding from the Ministry of Science and Environment. The area covered for the survey included Selangor and Perak and the survey is still going on. All samples were Malaysian hybrid of koi. Polymerase chain reaction techniques using koi herpesvirus (KHV) primers reported from Israel's cases had been used for this purpose and until now the results are negative (Abdullah, 2004).

Table 1a. Total importation of koi (pieces) via KLIA in 1998-2003

Country	1998	1999	2000	2001	2002	2003	2004 (Jan-May)
China	0	0	509	0	0	0	1, 000
Japan	21, 361	26, 358	23, 877	16, 563	20, 363	11, 735	5, 584
Indonesia	0	2, 796	0	1	727	0	0
Singapore	10	0	1, 111	360	48	0	0
Thailand	0	0	0	0	1, 425	4, 914	410
Taiwan	0	3, 248	5, 926	10, 124	6, 451	3, 576	40
Total	21, 371	32, 429	31, 423	27, 048	29, 014	20, 225	7, 034

Table 1b. Total importation of koi via BLIA in 1998-2003

Number of Pieces	1998	1999	2000	2001	2002	2003	2004 (Jan-May)
	5, 403	6, 696	6, 866	5, 309	4, 234	22, 022	1, 132
Exporting countries	HK, T, J	HK, T, J, S	HK, T, J, S	HK, T, J, S	T, J	HK, T, J	T, J

Table 1c. Total exportation of koi via BLIA in 2001-2003

Year	2001	2002	2003	2004(Jan-May)
Number of pieces	8, 351	20, 148	37, 711	12, 761
Importing countries	G, H, I, F, UK, HK, S, USA	G, H, UK, J, USA	G, H, I, UK, USA	G, H, HK, UK, USA

F – France G – Germany H – Holland HK – Hong Kong
 I – Indonesia J – Japan S – Singapore T – Taiwan
 UK – United Kingdom USA – United States of America

I-3. Production of Ornamental Fish

The total production of ornamental fish increased by 10.4% from 306,096,870 pieces in 2000 to 338,055,460 pieces in 2001. In terms of value, the increase was 12.6% from RM 71.95 million in 2000 to RM 81.03 million in 2001. Johor remains as the main producer of ornamental fish contributing 263,760, 236 pieces, which was 78% of the total production of ornamental fish in 2001. Table 2 shows the estimated total production of ornamental fish and its value for 1997-2001. Appendix 1 lists the common English, local and scientific names of the fishes which are found in Malaysia. Ornamental fish production for 2001 according to group follows:

Group	Number of pieces
1. Poecilids	102, 487, 656
2. Cyprinids/ Barbs/ Danio/ Goldfish/ Koi	97, 078, 229
3. Anabantids	39, 790, 903
4. Characins	23, 148, 553
5. Cichlid	19, 932, 165
6. Cyprinodontids	742, 130
7. Osteoglossids	33, 576
8. Callichthyids	318, 001
9. Cobitids	75, 035
10. Aquatic plants	45, 086, 359
11. Others	9, 362, 853
Total	338, 055, 460

Table 2. Estimated total production of ornamental fish and its value in 1997-2001

Year	Number of pieces	Value in RM million
2001	338, 055, 460	81.03
2000	306, 096, 870	71.98
1999	340, 439, 721	80.23
1998	324, 542, 970	70.40
1997	309, 093, 053	61.22

II. Current Status of Viral Diseases in the Production of Shrimps and Prawns

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*) and White Shrimp (*P. merguensis*)

The shrimp industry consists of the capture and aquaculture sectors. From capture fisheries using push nets and trawlers, 77,465 MT of shrimp worth of RM 875.5 million (Euro 203 million) were harvested in 2001. This figure is expected to remain constant for the next decade as a result of the moratorium imposed on trawling in the coastal areas.

Shrimp aquaculture is fast growing and production figure in 2001 was 27,013 MT worth RM 937.5 million (Euro 175 million). Two species are cultured: tiger shrimp *Penaeus monodon* and the white shrimp *P. merguensis*. Table 3 shows the estimated total production of shrimps (Saidin, 2003; Syed Omar, 2004).

Table 3. Estimated total production of cultured *Penaeus monodon* and *P. merguensis* in 1998-2003

Year	Number of pieces	Value in RM million
2003	20, 000	N.A
2002	27, 000	N.A
2001	26, 351	744, 796
	<i>662</i>	<i>18,968</i>
2000	15, 893	490, 000
1999	11, 733	328, 093
	<i>454</i>	<i>214, 645</i>
1998	9, 685	283, 443
	<i>150</i>	<i>4, 429</i>

Note: Figures in italics refer to *P. merguensis*; *value in thousands of Malaysian Ringgit

Pond culture technology developed rapidly in the early 1980s with the importation of postlarvae from Taiwan. Malaysia is blessed with abundant supply of tiger shrimp broodstocks in the coastal areas of Sabah and Sarawak. The development of captive maturation and breeding technology resulted to the mushrooming of private hatcheries. Currently, there are 160 shrimp hatcheries with more than 80% in West Malaysia producing about 8 billion postlarvae annually.

The outbreak of white spot virus disease in the mid-1990s had affected many farmers resulting in economic losses amounting to about USD25 million (Euro 21 million). Thus, the shrimp aquaculture technology evolved from open culture system to close system to combat disease problems, particularly white spot syndrome.

At present, there are 1,126 shrimp farms employing about 22,000 farmers. Twenty percent of these are big farms having more than 20 to a few hundred ponds. Small and medium farms have less than 10 ponds. The culture practice is intensive with high inputs that produce an annual average of 3.5 MT.

In 2001, Malaysia exported about 144,590 MT of fish and fishery products valued at RM1.35 billion which mainly came from the exported shrimp products. The biggest exports went to Italy and Japan.

There had been reports of *Litopenaeus vannamei* being cultured illegally in the state of Perak in 2003, but no official written documents had been submitted since the farmers were very uncooperative (Saidin, 2003; Syed Omar, 2004).

b. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

Macrobrachium rosenbergii has always been found in Malaysian rivers. The fry and culture production figures are shown in Table 4.

Table 4. Estimated total production of freshwater prawn, *Macrobrachium rosenbergii* in 1998-2001

Year	Fry production from government hatcheries	Production in tons	Value in RM '000
2001	5, 469, 470	2, 034	19, 964
2000	5, 625, 250	1, 338	32, 998
1999	6, 038, 874	653	15, 250
1998	5, 612, 600	281	6, 361

Spawners are obtained locally and postlarvae are produced by private and government hatcheries. Grow-out culture is carried out in earthen ponds. There has been no record of importation for the species.

II-2. Major Shrimp Diseases

A. White Spot Syndrome Virus (WSSV)

WSSV is one of the most devastating viruses to infect penaeid shrimp. First discovered in Taiwan in 1992, it has spread rapidly to most growing countries in Asia. In Malaysia, it was first reported in 1994 and had spread to affect 80% of farms by 1996. Many species of penaeid shrimps can be infected, as well as crabs, spiny lobsters, and fresh water prawn. A number of small aquatic arthropods can harbour the virus. Virulence studies have shown that WSSV isolates are extremely virulent, with cumulative mortalities reaching 100%. During the second half of 2003, WSSV had reduced the annual production to 20,000 MT, 15% of which was *Litopenaeus vannamei*.

a. Etiology

White spot syndrome virus, a double stranded DNA virus within a new group Nimaviridae.

b. Clinical Signs

The shrimp experience anorexia and lethargy having loose cuticle with numerous white spots (0.5-2 mm) on the inside surface of the carapace. Moribund shrimp showed pink to red discoloration.

B. Bacterial White Spot Syndrome (BWSS)

It affects *P. monodon* and was first reported in 1998 (Wang *et al.*, 1999, 2000).

a. Etiology

Bacillus subtilis has been suggested due to its association with the white spots.

b. Clinical Signs

Dull white spots on carapace and all over the body. The white spots are rounded but not dense. Shrimp exhibit delayed moulting and reduced growth.

C. Yellow Head Virus (YHV)

It affects *P. monodon*, *Acetes* spp. and other small shrimps. Tests that had been conducted, so far, gave negative results.

a. Etiology

YHV is a single stranded RNA, rod-shaped, enveloped, cytoplasmic virus likely related to members of family Coronaviridae.

b. Clinical Signs

The disease causes abrupt cessation of feeding. Shrimp aggregate at edges of pond or near surface. The hepatopancreas become discolored giving a yellowish appearance and shrimp generally becomes abnormally pale.

c. Significance

YHV has been reported in the absence of the classic yellowish cephalothorax. The clinical signs are not always present. Postlarvae (PL₂₀₋₂₅) and older shrimp are more susceptible where mortality can reach 100% within 3-5 days. It is believed that infection can be transmitted horizontally and vertically by shrimp having chronic sub-clinical infection.

II-3. Significant and Emerging Viral Diseases of *Macrobrachium rosenbergii*

There is no record of any viral disease in *M. rosenbergii*. From normal observation, the prawns in the ponds may exhibit necrotic shells at most.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

The responsible or Competent Authority (CA), facilities, and their locations are as follows:

Fish Quarantine and Quality Control Division
Department of Fisheries Malaysia,
Ministry of Agriculture and Agro-base Industry,
8th & 9th Floor, Wisma Tani,
Jalan Sultan Salahuddin,
50628 Kuala Lumpur, Malaysia

The functions of this division are to:

- Conduct fish inspection and quarantine procedures on imported live fish
- Conduct regular inspection on health status and sanitary conditions of registered fish farms particularly those with fish for export market
- Conduct inspection of live fish at the point of exits prior to the issuance of Health Certificates
- Ensure fish which are controlled by CITES are imported with valid documents. All CITES fish can only be exported through the Kuala Lumpur International Airport (KLIA), Sepang
- Provide extension services in fish diagnosis and treatment

a. Location of Facilities

1. Fish Health Management and Quarantine Center
Department of Fisheries Malaysia
Jalan Pekeliling 4
46000 KLIA Sepang
Selangor
2. Fish Quarantine Center
Jalan Batu Maung
11960 Batu Maung
Penang
3. Fish Health Management and Quarantine Center
Bukit Kayu Hitam
06050 Jitra
Kedah
4. Fish Health Management and Quarantine Center
Kompleks Sultan Abu Bakar
Tanjung Kupang
61560, Gelang Patah, Johore

5. Jabatan Perikanan Negeri Kelantan
Tingkat 6, Wisma Persekutuan
Jalan Bayam
15628 Kota Baru, Kelantan

b. Responsible Persons

The following are the personnel who take care of the various Quarantine and Inspection Centers (QIC) in Peninsular Malaysia:

1. Mrs. Rosmawati Ghazali
2. Mr. Hamid Hassan
3. Mr. Nummeran Nordin
4. Mr. Salehudin Ismail
5. Mr. Khaidir Othman

No surveillance and monitoring for diseases of aquatic animals are conducted regularly or periodically by these agencies due to staff constraints. Whenever alerts of disease outbreaks are received, staff from QIC will inform the state director and the National Fish Health Research Centre (NaFisH) will be instructed to investigate the case with them.

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

a. Definition of Levels of Diagnosis

- Level I: Diagnostic activity limited to observation of animal and the environment, and clinical examination (On Site or Field Diagnosis)
- Level II: Diagnostic activity includes Parasitology, Bacteriology, Mycology, and Histopathology (Laboratory Diagnosis)
- Level III: Diagnostic activity includes Virology, Electron microscopy, Molecular biology and Immunology (Laboratory Diagnosis)

All of the above-mentioned QICs have Level I capability for disease diagnosis. Table 5 lists the other fish health laboratories in Malaysia.

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

For quarantine services, the same laboratories and agencies are involved as reported in section III-1. Level I and sometimes Level II of diagnosis are available in these stations.

IV-2. Procedures and Requirements for Importation

Malaysia is one of the countries which follows the Food and Agriculture Organization of the United Nations (FAO) procedures and techniques for

Table 5. Fish Health Laboratories (government, private, university-based, etc.) in Malaysia, their level of diagnostic capability, and contact information

No.	Fish Health Laboratory	Level of Diagnostic Capability	Status	Contact Information
1.	National Fish Health Research Centre, Fisheries Research Institute, 11960 Batu Maung, Penang	Level III	Government	Contact Information Tel.: 046263922 Fax: 045263977 e-mail: nafish@tm.net.my; ambigadevip@yahoo.com
2.	Freshwater Fisheries Research Centre, Malacca	Level II	Government	Tel.: 063172485 Fax: 063175705 e-mail:roslyffrc@hotmail.com
3.	National Prawn Fry Production and Research Centre, Kg. Pulau Sayak, Kedah	Level II	Government	Tel.: 044374021 Fax: 044374470 e-mail: pppbuk@po.jaring.my
4.	Marine Fish Research Centre, Tg. Demong, Terengganu	Level II	Government	Tel.: 096956778 Fax: 096958626 e-mail:hussin58@msn.com
5.	Brackishwater Aquaculture Research Centre, Gelang Patah, Johore	Level II	Government	Tel.: 075101202 Fax: 075103015 e-mail:pptap@po.jaring.my
6.	Fisheries Research Institute, Bintawa, Kuching Sarawak	Level II	Government	Tel.: 082-334144 Fax: 082-331281 e-mail: friswak@po.jaring.my
7.	Fisheries Research Institute, Likas, Kota Kinabalu, Sabah	Level II	Government	Tel.: 088-428416 Fax: 088-425890 e-mail: Ahemad.Sadi@sabah.gov.my
8.	Aquatic Animal Health Center, Faculty of Veterinary Medicine, University Putra Malaysia, 43400 UPM Serdang, Malaysia	Level III	University	e-mail: shariff@vet.upm.edu.my

fish quarantine. Quarantine measures are necessary to facilitate transboundary trade in live fish. This helps to minimize the risk of spreading infectious diseases. Appropriate infrastructure or facilities is important to ensure no possible escape of pathogen to other aquaculture establishments, the environment, or to any natural aquatic resources or systems.

a. Procedures for Importation

The following documents have to be provided:

- 1) Application Form, FQ1DOF;
- 2) Import Licence from Fisheries Development Board (LKIM);
- 3) Import Permit from DOF;
- 4) Health Certificate from the exporting country;
- 5) Details of species (common and scientific name, quantity, number of containers/ cartons/packages);
- 6) 2 copies of invoices;
- 7) Airway Bill;
- 8) Custom Form K; and
- 9) CITES Certificate, where applicable.

b. Quarantine Procedures (Import)

- 1) Importer/owner must have quarantine facilities approved by the CA;
- 2) Upon arrival, all consignment must be quarantined for specified duration;
- 3) Adequate samples of every species must be sent to the laboratory for observations;
- 4) Used water, packing materials, containers and other associated shipping materials must be disinfected/sterilised;
- 5) Treatment for infected fish until all fish is free of diseases should be done;
- 6) If treatment is not successful, the consignment should be destroyed;
- 7) If extended period of quarantine is necessary, approval from the CA should be obtained;
- 8) Any abnormality/mortality during quarantine should be recorded;
- 9) Dead animals should be buried or destroyed in an incinerator; and
- 10) Only fish certified as pathogen-free can be released.

c. Quarantine Area

The quarantine area or premise to hold live aquatic species should conform to certain requirements as stipulated by the CA. The following requirements must be followed or complied to by the owner, or the importer or exporter, in order that quarantine measures can be effectively undertaken:

- 1) The location of the approved quarantine premise is easily accessible to facilitate inspection by the CA;
- 2) The quarantine premises must be located in an area free of flood, and away from any other aquaculture establishments including recreational fish farms, food processing plants, and natural aquatic systems such as rivers, lakes, wetlands and reservoirs;

- 3) The quarantine room or area must have a clear signage;
- 4) The quarantine room or area must be used exclusively for quarantine purposes;
- 5) The quarantine room must be fully enclosed, and walls and floor must be impervious and sufficiently smooth to facilitate cleaning and disinfection. Windows, if installed must be sealed or screened against entry of insects. The door must be self-closing and fitted with insect screen or insect proof screen door;
- 6) The floor must be able to contain spilt water, and must facilitate complete drainage into a treatment tank or reservoir approved by the CA;
- 7) Used water must be treated before discharge;
- 8) Adequate facilities must be provided to disinfect all equipment used;
- 9) Facilities must be provided for staff and inspectors to wash their hands and foot wears prior to entering and leaving the quarantine room;
- 10) All tanks and associated equipment must be properly and clearly labelled for the purpose of inspection;
- 11) All tanks must provide good visibility to facilitate inspection;
- 12) The quarantine room must be sufficiently lighted to permit inspection;
- 13) All dead aquatic species must be temporarily kept in a separate freezer and properly labelled; and
- 14) The quarantine room must not be accessible to unauthorized persons.

d. Protocols for Introduction or Transfer

- 1) Any individual intending to introduce or transfer new live aquatic species for commercial purposes must obtain written approval from the CA.
- 2) Detailed information on the live aquatic species must be provided for risk analysis as follows:
 - a. feeding habits and food organisms utilized
 - b. reproductive pattern and strategy (when, where, how)
 - c. competition with other species
 - d. predation by or on other species
 - e. migration routes and timing (if applicable)
 - f. disease history
- 3) Once approval by the CA has been granted, only a small quantity (to be specified by CA) will be introduced.
 - i) Upon arrival, the consignment has to be surrendered to CA for further risk analysis and monitoring.
 - ii) If the results of the risk analysis and monitoring indicate no negative impact on the environment and living aquatic resources, further introduction may be allowed.
 - iii) Once introduced, the importer or owner is responsible to submit written report on the progress of the culture to the CA as and when required.
 - iv) No movement or transfer is allowed from the owner's premise without the approval of the CA.

e. Species Already Used in Aquaculture

This group includes, but is not restricted to, live aquatic species which is introduced or transferred in large quantities without permanent occupation of the ecosystem (maintained in tanks or in outside systems with no access to open waters). The following are standard procedures in handling these species:

Inspection and Certification

If continued movement from one country to another, or one area to another, is necessary to maintain the commercial enterprise, each shipment should include certification attesting to their pathogen- and disease-free status and should be inspected upon arrival for possible signs of pathogens by the CA. Quarantine measures may have to be carried out by the importer as and when required by the CA. Risk analysis may have to be carried out if the species is deemed to be susceptible to other diseases that may not be virulent in the country of origin.

Transport

The transport of live aquatic species should be done in such a manner as to avoid loss of water en-route to the importer or owner's premises. If water loss is inevitable en-route, consideration of use of sterile water or water sterilization should be considered.

Handling

All packing materials and water must be appropriately and adequately disinfected upon arrival at the owner or importer's premises and quarantine area.

Control

In order to control and contain any possible escape of pathogen, holding sites or quarantine area at the importer or owner's premises must be secured against any means of escape.

f. Species Imported Solely for Scientific Purposes

Any person or research organization intending to import any live aquatic species for research purposes must not do so without prior consultation with the CA.

The purpose of importation or introduction must be clearly stated.

Prior to importation or introduction of any live aquatic species for research purposes, the CA should be notified giving details of the species, its history, biology, potential for pathogenic infection, and any other scientific information deemed necessary for the purpose of risk analysis.

- Risk analysis should be carried out rigorously before permission is granted. Importation can be allowed once the necessary documentations are in order and the Competent Authority is satisfied that would be imported species pose no danger to other natural living aquatic resources.

- Upon arrival, the procedures as in item d. iii. shall be complied.
- The facilities in the laboratory or in any other premise where the research would be carried out should prevent any means of escape throughout the research activities.
- Regular monitoring by the CA needs to be carried out, especially on health management.
- All research findings should be made available to the CA.
- Disposals or transfers to any other premise or destination are not allowed without prior approval of the CA.

g. Legislation, Laws and Regulations

Under legislation, Malaysia has to abide by the Fisheries Act 1985 (Act 317) Amendment 1993, Custom Act 1967 and CITES Regulations. To date, there is no special provision in the Fisheries Act which covers the need to quarantine live fish to prevent disease outbreak. However, Section 40(1) and 40(2) of the Fisheries Act does provide some control of aquatic animal disease.

Section 40 – Control of Live Fish

(1) Any person who:

- a) Imports into or exports out of Malaysia;
- b) Transports from West Malaysia into the Federal Territory (FT) of Labuan, states of Sabah and Sarawak;
- c) Transports from FT of Labuan or the state of Sabah and Sarawak into West Malaysia
- d) Transports from FT of Labuan into the state of Sabah and Sarawak;
- e) Transports from the state of Sabah into the FT of Labuan or the state of Sarawak; or
- f) Transports from state of Sarawak into the FT of Labuan or State of Sabah.

Live fish without a permit or in breach of any condition in a permit issued by the Director General under this section shall be guilty of an offence.

- (2) The Director General may impose such conditions as he thinks fit in the permit, including conditions concerning the state of cleanliness of the fish to be exported, imported or transported and measures to avoid the spread of communicable fish diseases, or to avoid the release into the natural environment of non-indigenous species of fish.

h. Import Prohibition

The following are prohibited for import by special directives from the Director General of Fisheries:

- 1) Tiger shrimp broodstock
- 2) Exotic white shrimp, *Litopenaeu vannamei* – fry and broodstock
- 3) All exotic species for research purposes, without written approval from the Director General of Fisheries
- 4) All species of piranhas

i. Export Prohibition

The following are prohibited for export by special directives from the Director General of Fisheries:

1. Tiger shrimp broodstock
2. All types of corals
3. Cockles (*Anadara granosa*) < 25mm in size
4. Grouper fry < 6in (15.24cm) in size

j. Penalties

Section 25(b) stipulates a penalty of not more than RM 20,000.00, or jail term not more than 2 years, or both.

IV-3. List of Quarantinable Diseases of Aquatic Animals

Following is the list of quarantinable diseases of aquatic animals:

a. Viral Diseases

- White spot syndrome virus (WSSV)
- Iridovirus
- Viral nervous necrosis (VNN)
- Taura syndrome virus (TSV)
- Yellow head virus (YHV)
- OIE listed diseases
- Koi herpesvirus (KHV)

b. Bacterial Diseases

- Septicemia and dropsy
- Vibriosis

c. Fungal Diseases

- None

d. Parasitic Diseases

- Cryptocaryosis

e. Other Diseases

- None

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals**a. Current Research Activities**

- Determination of protective antigens against Cryptocaryoniasis in marine fish cultures, for future vaccine development
- Identification and diagnosis of fish viral pathogens
- Streptococcosis in tilapia cultured in cages

- Immunity of indigenous fish and shrimp to bacterial pathogens (*Vibrio alginolyticus* and *Flexibacter columnaris*) and protective ability of these bacterial immunogens
- Morphological, serological and molecular characterisation of pathogens and non-pathogenic ectoparasites (Monogenea) on cultured and wild fish
- Inventory of fish pathogens in local aquaculture
- Epidemiology, immune response and diagnosis of blood parasites
- Epidemiology of viral diseases in fish and shellfish: hatchery phase study
- Development of rapid diagnostic technologies for screening and control of commercially important shrimp pathogens
- Development of fish disease management system for species indigenous to local aquaculture
- Isolation of microbial pathogens and development of effective vaccines and immunostimulants for fish and shrimp cultures
- Development of a DNA vaccine against *Vibrio cholerae*
- Establishment of primer databank for rapid identification of local bacterial pathogens

b. Departments and Universities for Research of Aquatic Animal Diseases

- i. Department of Fisheries, Malaysia
- ii. University Putra Malaysia, Serdang, Selangor
- iii. University of Malaya, Kuala Lumpur
- iv. University Science, Penang
- v. Kolej Universiti Sains dan Teknologi Malaysia, Trengganu
- vi. Department of Veterinary, Malaysia
- vii. Department of Environment
- viii. Lembaga Kemajuan Ikan Malaysia (LKIM, or the Malaysian Fisheries Authority Board)

c. Training

Training for fish disease are conducted by the Department of Fisheries National Fish Health Research Centre (NaFish), Fisheries Research Institute, 11960, Batu Maung, Penang.

Fish Health staff in Malaysia are trained to detect clinical symptoms, and to conduct basic parasitology, bacteriology, water quality and basic techniques using rapid test kits in the field for quarantine, diagnosis and surveillance of aquatic animals. Research Officers are trained in the postgraduate level at various Universities (USM, UPM and UM). Short-term trainings at AAHRI and SEAFDEC have also been awarded to them.

Training on TEM, SEM, X-ray techniques, virology, immunology and molecular techniques are required to support the needs for research, surveillance, monitoring and diagnosis of fish diseases in the country.

The Department of Fisheries Malaysia is continuing its efforts to update the quarantine system with more infrastructure and capability build-up since there is increased activity in live fish movements from aquarium fish and

aquaculture industry within the country and throughout the world. Other proactive steps to be implemented include:

- Highly trained man-power inputs (fish disease diagnosticians, backed by services in virology, bacteriology, mycology, parasitology and water chemistry);
- Fish disease monitoring system (or surveillance) with legislation and enforcement;
- Epidemiology data base to facilitate early warning system; and
- Increased capability in fish diagnostics with R & D back-up.

However, the cooperation and commitment of the industry stake-holders are also expected so that a well accepted and an effective quarantine system can be operational. In any case, in order to ensure the responsibilities of farmers, culturists and hobbyists, the Department of Fisheries has drawn a number of code of practices for the sustainability of aquaculture and fisheries.

d. Major Publications in Aquatic Animal Diseases

The major publications (scientific papers, reports, and others) on viral diseases of fishes and shrimps in Malaysia from 1998 to 2003 (in English or in local language) are listed in the References marked with an asterisk (*).

References

Annual Fisheries Statistics. 1998. Volume 1. Department of Fisheries Malaysia, 8th & 9th Floor, Wisma Tani, Jalan Sultan Salahudin, 50628 Kuala Lumpur, Malaysia.

Annual Fisheries Statistics. 1999. Volume 1. Department of Fisheries Malaysia, 8th & 9th Floor, Wisma Tani, Jalan Sultan Salahudin, 50628 Kuala Lumpur, Malaysia.

Annual Fisheries Statistics. 2000. Volume 1. Department of Fisheries Malaysia, 8th & 9th Floor, Wisma Tani, Jalan Sultan Salahudin, 50628 Kuala Lumpur, Malaysia.

Annual Fisheries Statistics. 2001. Volume 1. Department of Fisheries Malaysia, 8th & 9th Floor, Wisma Tani, Jalan Sultan Salahudin, 50628 Kuala Lumpur, Malaysia.

Abdullah A. 2004. Pre-KHV Symposium Country Report. Presented at the International Symposium on Koi Herpesvirus Disease Control in Yokohama, Japan, 13 March 2004.

Abdullah SZ, Kua BC. 2003. An Overview of Diseases in Marine Food Fish. Paper presented at the Harmonization of Quarantine Procedures for Live Fish Among ASEAN Member Countries held on 24-26 February 2003 in Penang, Malaysia.

*Hassan MD, Samsoun S, Abdul Manaf A, Shariff M. 1995. Structural

analyses of a fish herpes virus isolated from Malaysian koi carps with pox disease. Malaysian Science and Technology Congress, Kuala Lumpur, Malaysia.

Lihan S. 2003. Microbiological Hazard of Antibiotic Resistance Associated with Fish. *Fish Mail* 12:11-13

Mohd. Noor N, Fauzidah O. 2003. Import, Export, Transport and Quarantine Procedures of Live Fish in Malaysia. Paper presented at the Harmonization of Quarantine Procedures for Live Fish among ASEAN Member Countries held on 24-26 February 2003, Penang, Malaysia.

*Musa N, Leong LK. 2003. Luminous vibriosis: A major threat in penaeid shrimp farming. *Fish Mail*. 12: 3-5

*Oseko N. 2002. Development of technology for the diagnosis and prevention of shrimp viral diseases. Paper presented at the Symposium on White Spot Virus of Shrimp in Penang, 18-19 September 2002, p.12-30.

Palanisamy V, Abdullah SZ, Chuah TT. 2001. Healthy and Wholesome Aquaculture. A paper presented at the National Conference on Food Sustainability and Safety in the New Era: Fish For All, held in Kuala Lumpur on 8-9 May 2001.

*Palanisamy V. 2002. Some aspects of carriers and vectors of WSSV. Paper presented at the Symposium on white spot virus of shrimp in Penang 18-19 September 2002, p. 32-37.

Syed Omar SJ. 2004. Experiences of shrimp producers from Malaysian Shrimp Industries Association. A Powerpoint document presented at the Investment Seminar: Market Access, Opportunities and Challenges in the Shrimp Industry in Kuala Lumpur on 14 January 2004.

Saidin T. 2003. Food Safety Measures in Shrimp Industry in Malaysia. Paper presented at the Partnership Workshop For Shrimp Product Safety, Surabaya, Indonesia on 6-8 October 2003.

*Subramaniam K. 2003. Use of probiotics to provide suitable culture environment and enhance the defence mechanism of shrimp against white spot virus (WSV). Paper presented at the Symposium on White Spot Virus of Shrimp in Penang on 18-19 September 2002, p. 53-69.

*Wang YG, Hassan MD, Shariff M, Zamri SM, Chen X. 1999. Histopathology and cytopathology of white spot syndrome virus (WSSV) in cultured *Penaeus monodon* from Peninsular Malaysia with emphasis on pathogenesis and the mechanism of white spot formation. *Dis Aquat Org.* 39:1-11.

*Wang YG, Lee KL, Najiah M, Shariff M, Hassan MD. 2000. A new bacterial white spot syndrome (BWSS) in cultured tiger shrimp *Penaeus monodon* and its comparison with white spot syndrome (WSS) caused by virus. *Dis Aquat Org.* 41:9-18.

- Yaakob A, Fariduddin O, Badrulnizam B. 2002. Ciri-ciri postlarva bagi tujuan pencegahan penyakit pada ternakan udang harimau. Paper presented at the Symposium on white spot virus of shrimp in Penang on 18-19 September 2002, p. 38-50.
- Zulkifli AR. 2001. Freshwater Aquaculture: Issues and Challenges. Paper presented at the National Conference on Food Sustainability and Safety in the New Era: Fish For All, held in Kuala Lumpur on 8-9 May 2001.

Appendix 1A. List of live aquatic animal species involved in transboundary movement: Freshwater food fish

Common Name	Scientific Name
Aruan, Ruan Haruan, Toman Paya - Striped Snakehead	<i>Channa striatus</i>
Baung - River catfish	<i>Mystus nemerus</i>
Belut - Eel	<i>Anguilla</i> sp.
Belut - Freshwater eel	<i>Monopterus albus</i>
Jelawat – Sultan Fish	<i>Leptobarbus hoevenii</i>
Kap Rumput - Grass Carp	<i>Ctenopharyngodon idellus</i>
Kap kepala besar - Big head carp	<i>Aristichthys nobilis</i>
Katla - Catla	<i>Catla catla</i>
Kelah - Red Masheer	<i>Tor tambroides</i>
Keli Bunga - Walking catfish	<i>Clarias macrocephalus</i>
Keli Kayu - Walking catfish	<i>Clarius batrachus</i>
Ketutu – Marble goby	<i>Oxyleotris marmoratus</i>
Lampan Jawa - Javanese carp	<i>Puntius gonionotus</i>
Lampan Sungai - Tinfoil barb	<i>Puntius schwanenfeldii</i>
Lee Koh - Common carp	<i>Cyprinus carpio</i>
Patin - Striped catfish	<i>Pangasius sutchi</i>
Temoleh - Temoleh	<i>Probarbus jullieni</i>
Tilapia - Nile tilapia	<i>Oreochromis niloticus</i>
Tilapia Merah - Red tilapia	<i>Oreochromis</i> sp.
Toman – Red snake head	<i>Channa micropeltes</i>
Udang galah –Giant freshwater prawn	<i>Macrobrachium rosenbergii</i>
Udang gantung – Glass shrimp	<i>Macrobrachium lancestreii</i>

Appendix 1B. List of live aquatic animal species involved in transboundary movement: Freshwater ornamental fish

Common Name	Scientific Name
Silver bala shark	<i>Balantiocheilos melanopterus</i>
Clown barb	<i>Barbodes everetti</i>
Striped barb	<i>Barbodes fasciatus</i>
Six banded barb	<i>Barbodes hexazona</i>
T' spanner barb	<i>Barbodes lateristriga</i>
Black ruby barb	<i>Barbodes nigrofasciatus</i>
Five banded barb	<i>Barbodes pentazona</i>
Tinfoil barb	<i>Barbodes schewanenfeldii</i>

Appendix 1B. (continuation)

Common Name	Scientific Name
Tiger barb	<i>Barbodes tetrazona</i>
Pearl danio	<i>Brachydanio albolineatus</i>
Leopard danio	<i>Brachydanio Frankie</i>
Zebra danio	<i>Brachydanio rerio</i>
Longfin barb	<i>Capoeta arulius</i>
Checkered barb	<i>Capoeta oligolepis</i>
Cherry barb	<i>Capoeta titeya</i>
Goldfish	<i>Carrassius auratus</i>
Fancy carp	<i>Cyprinus carpio</i>
Giants danio	<i>Danio malabaricus</i>
Red tail black shark	<i>Epalzeorhynchus bicolor</i>
Rainbow shark	<i>Epalzeorhynchus frenatus</i>
Flying fox	<i>Epalzeorhynchus kalopterus</i>
Flying barb	<i>Esomus metallicus</i>
Red barb	<i>Hampala macrolepidota</i>
Black shark	<i>Labeo chrysophekadion</i>
Red-finned cigar shark	<i>Leptobarbs hoeveni</i>
Flower horn	<i>Cichlasoma rajah</i>
Apollo shark	<i>Luciosoma setigerum</i>
Black phantom tetra	<i>Megalomphodus megalopterus</i>
Red phantom tetra	<i>Megalomphodus sweglesi</i>
Red eye tetra	<i>Moenkhausia sanctaefilomenae</i>
Emperor tetra	<i>Nematobrycon palmeri</i>
Hard-lipped barb	<i>Osteochilus hasseltii</i>
Rosy barb	<i>Puntius conchoniuis</i>
Odessa barb	<i>Puntius conchoniuis hybrid</i>
Golden barb	<i>Puntius sachsii</i>
Redtail rasbora	<i>Rasbora borapetensis</i>
Red scissor tail rasbora	<i>Rasbora caudimaculata</i>
Emerald eye rasbora	<i>Rasbora dorsiocellata</i>
Blue striped rasbora	<i>Rasbora einthoveni</i>
Elegant rasbora	<i>Rasbora elegans</i>
Harlequin rasbora	<i>Rasbora heteromorpha</i>
Clown rasbora	<i>Rasbora kalochroma</i>
Spotted rasbora	<i>Rasbora maculate</i>

Appendix 1B. (continuation)

Common Name	Scientific Name
Red striped rasbora	<i>Rasbora pauciperforata</i>
Scissor tail rasbora	<i>Rasbora trilineatus</i>
Bittering	<i>Rhodeus ocellatus</i>
White cloud mountain	<i>Tanichthys albonubes</i>
Climbing perch	<i>Anabas testudineus</i>
Combtail gourami	<i>Belontia hasselti</i>
Local fighting fish	<i>Betta imbellis</i>
Mouthbrooding betta	<i>Betta pugnax</i>
Fighting fish	<i>Betta splendens</i>
Honey gourami	<i>Colisa chuna</i>
Thick lip gourami	<i>Colisa labiosa</i>
Dwarf gourami	<i>Colisa lalia</i>
Kissing gourami	<i>Helostoma temmincki</i>
Paradise fish	<i>Macropodus opercularis</i>
Giant gourami	<i>Osphronemus goramy</i>
Chocolate gourami	<i>Sphaerichthys osphromenoides</i>
Pearl gourami	<i>Trichogaster leeri</i>
Moonlight gourami	<i>Trichogaster microlepis</i>
Snake skin gourami	<i>Trichogaster pectoralis</i>
Three spot gourami	<i>Trichogaster trichopterus</i>
Croaking gourami	<i>Trichopsis vittatus</i>
Molly	<i>Poecillia latipinna</i>
Guppy	<i>Poecillia reticulata</i>
Blue lamp eye	<i>Pseudomugil gertrudae</i>
Swordtail	<i>Xiphophorus helleri</i>
Platy	<i>Xiphophorus maculatus</i>
Parrot platy	<i>Xiphophorus variatus</i>
Argentina bloodfin tetra	<i>Aphyocharax anisitsi</i>
White spot tetra	<i>Aphyocharax paraguayensis</i>
Blind Cave tetra	<i>Astyanax mexicanus</i>
Blue tetra	<i>Boehlkea fredcochui</i>
Flag dwarf cichlid	<i>Aequidens curviceps</i>

Appendix 1B. (continuation)

Common Name	Scientific Name
Keyhole cichlid	<i>Aequidens rivulatus</i>
Blue acara	<i>Aequidens maroni</i>
Green terror	<i>Aequidens pulcher</i>
Agassizi	<i>Apistogramma agassizi</i>
Umbrella dwarf cichlid	<i>Apistogramma borelli</i>
Ramirez	<i>Apistogramma ramirezi</i>
Oscar	<i>Astronotus ocellatus</i>
Freiberg's peacock	<i>Aulonocara jacobfreibergi</i>
Nyassae peacock	<i>Aulonocara nyassae</i>
Badis badis	<i>Badis badis</i>
Peacock cichlid	<i>Cichla ocellaris</i>
Chocolate cichlid	<i>Cichlasoma coryphaenoides</i>
Texas cichlid	<i>Cichlasoma cyanoguttatum</i>
Flag cichlid	<i>Cichlasoma festivum</i>
Managuense cichlid	<i>Cichlasoma managuense</i>
Firemouth	<i>Cichlasoma meeki</i>
Zebra cichlid	<i>Cichlasoma nigrofasciatum</i>
Severum cichlid	<i>Cichlasoma severum</i>
Flower horn	<i>Cichlasoma</i> spp.

Appendix 1C. List of live aquatic animal species involved in transboundary movement: Marine food fish

Common Name	Scientific Name
Aruan tasek - Black kingfish/Cobia	<i>Rachycentron canadum</i>
Bawal emas - Silver pomfret/Snubnose dart	<i>Trachinotus blochii</i>
Celoreng – Spottedsnapper	<i>Lutjanus erythrotherus</i>
Cupak - Longfin cavalla	<i>Carabgiodes ciliaris</i>
Gerong-gerong - Golden trevally	<i>Gnathanodon speciosus</i>
Jenahak - John's snapper, Golden snapper	<i>Lutjanus johni</i>
Kaci - Painted sweetlip	<i>Plectorhynchus pictus</i>
Kerapu bara – Coral trout	<i>Cephalopholis miniatus</i>
Kerapu bara – Leopard coral grouper	<i>Plectropomus leopardus</i>
Kerapu bara – Spotted coral grouper	<i>Plectropomus maculatus</i>
Mamin – Napoleon wrasse	<i>Cheilinus undulatus</i>
Kerapu lilin/lumpur - Malabar grouper	<i>Epinephelus malabaricus</i>
Kertang - King grouper	<i>Epinephelus lanceolatus</i>
Kerapu bunga – Greasy grouper	<i>Epinephelus coioides</i>
Kerapu - Six-banded grouper	<i>Epinephelus sexfasciatus</i>
Kerapu harimau - Brown marble grouper	<i>Epinephelus fuscoguttatus</i>
Kerapu tikus - Polka-dot grouper	<i>Cromileptis altivelis</i>
Merah - Malabar red snapper	<i>Lutjanus malabaricus</i>
Senangin - Fourfinger threadfin	<i>Eleutheronema tetradactylum</i>
Senangin Taiwan - Red drum	<i>Sciaenops ocellatus</i>
Siakap - Giant sea perch	<i>Lates calcarifer</i>
Siakap merah – Red snapper	<i>Lutjanus argentimaculatus</i>

Appendix 1D. List of live aquatic animal species involved in transboundary movement: Marine ornamental fish

Common Name	Scientific Name
Angel fish	Pomacanthidae
Butterfly fish	Chaetodontidae
Clown fish	<i>Amphiprion</i> spp.
Dottybacks	<i>Pseudochromis</i> spp.
Dragonets	Callionymidae
Goby	<i>Gobiosoma</i> spp.
Parrot fish	Labridae
Seahorses, Pipefishes	Syngnathidae
Soft and stony corals	–
Trigger fish	Balistidae

Appendix 1E. List of live aquatic animal species involved in transboundary movement: Molluscs

Common Name	Scientific Name
Siput metiah - Abalone	<i>Haliotis asinis</i>
Belangkas - Horse shoe crab	<i>Limulus polyphemus</i>
Kerang - Cockles	<i>Anadara granosa</i>
Kepah	–
Kupang (Siput sudu) - Green mussels	<i>Perna viridis</i>
Siput belitong	–
Siput retak seribu - carpet clam	<i>Paphia undulata</i>
Tiram - Rock Oyster	<i>Ostrea folium</i>
Flat oyster	<i>Crassostrea</i> sp.

Appendix 1F. List of live aquatic animal species involved in transboundary movement: Crustaceans

Common Name	Scientific Name
Udang galah - Malaysian giant freshwater prawn	<i>Macrobrachium rosenbergii</i>
Udang harimau - Giant black tiger shrimp	<i>Penaeus monodon</i>
Udang karang - Spiny lobster	<i>Panulirus polyhagus</i>
Udang putih - Red-legged banana/white shrimp	<i>Penaeus indicus</i>
Udang putih - Banana/white shrimp	<i>Penaeus merguensis</i>
Ketam renjung - Swimming crab	<i>Portunus pelagicus</i>
Ketam nipah - Mud crab	<i>Scylla serrata</i>

Appendix 2. Estimated aquaculture production in 1998 of major carp species from freshwater culture systems and their estimated wholesale value (RM '000)

Species (RM '000)	Production in different culture (MT)					Total
	Freshwater ponds	Freshwater cages	Ex-mining pools	Cement tanks	Pen culture	
Javanese carp	1, 617 (8, 502)	7 (30)	147 (623)	5(21)	31 (153)	1,807 (9,329)
Common carp	896 (5, 834)	0 9(33)	102 (424)	0	0	997 (6, 258)
Grass carp	658 (3, 121)	0	246 (1,104)	0	5 (21)	917 (4, 279)
Big head carp	99 (3, 089)		772 (2, 037)	0	3 9	874 (2, 434)

Appendix 3. Estimated aquaculture production in 1999 of major carp species from freshwater culture systems and their estimated wholesale value (RM '000)

Species (RM '000)	Production in different culture (MT)					Total
	Freshwater ponds	Freshwater cages	Ex-mining pools	Cement tanks	Pen culture	
Javanese carp	1, 276 (6, 758)	7 (30)	147 (623)	5 (21)	31 (153)	1,788 (8,920)
Common carp	887 (6, 061)	0	102 (424)	0	0	1, 042 (6, 680)
Grass carp	813 (4, 031)	9 (32)	246 (1, 104)	0	5 (21)	1,454 (6, 842)
Big head carp	146 (484)	0	772 (2, 037)	0	3 (9)	1, 125 (2, 961)

Appendix 4. Estimated aquaculture production in 2000 of major carp species from freshwater culture systems and their estimated wholesale value (RM '000)

Species (RM '000)	Production in different culture (MT)					Total
	Freshwater ponds	Freshwater cages	Ex-mining pools	Cement tanks	Pen culture	
Javanese carp	1, 214 (6, 100)	39 (174)	396 (1, 604)	0		1, 678 (8, 003)
Common carp	757 (5, 119)	0.1 (0.4)	222 (925)	0		981 (6, 052)
Grass carp	970 (4, 449)	48 (190)	452 (2, 043)	0		1, 484 (6, 746)
Big head carp	127 (788)	1.4 (3.5)	1, 486 (3, 811)	0		1, 620 (4, 617)

Appendix 5. Estimated aquaculture production in 2001 of major carp species from freshwater culture systems and their estimated wholesale value (RM '000)

Species (RM '000)	Production in different culture (MT)					Total
	Freshwater ponds	Freshwater cages	Ex-mining pools	Cement tanks	Pen culture	
Javanese carp	833 (4, 351)	17 (77)	147 (645)	0 0	15 (65)	1, 013 (5, 138)
Common carp	777 (5, 355)	0.1 (0.7)	163 (657)	0	0	941 (6, 013)
Grass carp	642 (3, 418)	10 (54)	163 (823)	0	6 (28)	820 (4,324)
Big head carp	115 (386)	0	1, 074 (2, 663)	0	0.9 (2)	1, 190 (3, 052)

Appendix 6. Fry production from hatcheries for major carp species in Malaysia from 1998-2001

Year	Javanese carp	Common carp	River carp
2001	2, 748, 775	199, 229	0
2000	4, 423, 654	711, 814	1, 403, 696
1999	8, 507, 705	1, 753, 753	2, 876, 029
1998	7, 119 438	2, 341, 625	3, 203, 728

Current Status of Transboundary Fish Diseases in Myanmar: Occurrence, Surveillance, Research and Training

Saw New Year

*Department of Fisheries
Sinn Min Road, Ablone Township
Yangon, Myanmar*

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

a. Production of Common Carp

To initiate first development of freshwater aquaculture, Myanmar imported some exotic species such as tilapia (*Oreochromis mossambica*), kissing gouramy (*Trichogaster pectoralis*) and common carp (*Cyprinus carpio*) in 1954. Common carp was imported from Indonesia and in 1965, the mirror carp (*Cyprinus carpio*) was imported from Israel. But up to 1970, culture of common carp was not popular among the fish farmers. The fish was new to the people of Myanmar with its colorful yellow color that they correlated as significant with the Buddhist religion. The Myanmar-Chinese people begun to eat common carp since the fish is rich in fat. Freshwater fish culture is now well established in Myanmar using various species of major carps such as catla (*Catla catla*), rohu (*Labeo rohita*) and mrigala (*Cirrhina mrigala*) that inhabit the surface layer, middle layer and bottom layer of water bodies, respectively. Up to 1995, freshwater fish, including cultured fish, was not allowed for export as it was solely for domestic consumption.

In some areas, common carp is cultured as a substitute fish for mrigala, but not in large quantities. Common carp inhabits the bottom layer of the pond and browse the pond dikes. This habit has been a major constraint for common carp culture because the fish farmers worry that the fish may cause dike erosion. In general, common carp culture comprises only 20% of the volume of other carps being cultured.

After 1995, freshwater fish produced in Myanmar was allowed for export since production exceeded the domestic consumption (Table 1). Myanmar usually exports major carps to Bangladesh where they command a higher price. However, common carp remains for domestic consumption. The fish is normally cultured in earthen ponds and rarely in tanks. In terms of pond sizes, the smallest ponds are 0.1 ha, while the largest ponds are 10-20 ha. Small ponds are located in the upper region of Myanmar and the larger ponds are located in the lower region of the country, especially in river delta areas. Small-scale fish farms normally purchase the fingerlings from government or privately-owned hatcheries. Rice bran and ground-nut oil cake are common feed for the freshwater fish. Recently, a new feed type like the floating pellet was developed and became more popular among the fish farmers.

Table 1. Yearly freshwater fish production record in the last 5 years

Year	Number of fish farmers	Fish pond area (ha)	Fish production (MT)
1998-1999	12,012	49,046.70	84,130.72
1999-2000	12,087	49,234.60	94,008.17
2000-2001	12,907	57,360.98	121,583.33
2001-2002	14,142	90,732.91	189,418.30
2002-2003	14,792	124,112.24	221,006.54

Large-scale fish farm systems include nursery ponds, transition ponds, and rearing ponds in the farm design. The fish fry of 3-5 day old hatchlings are nursed in the nursery ponds. This procedure needs skill and experience to produce about 25-30 % survival. When the fingerlings attain the size of 2-3 inches after about 45 days rearing period, they are transferred to transition ponds where they are grown up to 500 g in one year. They are called yearlings and are used as stockfish in grow-out ponds.

Common carp was found to be the appropriate species to culture in rice fields. The Department of Fisheries has stocked good quality fish seed including common carp into the reservoirs, lakes, natural impoundments, rivers, streams and natural water bodies to maintain the fishery resource. Because of this, the common carp can be found in the wild habitats now.

Aside from this, Myanmar has a local strain of common carp found in the Inle Lake of the Southern Shan State in the northern region of Myanmar. However, the appearance, color, and small size of the fish, and the texture of the flesh make it unattractive for culture. This fish is only consumed by poor people in rural communities near the lake.

Spawners of common carp for seed production are selected from among the largest fish in grow-out ponds. Common carp is easy to breed from February to May each year. Fish farmers can easily produce common carp seed or they may purchase fingerlings from government and private hatcheries. The first common carp fish stock was imported from Indonesia in 1954, but the fish has been domesticated ever since the first import.

Common carp is not included in the fishes that are exported due to lack of demand. Due to repeated inbreeding of cultured common carp, it is assumed that the genetic characteristic has declined and this may lead to poor resistance or susceptibility to diseases in long term.

b. Production of Koi

Koi is also known as colored carp. It is a popular ornamental fish in Myanmar and normally found in aquaria for hobbyists. It has never been reported that koi is produced commercially in Myanmar. Seed production method is similar to common carps, but the colorful koi may command much higher price. There is no information on the fish's genetic management, mutation, and other sophisticated technologies practiced in Myanmar. Some attractive and beautifully colored koi may be imported illegally.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

No information on any outbreak of koi herpesvirus disease (KHVD) has been reported yet. Importation of koi for ornamental purposes is very few and KHVD is not being analyzed since koi trade is not common. Culture of common carp is also small-scale and no report of KHVD outbreak is available.

I-3. Handout on KHVD

Despite the absence of KHVD outbreak in Myanmar, the Disease Section under the Department of Fisheries has published a handout on KHVD as a preventive measure. It is published in Myanmar language (Fig. 1). The handout contains the following information:

- a. External and internal signs
 - Skin becomes tough and abrasion can be found on the skin
 - Gill tissues appear rotten
 - KHVD may affect internal organs like kidney, liver, spleen, heart, intestines
- b. Secondary diseases associated with KHVD
 - Bacterial
 - Parasitic
 - Fungal
- c. Primary cause
 - Koi herpesvirus
 - Cyprinid herpesvirus
- d. Affected age
 - Fingerlings to adults
- e. Diagnostic tests
 - Check external features – Level I
 - Check with PCR – Level III
- f. Transmission
 - Horizontal

- g. Preventive and control measures
- maintain better water quality and pond environment
 - minimize stress during handling and transportation
 - protect the invasion (prevent the entry) of disease carriers
 - send specimens and report suspected cases to Disease Section

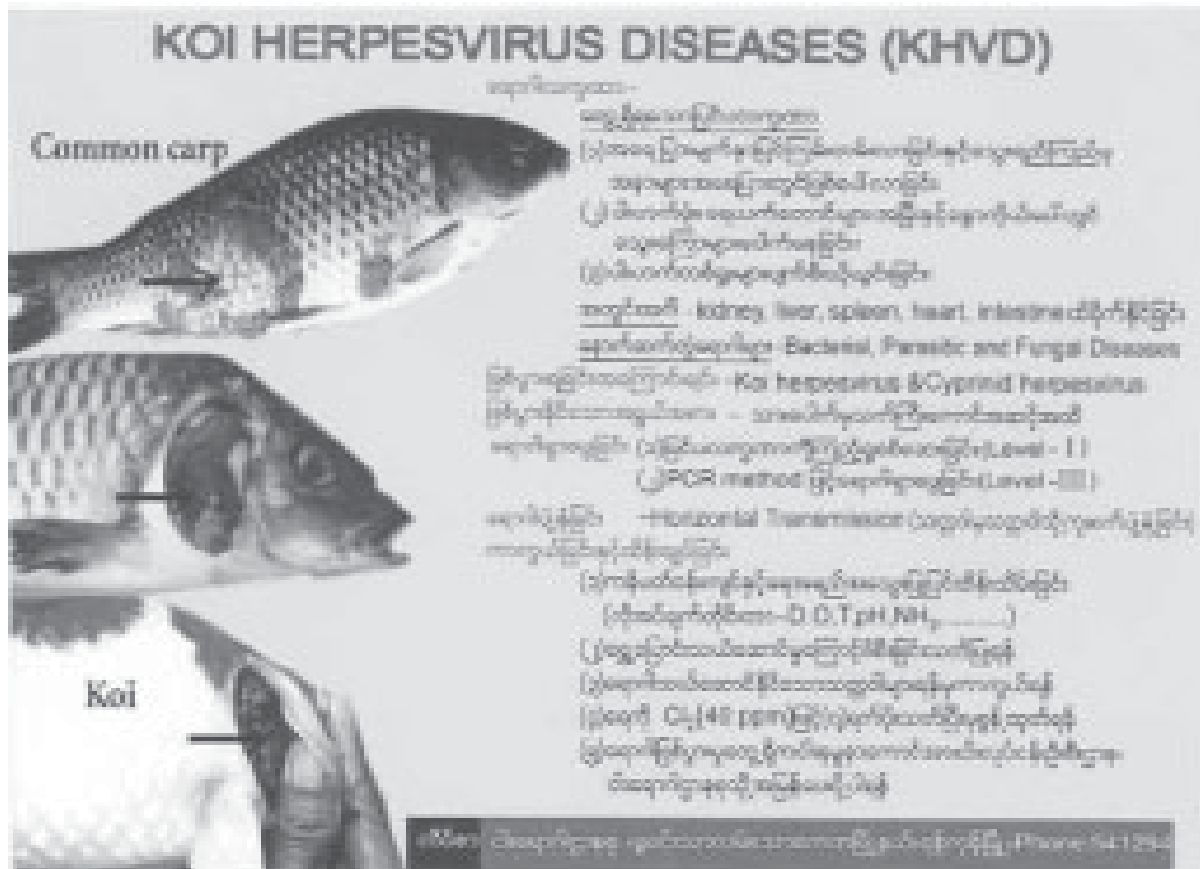


Fig. 1. The handout on KHVD which is distributed free of charge to farmers

II. Current Status of Viral Diseases in the Production of Shrimps and Prawn

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

In the 1970s, shrimp production originated from a purely traditional method commonly called “trap and hold”, whereby shrimp production in very large ponds came mainly from postlarvae (PLs) that came in with the tide and derived nourishment from available natural food. In the past, even this method was not popular among the people of Myanmar. However, the number of traditional shrimp ponds increased year by year.

The Department of Fisheries (DOF), under the Ministry for Livestock and Fisheries, implemented a 3-year project on shrimp aquaculture development that was started in 1999-2000 and ended in 2002-2003. This was followed by another 3-year project which the Ministry for Livestock and

Fisheries started implementing in 2003-2004 to last until 2005-2006. The first project included the development of all culture systems such as extensive system, extensive plus system and semi-intensive systems. The second project encourages the development of intensive systems only. The yearly shrimp production recorded from various culture systems is shown in Table 2.

Table 2. Yearly production of cultured shrimp

Year	Number of shrimp farmers	Fish pond area (acre)	Shrimp production (MT)
1998-1999	3,752	62,604.98	4,900.33
1999-2000	4,312	67,446.97	4,967.32
2000-2001	6,925	101,803.64	7,473.90
2001-2002	7,961	119,784.47	11,357.08
2002-2003	11,429	199,961.19	19,120.78

Myanmar has rich resource of tiger shrimp spawners in the Andaman Sea and Bay of Bengal. There are 29 existing shrimp hatcheries owned by the government and the private sector capable of producing about 600 million PLs/year. Existing shrimp hatcheries can supply the requirements of the grow-out farms.

Before the hatcheries were successful, some PLs were imported from Thailand in 1999-2000. Due to uncertified importation, disease outbreak of white spot syndrome virus occurred which was later transmitted horizontally to other farms. Black tiger shrimp spawners have not been imported, but they are exported to some Asian countries like Vietnam, Thailand, Malaysia and Taiwan.

b. Production of Pacific White Shrimp (*Litopenaeus vannamei*)

Generally, Myanmar does not allow the culture of Pacific white shrimp, but some shrimp farmers requested the Ministry of Livestock and Fisheries, and the DOF to allow importation of the species. After several consultations made with NACA, SEAFDEC and other agencies, the DOF decided not to allow importation and culture of *L. vannamei* to prevent the introduction and outbreak of Taura syndrome virus (TSV). Therefore, Myanmar has no problem with TSV outbreak at present.

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

It is indeed fortunate that Myanmar has very good sources of good quality freshwater prawn (*M. rosenbergii*). However, the technology for freshwater prawn culture in Myanmar is not well developed. Generally, the prawns are cultured with freshwater finfishes like Chinese carp and other carps. Monoculture of the prawn was attempted by private companies during the last 2-3 years, but due to the uneconomically viable results, the system was converted again to polyculture or mixed species culture.

II-2. White Spot Syndrome Virus (WSSV)

The first 3-year project of shrimp aquaculture that commenced in the year 1999-2000 triggered a sudden increase in intensive shrimp ponds that caused imbalance in the supply of shrimp PLs from the local shrimp hatcheries. In that year, some shrimp farmers were allowed to import shrimp PLs from Thailand. Due to high stocking density, ignorance of best pond management, and lack of PCR analysis, the shrimp ponds stocked with imported PLs experienced outbreaks of white spot disease that spread to other ponds through horizontal transmission. Shrimp farmers lost tremendously and the disease almost paralyzed the development of the shrimp industry in Myanmar. The disease has become a major threat to shrimp aquaculture development where the *P. monodon* is the only species for culture. Normally, WSSV was found in shrimp stocked after 20-60 days. According to the climatic condition, shrimp culture operations were initially done from December to April. The period between November and February is the winter season and the water temperature goes down to 23-24°C. In that situation, the feeding rate of the shrimp decreases and most diseases occur in that period. The DOF established a laboratory for PCR analysis only in the year 2002. Before that, the local hatcheries sent broodstocks and also PLs to Thailand for PCR check up. Up to year 2000, the broodstocks harvested from the wild were found WSSV-free. However in 2003, some spawners were found positive for WSSV after PCR analysis. This indicates that the disease has already spread to wild stocks. WSSV usually causes 100% mortality in infected stocks.

Currently, DOF has a Disease Section that is equipped with a laboratory capable of conducting PCR analysis. In 2002, trainings and monitoring of WSSV, TSV, IHHNV, MBV and *Vibrio* spp. were conducted in collaboration with the Food and Agriculture Organization (FAO) of the United Nations and Myanmar DOF.

II-3. Taura Syndrome Virus (TSV)

Myanmar has not allowed the importation and culture of *Litopenaeus vannamei* yet and there is no information on TSV occurrence.

II-4. Significant and Emerging Disease of *Macrobrachium rosenbergii*

Culture of freshwater prawn is by polyculture methods with Chinese carps or major carps. As it is very extensive due to very low stocking density, there has been no information on the occurrence of significant disease or disease outbreak in this species.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

Facility location: Department of Fisheries

- a. Fish Disease Section
Shukhintha Road, Thaketa Township, Yangon, Myanmar
- b. Contact personnel
Ms. Nwe Ni Aye
Section Head
Tel : 095-01-541294
Fax : 095-01-228258
E-mail : DOF@mptmail.net.mm

The DOF staff makes occasional visit to fish and shrimp farms, which they monitor and survey. Sometimes, the Fish Disease Section contacts the Township Fisheries Officers, or the farmers, themselves, contact the staff of the Fish Disease Section.

III-2. Diagnostic Capabilities and Major Diseases Aquatic Animals

a. Laboratories

1. Government
DOF, Fish Disease Section – Level I and Level III (PCR)
Tel: 01-541294, Fax: 01-228258
E-mail : DOF@mptmail.net.mm
2. Private-based – Level III PCR
3. University-based – Levels I and II

b. Economically-Important Diseases

Name of disease: WSSV, IHNV
Affected animals: *P. monodon*
Level of diagnosis: Level III (PCR)

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

The decision maker regarding requests for importation of live aquatic animals is the Director General (DG) of the DOF. Quarantine decisions are made by the Director of Research and Development Division, DOF, while inspections are conducted by the Quarantine Inspection Section, DOF.

Inspection on arrival at airport is conducted. The samples obtained at the airport are examined at the Quality Control Laboratory, Thaketa under the DOF. Levels II and III diagnosis are used.

IV-2. Procedures and Requirements for Importation and Exportation

- a. Importers have to apply to the DG of the DOF. Import and export of live aquatic animals are decided by the DG with the approval of the Ministry after careful determination on whether the animal may cause environmental impact or has a positive effect on national economy.
- b. When the live aquatic animals arrive, the authorized inspectors from DOF inspect health certificates and the live animals at the airport. If necessary, the samples are examined at the Quality Control Laboratory and Disease Section, Thaketa.
- c. Laws and Regulations concerned with import/export of live aquatic animals have been included in the Laws Relating to Aquaculture. The DG is the only authorized person who can make decisions about importation and export of live aquatic animals.
- d. Importers have to apply to the DG of the DOF. Exporters have to hold the Collection License at first and can apply to the Ministry of Commerce for export. An example of a Collection License and its accompanying instruction is in Annex I.

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

- a. Current research activities – Nil
- b. List of agencies – Nil
- c. List of publications
 - Outbreak of White Spot Diseases in Myanmar by Minn Thame
 - Guidelines to shrimp farmers for the preventive measures of WSSV (in local language)
 - Hand-out on Koi Herpesvirus Disease (KHVD) by Fish Disease Section (in local language)

- d. Agencies Conducting Trainings on Diseases

Research and Development Division (DOF)

U Tin Win, Director

Tel: 095-01-211376, Fax: 095-01-228258

E-mail: DOF@mptmail.net.mm

- e. Training Courses

1. Strengthening of Fish Disease Diagnosis (Mycology, Virology, Bacteriology, Histopathology) (Japan, 1994)
2. Shrimp Health Management Training by NACA (Thailand, 1999)
3. Fish Health Management Training by SEAFDEC (Philippines, 2000)

4. Aquaculture Health Management by SEAFDEC (Philippines, 2002)
5. PCR Training by Private Company Limited (Thailand, 2002)
6. Hands-on Training for Important Viral Disease of Shrimp and Marine Fishes by SEAFDEC (Philippines, 2002)
7. Second Hands-on Training for Important Viral Disease of Shrimp and Marine Fishes by SEAFDEC (Philippines, 2003)

f. Training Needs

Specific trainings on basic diagnosis of parasites, virus, bacteria, fungus on major culture species like, carps, prawns, shrimps, marine finfishes; training on how to conduct surveillance, monitoring and diagnosis.

Annex 1. Example of a Collection License used in Myanmar

GOVERNMENT OF THE UNION OF MYANMAR
 MINISTRY OF LIVESTOCK AND FISHERIES
 DEPARTMENT OF FISHERIES

License No

License for Collection and Marketing of Aquatic Products

In accordance with existing Laws and Instructions herewith attached, the Director General of the Department of Fisheries, Ministry of Livestock and Fisheries, issues this License.

1. (A) Name of applicant
- (B) National Registration
- Card number
- (C) Address
2. (A) Permitted Area
- (B) Permitted Kind of.....
- Aquatic Product
- (C) Quantity/ volume
3. In terms of license duration, it starts the date of and shall end on the date of

Issue Date

Director General
 Department of Fisheries

Instructions

1. This license must be shown to authorities concerned when checked.
2. The license holder must abide by the existing Laws and the Directives occasionally issued by the Department of Fisheries.
3. Permitted aquatic through this license must be carried in the prescribed area and time limit.
4. License holder must submit the monthly report on the collected area and quantity to the fisheries authorities.
5. License holder has the right to collect the aquatic products for marketing.
6. When marketed aquatic products are to be carried, license holder must keep the carry permit which is available at local fisheries authority.
7. Legally allowed aquatic products shall have to be handed over and marketed according the existing laws.

Current Status of Transboundary Fish Diseases in the Philippines: Occurrence, Surveillance, Research and Training

Simeona E. Regidor, Juan D. Albaladejo and Joselito R. Somga

Fish Health Section

Bureau of Fisheries and Aquatic Resources

860 Quezon Avenue, Quezon City, Philippines

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi Carp

I-1. Production of Common Carp and Koi Carp

a. Production of Common Carp

In 2003, production of common carp (*Cyprinus carpio*) was estimated at 667 metric tons (MT). Most of the production came from the provinces of Luzon particularly Rizal, Laguna, Quezon, Ifugao and Cordillera. The fish is commonly cultured in ponds and some in pens, mainly as monoculture and, to a lesser extent, polyculture with tilapia. Common carp production remains limited because of inadequate supply of fingerlings.

Common carp was introduced from China in 1915. The fish was stocked in several lakes and rivers all over the country. In Luzon, it was introduced in Laguna de Bay, Bato and Baao in Bicol, Paoay Lake in Ilocos Norte, Lake Naujan in Mindoro, and Taal Lake. It was also introduced into Magat River in Nueva Viscaya, Lakes Bato and Buhi in Camarines Sur, and Cagayan River in Isabela. In Mindanao, it was introduced in Lakes Lanao, Mainit and Buluan. Since then, common carp has become prevalent in many rivers, lakes and reservoirs in the country.

In the 1990s, the Bureau of Fisheries and Aquatic Resources (BFAR), through the National Inland Fisheries Technology Center (NIFTC) in Tanay, Rizal, in collaboration with Philippine Council for Aquatic and Marine Research and Development (PCAMRD), and the University of the Philippines Los Baños (UPLB), established common carp farming technology for the upland areas of Rizal, Laguna, Quezon, Ifugao and Cordillera. BFAR-NIFTC served as the main source of fingerlings, as well as other BFAR Centers and Stations situated in Luzon.

At present, BFAR is conducting research for the genetic improvement of this species. The Department of Agriculture (DA) and BFAR boosted carp productivity and has launched a national carp dispersal program by stocking the new genetically-improved fingerlings in Laguna de Bay. This is a product of successful intra-specific breeding of domesticated carp with three strains from Indonesia and Vietnam: the Majalaya, Sukabumi and Vietnam strains. It is also the potential species for other inland bodies of water such as Taal Lake in Batangas, San Roque Dam in Pangasinan, Magat Dam in Isabela, and Lanao Lake and Liguasan Marsh in Mindanao.

b. Production of Koi

There is limited information on koi production in the Philippines. The Ornamental Fish Association of Southern Tagalog is producing koi for the local market. In 2003, their production was about 1.5 million pieces. Another six farms in Pila, Laguna produced about 300,000 koi last year. The BFAR National Fisheries Biological Center (NFBC) is also into production of koi with 50,000 koi were produced last year for the local market. However, the koi they produce is not yet comparable with imported ones when it comes to quality.

There are also ornamental fish traders that import koi for local hobbyists. These koi are usually stocked as ornamentals in concrete ponds in gardens. According to importers, they usually import the best quality koi from Japan.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

So far, KHVD has not yet been reported in the Philippines. When there was an outbreak of mass mortalities of koi and common carp in Indonesia in 2002, BFAR issued a temporary suspension of carp importation in June of that year and conducted a consultation with the aquarium fish traders, hobbyists and concerned government agencies. It was unanimously agreed that koi should be imported from Japan, where there was no reported KHVD at that time. The importer's holding facility shall be inspected by BFAR prior to issuance of import permit. The fish should be in quarantine for 15-30 days and the health status monitored by a Fish Health Officer. However, after the KHVD outbreak in Japan in October 2003, BFAR issued another temporary suspension for importation of koi from all countries in January 2004. All BFAR regional offices and centers were instructed to strengthen their reporting and monitoring of any disease problems of common carp and koi in their area.

II. Current Status of Viral Diseases in the Production of Shrimps and Prawns

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

The Philippines attained its highest shrimp production in 1994 with 90,000 MT, making it as the third largest producer in the world. From 1997 to present, total production figures are almost similar (Fig. 1).

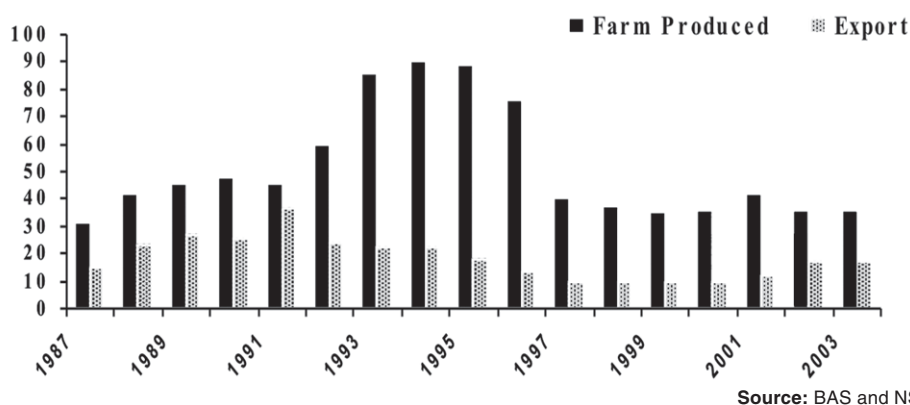


Fig. 1. Philippine shrimp culture production and export, 1987-2003. Production figures are in metric tons $\times 1,000$.

Export figures vary from year to year. The overall production experienced a steady decline starting in 1996 and this was attributed to the increasing environmental degradation and disease problems, particularly luminous vibriosis. This was further aggravated in 1999 with the appearance of white spot syndrome virus (WSSV), first in intensive farms and then in extensive farms in 2002.

Timely intervention of the national government particularly the DA-BFAR started in 1996 through the formation of the inter-agency Task Force, the Oplan Sagip Sugpo, whereby the recovery program for shrimp production was set with immediate and long-term interventions. The program was enhanced by the formation of the Shrimp Task Force in 2000 to undertake the following tasks:

1. Fast track specialized technical support through strengthening of regional laboratories to handle specialized laboratory protocols such as the use of molecular diagnostic procedures, like polymerase chain reaction (PCR), as early detection tools for viruses like WSSV;
2. Disease surveillance to prevent the spread of the viral diseases through active and passive disease monitoring;
3. Promotion of good farm practices through implementation of codes of practice;
4. Adoption of innovations that are environmentally sound and sustainable; and
5. Conduct aggressive continuing education among the national government and private sector field laboratory technicians and fishery extension officers.

Source of Spawners, Broodstock and Postlarvae: Almost 90% of shrimp postlarvae originate from hatcheries, while supply for spawners and broodstock rely mostly on capture fisheries and collectors from wild sources. The remaining 10% of shrimp postlarval supply are wild-caught stocks gathered from nearshore areas during its season for collection. Most of the

successful hatchery operators are located in Western and Central Visayas supplying 60% of the country's postlarval requirement. Traditional wild spawner and broodstock collection sites are in the following areas:

Luzon: Quezon, Masbate
Visayas: Capiz, Negros, Bohol, Leyte
Samar: Surigao, Davao, Misamis Occidental, Zamboanga del Norte

Country of Origin of Imported Stocks: The only known importation of *P. monodon* into the Philippines came from Thailand in 1992. This was made by Dole Philippines for their production ponds in General Santos City, Mindanao. This introduction prompted the Negros Prawn Producers Marketing Cooperative, Incorporated (NPPMCI) to lobby for the passing into law the prohibition of importation of any exotic shrimp species into the country. Thus, in 1993, Fisheries Administrative Order (FAO) No. 189 was passed. This was on the "Prohibition of the importation of all live stages of shrimps and prawns". In 2001, this Order was amended by FAO No. 207 which includes the prohibition of the culture of imported exotic shrimp species.

Live Export Records: As specified in FAO No. 143-5 and stated in "Amending Section 1, FAO No. 143-4", the exportation of live pond-raised prawns not more than sixty (60) grams per piece is allowed. Live marketable size black tiger shrimp (*P. monodon*) were exported in small quantities to Taiwan, HongKong and Thailand as part of the live fish trade to these countries.

b. Production of Pacific White Shrimp (*Litopenaeus vannamei*)

The Philippine government, through BFAR has been implementing a total ban in the importation of live shrimps and prawn of all stages as early as 1993 through FAO 189 that was further amended in 2004 to include not just the importation, but also the culture of imported exotic shrimp species. However, the lure of Pacific white shrimp culture resulted in illegal importation of postlarvae of *L. vannamei* originating mostly from Kaoshiung, Taiwan starting in 1998. The illegal shipment is technically smuggling exotic species in the guise of milkfish fry (*Chanos chanos*). Approved permits issued by BFAR for importation of milkfish fry were replaced with the fry of *L. vannamei*. This can be gleaned from the series of confiscations conducted in international airports.

To stop the rampant mis-declaration of live fish to these ports, the following BFAR office directives were issued (see Box):

- Shrimp Importation Monitoring and Surveillance Task Force - created on January 14, 2003;
- Fisheries Memorandum Order No. 078, Series of 2003 - Restricts entry of live fish species imported from Taiwan and China. Entry of live fish from either Taiwan or China, particularly milkfish fry, is restricted to Ninoy Aquino International Airport only;

Date	Airport	Volume confiscated	Total No.	Value in pesos
22 Sept 2002	Ninoy Aquino Int'l. Airport	63 boxes Milkfish fry and 42 boxes shrimp fry	6.3 M	PHP 1.57M
09 March 2003	Subic Freeport Int'l. Airport	100 boxes shrimp fry	15 M	PHP 3.75M
08 May 2003	NAIA	67 boxes shrimp fry	10.05 M	PHP 2.51 M
07 July 2003	Diosdado Macapagal Int'l. Airport UPS Courier Plane	5 boxes shrimp fry Liquid dietary feed	1.0 M –	PHP 0.6M –
11 July 2003	Laoag Int'l. Airport	44 boxes shrimp fry	6.6M	PHP 2.31M
04 Nov. 2003	NAIA	24 boxes shrimp fry Xiamen, China 3.6M	3.6 M	PHP 1.26 M

- Fisheries General Memorandum Order No. 119, Series of 2003 - Guidelines in the importation of milkfish (bangus) fry, *Chanos chanos*. This is an additional guideline in the implementation of FAO 221 that was issued due to persistent illegal importation of shrimp fry under the guise of milkfish fry; and
- Implementation of the total ban on live shrimp importation was further strengthened with the passing of a resolution by the Philippine Shrimp Industry Association (PHILSHRIMP) fully supporting the ban and urging for the stricter implementation of Fisheries Administrative Order 207, Series of 2001.

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

Commercial production of *M. rosenbergii* in freshwater ponds and rice-prawn culture systems was given a boost in 2001 after commercial prawn fry production was achieved. The estimated production was 70 metric tons with yearly increase of 10%. However, the bulk of production is still mainly derived from wild caught fisheries with only 10% being contributed by aquaculture. Increase in freshwater prawn aquaculture is promising since new areas for grow-out production (pond and rice-prawn culture) are currently being developed in Regions 1-8 and 11.

II.1. Diseases of Shrimps and Prawn

a. White Spot Syndrome Virus (WSSV)

Viral infections remain untreatable, thus exclusion is the most logical alternative to prevent their entry into culture facilities. This highlights further the need to screen for viruses using the most sensitive and specific method available. A DNA-based PCR protocol developed for WSSV by Tapay *et al.* (1999) has been reported to detect isolates of the virus from various geographic regions like China, Indonesia, Japan, the United States, and India.

Furthermore, the same protocol has been used extensively in testing for WSSV in asymptomatic shrimp from hatcheries and grow-out ponds.

In February 2000, the first mortality associated with WSSV infection in the Philippines was observed in cultured *P. monodon* in Negros Occidental. The causative agent was confirmed as WSSV using PCR (Magbanua *et al.*, 2000).

Sixteen PCR laboratories are currently in place in strategic regional sites conducting comprehensive monitoring and surveillance program. Most postlarvae are checked for WSSV carrier status before shipment to various islands within the country. In 2002, only 35 samples out of 1,115 analyzed (3.14%) were confirmed positive for WSSV, but in 2003, a 5-fold increase in WSSV positive samples was recorded (169 positive samples out of a total of 1,413).

Increased infection rate in 2003 was observed during the cold months of the year starting in October. Mortality in ponds was noted in the months of November to February, resulting to crop failure. In addition to previously recorded infected areas, WSSV infection spread to other shrimp producing provinces as such Davao del Sur, Camarines Sur, Iloilo, Capiz, Lanao del Norte, Masbate, Sorsogon, Samar, Leyte, and Pangasinan.

The impact of WSSV infection is limited in magnitude and spread compared with other countries due to the pro-active program instituted by the Philippine government, through BFAR's "National Action Program to Control WSSV in Shrimp". This program was conceived in March 2000, with the following specific objectives and activities:

1. Exclusion

This approach aims to prevent further introduction of WSSV carriers into the country. Since the most effective carriers of the virus are live shrimps and crustaceans, a complete ban on importation of live shrimps, prawns and other crustacean species is the logical preventive approach. This is implemented by virtue of Fisheries Administrative Order No. 189.

A new FAO was drafted to strengthen FAO 189 to include not only prohibition on the importation, but also the culture of imported live shrimp and prawn of all stages. The draft was presented in a series of regional consultations to various stakeholders, including the National Fisheries Aquatic Resources Management Council (NFARMC) as mandated by Republic Act 8850 of 1998 or the New Fisheries Code. After deliberation and upon endorsement of the Secretary of the Department of Agriculture (DA), Fisheries Administrative Order 207 Series of 2001 was signed into law on 17 May 2001.

2. Containment

The containment approach seeks to prevent the spread of WSSV. As much as possible, WSSV outbreaks should be contained within the areas originally affected so that areas that are still WSSV-negative can be spared from the potentially-devastating effect of the disease. The archipelagic nature of the country and the fact that shrimps can, on their own, potentially move from one part of the country to another makes this approach highly

challenging. Towards this end, five major activities are being implemented, namely:

- a. Detection and diagnosis of WSSV;
- b. Surveillance and reporting;
- c. Regulation of in-country movement of live shrimps, particularly postlarvae or fry stages;
- d. Hatchery accreditation scheme; and
- e. Promotion of environment-friendly shrimp farming and good farm management practices.

These strategies are envisioned to help improve the quality of shrimp postlarvae being produced and marketed in the country, to raise awareness among hatchery operators on the importance of using healthy shrimp spawners, and to highlight to shrimp growers the importance of using only high-health shrimp fry for stocking in grow-out ponds.

3. WSSV Detection and Diagnosis

Detection of the disease is the most basic requirement for its effective control. Thus, it was given highest priority by BFAR. Since PCR-based diagnostic techniques are currently the most reliable diagnostic tools, BFAR started a program in 2000 with disease surveillance as a focal point and “early detection of the virus” using PCR as a prevention strategy. At present, the BFAR has 16 PCR-capable facilities nationwide strategically located in shrimp growing areas (Table 1).

Table 1. List of PCR-capable facilities

Location of PCR facility	Regional Director Concern	Regional Fish Health Officer
BFAR Regional Office III, Berzon Building, San Agustin, San Fernando	Director Remedios E. Ongtangco	Carmencita Agustin Tel. (045) 9612784 Mobile: 09196698610
BFAR Central Office, 860 Quezon Avenue, Quezon City	Simeona E. Regidor, Chief, Fish Health Section	Juan D. Albaladejo Maria Abegail G. Apostol Tel. (02) 3725055 Mobile: 09173933605 09173672554
Fisheries Quarantine Office, BPI Complex, South Harbor, Port Area Manila	Director Rosa F. Macas	Ms. Ligaya Cabrera Ms. Maritess Guinto Tel. No. (02) 5270718 Mobile: 09198410973 09196505970
Provincial Fisheries Office, Rizal Avenue, San Jose, Occidental Mindoro	Director Virgilio A. Alforque	Ms. Dina dela Reyna Tel. No. (043) 4912138 Mobile: 09196722584
Southeast Asian Fisheries Development Center/Aquaculture Department, Tigbauan, Iloilo	Dr. Rolando Platon, Chief, SEAFDEC-AQD	Dr. Gilda Lio-Po Tel. No. (033) 3351009 Mobile: 09198519028

Table 1 (continuation)

Location of PCR facility	Regional Director Concern	Regional Fish Health Officer
Negros Prawn Producers Marketing Cooperative, Inc., 2nd Door, NEDF Bldg., 6th Street, Bacolod City (Private Sector accredited laboratory)	Mr. Roberto A. Gatuslao, Chair, Board of Director, NPPMCI	M. Roselyn Usero Tel. No. (034) 4332131 Mobile: 09209084599
BFAR Regional Office VII, Arellano St., Cebu City	Director Corazon M. Corrales	Ms. Carol Lopez Tel. No. (032) 2530661 Mobile: 09172512240
Bohol Aquaculture Foundation, Inc., Maribojoc, Bohol (Private Sector accredited laboratory)	Mr. Jimmy Bartolaba, President, BARFI	Ms. Nora Malmis Tel. No. (038) 4115224 Mobile: 09173602304
BFAR Regional Office, Barangay Diit, Tacloban City	Director Gil A. Adora	Mr. Ruben Francisco Tel. No. (053) 3254705
BFAR Regional Office, R.T. Lim, Kawa-kawa, Zamboanga City	Director Abdulgafor N. Abdua	Ms. Carolina S. Moron Tel. No. (062) 9925051 Mobile: 09193065826
BFAR Regional Office, Macablang, Cagayan de Oro City	Director Arlene B. Pantanosas	Ms. Evie Lumingkit Tel. No. (088) 8569610 Mobile: 09196772736
BFAR Regional Office, Magsaysay Avenue, Davao City	Director George Campeon	Mr. Raul Millana Tel. No. (082) 2245085 Mobile: 09168240915
BFAR-ROS Station, Lala, Lanao del Norte	Director Sani A. Macabalang	Ms. Sarah Mae Mamalangkap Cellphone: 09198003429 Dr. Jane Corcuera Mobile: 09198733730
BFAR Satellite Regional Fisheries Laboratory, Northern Mindanao School of Fisheries Campus, Matabao, Buenavista, Agusan del Norte	Director Alauya R. Olama Al Hadj	Ms. Melissa Lee Talavera Tel. No. (085) 3435255 Mobile: 09196239264
BFAR Regional Fisheries Laboratory, City Engineer Office, Surigao City	Director Alauya R. Olama Al Hadj	Mr. Ilvin Elumba Tel. No. (086) 8265538
National Institute of Molecular Biology and Biotechnology, UP Los Baños, Laguna	Dr. Veronica P. Migo	Dr. Veronica P. Migo Tel. No. (049) 5360587 Mobile: 09189050867

Aside from PCR, the laboratories are also equipped to undertake the following laboratory procedures:

1. Quantitative bacteriology;
2. Shrimp fry quality assessment; and
3. Water quality analysis.

PCR-based diagnosis is a sophisticated and precise technique that requires specialized training. Hence, a complimentary manpower capability-building on the operation of this specialized laboratory procedure was conducted for Regional Fish Health Officers and technicians from accredited private laboratories. Subsequently, on-site hands-on PCR trainings were also conducted with regular proficiency testing of the laboratory technicians to ensure good quality control standards.

In order to standardize the PCR procedure, the National Institute of Molecular Biology and Biotechnology (BIOTECH) of the University of the Philippines in Los Baños and SEAFDEC Aquaculture Department were designated by BFAR as the national reference laboratories for WSSV. These laboratories insure that all diagnostic kits used in the PCR protocol are standardized to keep the integrity and reproducibility of the procedure, and they serve as depository of the virus materials for maintenance and safekeeping. Furthermore, they serve as the agencies to resolve conflict of results that might arise in the conduct of the analysis.

Two non-government organizations, NPPMCI and BARFI, are also involved in the program in order to have participatory collaboration with the private sector by providing them with resources such as PCR equipment, training and technical support. These organizations are actively involved in the exchange of information and formulation of future strategies to control the spread of the viral diseases.

4. Surveillance and Reporting

Even prior to the formulation of the WSSV Control Program, BFAR has been actively involved in the Quarterly Aquatic Animal Disease Reporting System that has been adopted within Asia-Pacific region under the joint programs of the Food and Agriculture Organization (FAO), Network of Aquaculture Centers in Asia-Pacific (NACA) and Office International des Epizooties (OIE). To support this, BFAR requires participating field laboratories to submit monthly reports. Meanwhile passive surveillance in areas not covered by the participating laboratories continues using the National Aquatic Animal Disease Reporting format developed under the FAO/NACA/AusAid/APEC Project.

5. Regulation of in-Country Movement of Shrimp Fry

There is considerable movement of shrimp fry from one province to another due to the demand from shrimp growers. To minimize spread of disease, BFAR strengthened existing regulations covering in-country movement of live shrimps which includes issuance of health certificate/permit, and inspection procedures at ports of entries or origins. In addition, protocols for proper disposal of WSSV-infected postlarvae and for decontamination of WSSV-infected hatchery facilities will be prepared. The following Fisheries Office Orders are in force to insure smooth implementation:

- a. Fisheries Memorandum Order No. 240, Series of 2003 concerning regulations on transboundary movement of shrimp postlarvae;
- b. Fisheries General Memorandum Order No. 014, Series of 2004 containing the Guidelines for the Implementation of Fisheries Memorandum Order No. 240; and
- c. Fisheries Memorandum Order No. 013, Series of 2004 is on imposition of active surveillance mechanism for all shrimp hatcheries nationwide as part of the strict implementation of the National Action Program to Control White Spot Syndrome Virus in shrimp.

Continuing education and training of quarantine officers and laboratory technicians will be pursued on regular basis. Stakeholders in the shrimp industry, such as hatchery operators, shrimp fry traders and growers, will likewise be educated on the importance and benefits of compliance.

6. Shrimp Hatchery Accreditation Scheme

A Fisheries Administrative Order on rules and regulations for issuance of Compliance Certification based on “best practice” in the hatchery was presented for adoption by the Philippine Shrimp Hatchery Association (PHILFRY). Comments and inputs from the deliberation were incorporated in the final draft that was endorsed to the NFARMC for approval of the law.

7. Good Farm Management Practices

To augment the disease prevention strategies, promotion of good culture practices and bio-security measures are being promoted in-farm. This is based on the “Code of Practice for Sustainable Shrimp Farming”. Also, promotion of environment-friendly schemes in shrimp farming that have been field-tested by SEAFDEC and BFAR through the Joint Mission for the Accelerated Nationwide Technology Transfer Program will continue.

b. Taura Syndrome Virus (TSV)

Due to the existing ban on importation of exotic shrimp species in the country, there are no reports of TSV infection in the Philippines. At present, SEAFDEC is the only laboratory capable of testing for TSV. Samples submitted to SEAFDEC Aquaculture Department obtained from illegal shipments at airports showed negative results for the virus after analysis using PCR. BFAR is planning to include active surveillance for TSV in its monitoring program.

c. Significant and Emerging Viral Diseases of *Macrobrachium rosenbergii*

Testing for important prawn viruses that might infect local population of *M. rosenbergii* is now included in the National Action Program. Since government and private hatchery operations to produce prawn postlarvae is still inadequate, selective importation of postlarvae and broodstock was allowed to augment the local supply for stocking in ponds, and for genetic diversity and genetic selection programs. Special permits were issued by the

Department of Agriculture through the recommendation of BFAR to import a specific number of prawn from Thailand and Lao PDR. All importations were subjected to pre-border inspection from the country of origin by recognized Fish Health laboratories using techniques to detect economically important diseases of *M. rosenbergii*. Subsequent post-border inspection of the shipment was also performed in the Fish Health Central Laboratory in Manila.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

The Fish Health Section (FHS) of BFAR spearheads the implementation of monitoring of aquaculture farms, and provides diagnostic services as well as technical and advisory assistance to the aquaculture industry. Its monitoring program includes disease surveillance and reporting system, aquatic animal health certification and implementation of quarantine procedures, assessment of the health status of stocks of selected fish, and management of other aquatic resource farms in the Philippines.

The FHS operates a Central Fish Health Laboratory with the responsibility and competence for ensuring or supervising the implementation of the aquatic animal health measures recommended by the OIE and European Commission Directive 2003/858/EC. The FHS develops standardized routine procedures and guidelines for the operation of the 15 Regional Fish Health Laboratories (Fig. 2), supervises the activities, and sets directions for the operation of such laboratories, as well as provides technical guidance to 38 Regional Fish Health Officers (FHOs) on the execution of diagnostic activities and technical assistance on fish health-related problems. It also imparts specialized training programs on fish health for government fishery biologists, extension workers and fish farmers.

Surveillance and monitoring program of farms for diseases and drug residue monitoring was developed to know the animal health situation in the Philippines and in compliance with the requirements of trading partners. As exporter of fresh and frozen aquaculture products to European communities, the FHOs also implement disease monitoring and surveillance in fulfillment to the requirements of EC Directive 2003/858/EC. The FHOs also act as fishery inspectors authorized to certify fish products of aquaculture origin for export into the European Community for human consumption.

a. Regional Fish Health Laboratories

As indicated in Fisheries Office Order No. 211 series of 2003 issued on 28 August 2003, the FHOs shall be responsible for the implementation of residue monitoring report and plan in accordance with European Union Council Directive 96/23/EC in their area of responsibility and perform the following functions: a) assist in planning, directing, and implementing of



Fig. 2. Map of the Philippines showing the location of the Regional Fish Health Laboratories

the national program on fish health management; b) supervise and operate the RFHLs and satellite laboratories in their respective areas of jurisdiction; c) adopt FAO 220, series of 2001 concerning “Operation of the Fish Health Laboratories and Collection of Fees and Charges”; d) conduct fish kill investigation and implement the National Strategy on Fishkill Investigation, Reporting and Prevention; e) provide technical support to the fish inspection and quarantine services; f) act as quality control officer on the regulation of animal feed veterinary drugs and products in aquaculture; and g) submit quarterly accomplishment reports relating to program to the Bureau Director.

b. National Disease Monitoring and Surveillance

Table 2 lists the central and regional FHOs. The Central Fish Health Laboratory provides the technical know-how and formulates mechanisms to coordinate the conduct of disease surveillance, monitoring, and reporting. To harmonize activities on disease surveillance, a monitoring form was developed for field use. Quarterly reports are submitted to the Central Fish Health Laboratory for information and consolidation.

In 2003, disease surveillance and monitoring of 199 shrimp, 80 milkfish and 336 tilapia farms nationwide were conducted (Table 3). No major disease outbreaks were observed in these farms. Shrimp hatcheries were encouraged to screen their fry for WSSV and to conduct fry quality assessment prior to stocking to lessen the risk of disease outbreak.

Table 2. List of Fish Health Officers of the Bureau of Fisheries and Aquatic Resources

Name	Address	Tel. No./Fax
Ms. Rosario Segundina Gaerlan Ms. Marina Dumol	BFAR Region I - West Dagupan Pangasinan	(075) 523 085
Ms. Evelyn Ame Ms. Melba Francisco	BFAR Region II - Tuguegarao, Cagayan	(078) 844 4261
Ms. Carmencita Agustin Ms. Teresita Gulle Mr. Gonzalo Coloma Mr. Manuel Dizon Ms. Maxima S. Sabariaga Ms. Esperanza Gutierrez	BFAR Region III - San Fernando, Pampanga	(045) 961 2784
Ms. Ligaya Cabrera Ms. Josephine de la Vega Ms. Marilou Mosqueda Mr. Lizardo D. Lucido Ms. Maurita Rosana Ms. Elvira Casao Ms. Nenita Kawit Mr. Julian Clemente	BFAR Region IVA - FFRS, Los Banos, Laguna	(049) 536 0705
Mr. Rolando C. Miranda Ms. Dina de la Reyna Ms. Imelda Malabanan	BFAR Region IV-B - San Jose, Mindoro, Occidental	

Table 2 (continuation)

Name	Address	Tel. No./Fax
Ms. Simeona E. Regidor Ms. Mercedita A. Bantaya Dr. John D. Albaladejo Dr. Joselito R. Somga Ms. Abegail Aposto Dr. Sonia S. Somga	BFAR-Central Office, Central Fish Health Laboratory, 860 Quezon Avenue, Quezon City	(02) 372 5055
Ms. Edna Tud Ms. Irmí Mora	BFAR Region V - Mercedes, Camarines Sur	(054) 477 3948
Ms. Pricilla Pangantihon Ms. Evelyn Abad Ms. Helen Bandojo Ms. Balylou U. Tizon	BFRA Region VI - Muelle Loney St. Iloilo City	(033) 336 9878
Ms. Carolina Lopez Ms. Emma Gultiano Dr. Tom Cuyos	BFAR Region VII - Arellano Blvd., Cebu City	(032) 253 0661
Ms Remedios Lequin Mr. Ruel Amascual Ms. Maribel Dioloa Mr. Ruben Francisco Ms. Sharimae Lequin Ms. Guinevere Ramos	BFAR Region VIII - Brgy. Diit, Tacloban City	(053) 321 3152
Ms. Carolina Moron Ms. Sherdalyn A. Sajili Ms. Eden A. Alvarez Ms. Evelyn M. Salve Ms. Grace P. Dueay Ms. Rachel L. Tenorio Mr. Bonifacio Duterte	BFAR Region IX - RT Lim Blvd., Zamboanga City	(088) 856 9610
Ms. Evie Lumingkit Ms. Riza P. Pacuno	BFAR Region X - Macabalan, Cagayan de Oro City	(062) 991 8192
Mr. Raul Millana Dr. Celeste Santos Dr. Eb Morandante Ms. Madeleine Navarce	BFAR Region XI - Magsaysay Ave., Davao City	(064) 421 1213
Ms. Sarah Mae Mamalangkap Dr. Jane Corcuera Ms. Liberty Lagang	BFAR Region XII - General Santos City	(082) 224 5058
Ms. Anna Melissa Talavera Mr. Ilvin Celumba Mr. Vito A. Gamos	BFAR Region XIII - Surigao City, Surigao del Norte	(085) 343 5255
Ms. Cheryl Dimacisil Ms. Bambang A. Macargas Mr. Datumanong Dimacisil	Autonomous Region of Muslim Mindanao - ORG Complex, Cotabato City	(064) 421 1234
Ms. Petra Gayagay Mr. Roderick S. Pangan	Cordillera Autonomous RegionGuisad, Baguio City	(074) 443 6716

Table 3. Summary of farm visits by the Fish Health Officers in 2003

Region	Number of Farms Visited											Total
	II	III	IV	V	VI	VII	IX	X	XI	XIII	CAR	
Shrimp		50	8	4	7	19	30	20	16	45		199
Milkfish					4	5	55	13	3			80
Tilapia	154	55	61			7	50	6			3	336

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

The laboratories that conduct fish disease diagnosis and their corresponding level of diagnosis are listed in Table 4. Following are the levels of diagnosis: Level I: diagnostic activity limited to observation of animal and the environment, and clinical examination (on-site or field diagnosis); Level II: diagnostic activity includes parasitology, bacteriology, mycology and histopathology (laboratory diagnosis); and Level III: diagnostic activity includes virology, electron microscopy, molecular biology, and immunology (laboratory diagnosis).

a. Economically-Important Diseases in the Philippines

Significant disease outbreaks that caused mass mortalities of wild and cultured fish stocks are listed in Table 5. *Aphanomyces invadans*, a fungus, in association with *Aeromonas hydrophila* caused mass mortality of wild populations of *Clarias batrachus*, *Ophicephalus striatus* and *Mugil cephalus*. The outbreak started in 1985 in Luzon and was recently reported in Lake Lanao. Epizootic Ulcerative Syndrome (EUS) was confirmed by the presence of fungal hyphae in tissue sections of *Glossogobius aureus* caught in the lake.

Reports from Roxas City in Panay Island of mortality caused by parasitic diseases like monogeneans on the body surface and gills of fry of brown spotted grouper were received. It was reported that outbreaks are also occurring in Mindoro and Palawan, the sources of grouper fry. Another parasite, *Caligus epidemicus*, caused mass mortality of tilapia and milkfish cultured in brackishwater farms in Negros Occidental, Zambales, Bicol and Pagbilao, Quezon. One more parasite, an isopod identified as *Corallana grandiventra*, has been the cause of losses among tilapia cultured in cages at Taal Lake, a freshwater lake. Mortality of up to 100% was reported causing some fish farmers to cease operation.

Diseases outbreaks in *P. monodon* caused by *Vibrio* spp. have been associated with mass mortalities. *Aeromonas hydrophila* has been reported in fish mortalities associated with *Aphanomyces invadans* in EUS-infected fish.

b. Current Needs and Requirements

Although disease and drug residue surveillance and monitoring are in place, the activities need a lot of improvement. At the moment, project proposals are in the pipeline to upgrade the existing capacity and capability of BFAR Fish Health Section. There is a need to develop a proposal on

Table 4. List of official Fish Health Laboratories

Region	Location	Contact Person	Tel. No./Fax No.	Diagnostic Level
A. BFAR Fish Health Laboratories				
1	West Dagupan, Pangasinan	Ms. Marina Dumol	(075) 523 085	I,II-ab
2	Tuguegarao, Cagayan	Ms. Evelyn Ame	(078) 844 4261	I,II-ab
3	2nd Floor Berzon Bldg, San Agustin City, San Fernando, Pampanga	Ms. Carmencita Agustin	(045) 961 2784	I,II-ab
4-A	FFRS, Los Banos, LagunaAmbulong Tanauan, Batangas	Ms. Ligaya Cabrera	(049) 536 0705	I,II-a,III-a
4-B	Grnd Flr ICC Bldg. NIA Cmpd, EDSA Quezon City	Mr. Rolando C. Miranda	(02) 421-2138 (02) 928-2051	I,II-ab I,II,III
NCR	Central Fish Health Laboratory 860 Quezon Avenue, Quezon City	Ms. Simeona E. RegidorDr. Sonia S. Somga	(02) 372 5055	I,II-abc,III-ad
5	Mercedes, Camarines Sur	Ms. Edna Tud	(054) 477 3948	I,II-ab
6	Muelle Loney St., Iloilo City	Ms. Pricilla Pangantihon	(033) 336 9878	I,II-ab
7	Arellano Blvd., Port Area Cebu City	Ms. Carolina Lopez	(032) 253 0661	I,II-ab,III-a
8	CRM Center, Diit, Tacloban City	Ms Remedios Lequin	(053) 321 3152	I,II-ab,III-a
9	RT Lim Blvd., Kawa-kawa, Zamboanga City	Ms. Carol Moron	(088) 856 9610	I,II-ab,III-a
10	Macabalan, Cagayan de Oro City	Ms. Evie Lumingkit	(062) 991 8192	I,II-ab,III-a
11	Magsaysay Ave., Davao City	Mr. Raul Millana	(064) 421 1213	I,II-ab,III-a
12	Vensu Bldg., National H-way General Santos City	Ms. Sarah Mae Mamalangkap	(082) 224 5058	I,II-ab
13	Surigao City, Surigao del Norte	Ms. Anna Melissa Talavera	(085) 343 5255	I,II-ab,III-a
14	ARMM ORG Complex, Cotabato City	Ms. Cheryl Dimacisil	(064) 421 1234	I
CAR	Cordillera Autonomous RegionGuisad, Baguio City	Ms. Petra Gayagay	(074) 443 6716	I,II-ab
B. Other Government and Private Fish Health Laboratories				
4	Nat'l Institute of Mol. Bio. & Biotech-UP, Los Banos, Laguna*	Dr. Veronica P. Migo	(049) 536 0547/ 536 2724	I,II,III
6	SEAFDEC-AQD, Tigbauan, Iloilo	Dr. Gilda Lio Po	(033) 336 2937	I,II,III
6	Negros Prawn Producers Mktng Cooperative, Inc. JTL Bldg., BS Aquino Drive, Bacolod City	Ms. Roselyn Usero	(034) 433 2131	I,II-ab,III-a
7	Bohol Aquaculture Research Foundation, Inc., Maribojoc, Bohol	Mr. Daniel Vergara	(038) 504 9211	I,II-ab,III-a

*National reference laboratory

NCR = National Capital Region

quarantine, including a national program on monitoring and surveillance of emerging diseases such as, but not limited to, TSV, KHV and viral nervous necrosis (VNN). Assistance is also very much needed to implement the Technical Implementing Guidelines on Asia Regional Technical Guidelines on Health Management for Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy.

Table 5. Partial list of economically-important diseases of aquatic animals

Name of Disease	Affected Animals	Level of Diagnosis
Fungal		
Epizootic Ulcerative Syndrome	<i>Ophicephalus striatus</i> <i>Clarias batrachus</i> <i>Glossogobius giurius</i>	Level III
Parasitic		
Monogeneasis	<i>Epinephelus tauvina</i>	Level II
Caligosis	<i>Oreochromis niloticus</i> <i>Chanos chanos</i>	Level II
Isopodiasis	<i>Oreochromis niloticus</i>	Level II
Bacterial		
Vibriosis	<i>Epinephelus tauvina</i> <i>Penaeus monodon</i> <i>Tilapia hornorum</i>	Level III
Aeromonas	<i>Ophicephalus striatus</i> <i>Clarias batrachus</i>	Level II
Viral		
White Spot Disease	<i>Penaeus monodon</i>	Level III, PCR

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

a. Laws and Regulations

BFAR is the government agency responsible for the implementation of fisheries inspection and quarantine services as mandated by Republic Act 8550, section 67. Implementing rules and regulations are issued in the form of Fisheries Administrative Orders to properly implement the law. For the transboundary movement of live fish and fishery/aquatic products, the FAO No. 221, Series of 2003 was enacted. It contains the implementing rules and regulations pertaining to the importation of live fish and fishery/aquatic products to include microorganisms and bio-molecules. The following are the relevant documents for implementation of the movement of live aquatic animals:

- a) Fisheries Administrative Order No. 220, Series of 2001 pertains to the operation of Fish Health laboratories and collection of fees and charges therefore;
- b) Fisheries Administrative Order No. 207, Series of 2001 prohibits the importation and culture of imported live shrimp and prawn of all stages;
- c) Fisheries Administrative Order No. 221, Series of 2003 regulates further the importation of live fish and fishery/aquatic products under FAO No. 135 Series of 1981 to include microorganisms and bio-molecules;

- d) Fisheries Office Order No. 211, Series of 2003 is an amendment to Fisheries Office Order No. 147-01, Series of 2001 and pertains to designation of Regional Fish Health Officers;
- e) Fisheries Memorandum Order No. 240, Series of 2003 pertains to Regulations on Transboundary Movement of Shrimp Postlarvae;
- f) Fisheries Memorandum Order No. 078, Series of 2003 pertains to Restriction on Entry of Live Fish Species Importation from Taiwan and China;
- g) Fisheries General Memorandum Order No. 014, Series of 2004 are Guidelines for the Implementation of Fisheries Memorandum Order 240; and
- h) Fisheries Memorandum Order No. 013, Series of 2004 pertains to the imposition of active surveillance mechanism for all shrimp hatcheries nationwide as part of the strict implementation of the National Action Program to Control White Spot Syndrome Virus (WSSV) in shrimp.

b. Responsible Facilities and Location

There are two sections in BFAR that have responsibility over the movement of live aquatic animals: the Fish Health Section under the Office of the Director, and the Foreign Trade and Miscellaneous Permit Section under the Fisheries Regulatory and Quarantine Division.

The Fish Health Officers and the Fisheries Quarantine Officers (FQOs) implement the health management process as defined in the Asia Regional Technical Guidelines on Health Management for Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy. The FHO implements the pre-border (exporter) and post-border (importer) activities, and the FQO is concerned with border activities in the transboundary movement of live aquatic animals. Table 6 lists the Fisheries Quarantine Officers.

c. Conduct of Quarantine and Inspection Services

As outlined in FAO 221, all importation of live fish and fishery aquatic products, aquatic microorganisms, bio-molecules, including genetically modified organisms (GMOs) and endangered species will be categorized by BFAR, in cooperation and coordination with the Bureau of Plant Industry, Bureau of Animal Industry, and Protected Areas and Wildlife Bureau into the following: low risk species, medium risk species, high risk species, and prohibited or banned species.

IV-2. Procedures and Requirements for Importation

a. Filing

The importer must show intention to import live fish and fishery/aquatic products including microorganisms and bio-molecules through the filing of his application at least five working days prior to the importation of low risk species, and 10 to 15 days for medium risks species. The decision whether or

not to import high risk species will be given thirty (30) days after evaluation of the proposal and other documents which may be required by the Import Risk Analysis (IRA) Panel.

b. Review by Import Risk Analysis Panel

All importation is subject to review by the IRA Panel that shall serve as the secretariat and clearing house of all IRA cases and may tap a group of experts to resolve individual cases whenever necessary. The panel shall be chaired by a Fish Health Officer and has five permanent members who shall have the following minimum qualifications: a) one member shall be a member of the Philippine Bar; b) one member shall be a fish health officer; c) one member shall be a regulatory fisheries quarantine officer; d) one member shall be a member of NFARMC; and e) one member shall be a fishery biologist (on call, depending on the required expertise). The importation requirements are dependent on the category of the commodity which will be listed in the permit issued by BFAR (Section 7 FAO 221).

c. Importation Requirements According to Section 7 of FAO No. 221

- 1) For low risk species - duly accomplished form. Risk analysis shall not be required except when there is a reported significant outbreak in the country of origin.
- 2) For medium risk species
 - i. Duly accomplished application form;
 - ii. Duly accomplished proposal form with emphasis on health, ecological and genetic impacts of the proposed importation;
 - iii. Import risk analysis (IRA) by the IRA Panel;
 - iv. Health Certificate from the competent authority of the country of origin to be presented upon arrival; and

Table 6. List of Fisheries Quarantine Officers

Name	Area of Assignment	Region/Tel/Fax No.
Atty. Analiza Vitug Chief, Regulatory and Quarantine Division Mr. Edwyn Alesna OIC, Foreign Trade Section	National	372-5046
Mr. Orlando Lagoy	Water Ports of Ilocos Norte Laoag City, Ilocos Sur, Pangasinan and La Union	I Tel. (072)710-127 Fax (072)242-1559
Mr. Lorenzo de la Cruz	International Airport, Laoag City	
Ms. Marina B. Dumol	All major markets in Region 1	
Mr. Benjamin N. Baculi Mr. Loreto T. Lacerna, Jr Mr. Roberto T. Labang	Regional-FQS	
Mr. Cornelio A. Sebastian Mr. Leo S. Palolan	MCS Office-Appari/Port Irene/Sta Ana	

Table 6 (continuation)

Name	Area of Assignment	RegionTel/Fax No.
Mr. Reynaldo P. Lucas Mr. Leonido R. Apolinario	Sta Predex Checkpoint-Cagayan	II Tel. (078) 8044252 Fax (078)844-5331 (078)846-3661
Mr. Jessie Gaspar Mr. Samuel A. Trinidad	Ports of Aparri and Sta Ana, Cagayan Checkpoint-Camalaniugan, Cagayan	
Mr. Arsenio Tagaca	Airport-Tuguegarao City	
Mr. Rommel U. Arteta Mr. Rogelio N. Tejada Mr. Kenneth A. Abalos Mr. David A. Anuma Mr. Virgilio F. Viernes	Sta Fe and Nueva Viscaya Checkpoint	III Tel. (045) 9635515 Tel./Fax (045)9612784
Mr. Jorge A. Mogol Mr. Hilarion P. Vinuya	Lamao, Port, Limay, Bataan BASECO, Mariveles, Bataan	
Mr. Ernesto V. Pangan	Clark International Airport	
Mr. Felizardo C. Francisco Ms. Erlinda A. Quintos Mr. Nelson B. Bien	Subic International Airport and Seaport of Zambales, Shipyard	
Mr. Felipe I. Santamaria Mr. Ben Curativo Mr. Mario Trio	FQS-Ninoy Aquino International Airport	IVA Tel. (02) 926-8714 (02) 9261901 Fax (02) 926-8616
Ms. Leticia Castroverde Mr. Rex Sta Maria Mr. Wilfredo Carbonel Mr. Roberto Arcegonon	FQS-Manila Domestic Airport	
Mr. Baltazar T. Macas, Jr. Mr. Roque Torres Mr. Eliseo Encarnacion Mr. Joel Gutierrez Ms. Soledad Cajulis Mr. Edwin Espiritu Mr. Alberto Exclamador	FQS-South HarborMICP International Fisheries Quarantine Metro Manila	
Mr. Arnulfo Gil Mr. Arturo Pagjunasan	North Harbor-FQS	
Mr. Agripino Cantiga Mr. Eladio A. Comendador Ms. Teresita Cañezal Mr. Oliver A. Comia Mr. Monro Gulle Mr. Ramon Antonio Villalobos	FQS-Navotas	
Mr. Salvador Boncodin Ms. Margarita Panganiban Ms. Leonila Manalo	FQS-Batangas Port ,Batangas City	
Mr. Mario Abueg Mr. Celso Almonte	FQS-Puerto Princesa City Palawan	
Mr. Paciano Gianan Mr. Basilio Buban Mr. Jose B. Glanan	MCS Palawan	

Table 6 (continuation)

Name	Area of Assignment	RegionTel/Fax No.
Mr. Ronald Fabiano Mr. Rey Templonuevo Ms. Elsa S. Cruz	Coron Fisheries Station-Coron, Palawan	IV B Tel. (02)421-2138 (02)928-2051
Mr. Samuel Caligdong Mr. Franklin Sitchon Ms. Estrella Caligdong Mr. Ramilo Fadriquilan	Brooke's Point, Palawan	
Ms. Sonia Elloso Ms. Juanita Amurao Mr. Glenn Ladlana Mr. Cesar Ramos Mr. Domingo Timbal Mr. Felipe Hernandez	FQS-Dalahican, Lucena City	
Mr. Rex Gonzales Mr. Reynalso Laurena	FQS-San Jose. Occidental Mindoro	
Mr. Vicente de Galicia	FQS-Boac, Marinduque	
Mr. Jjacob Lloca	FQS-Romblon	
Mr. Ernesto B. Arandia Ms. Cherry F. Calaveron	FQS Regional	
Mr. Reynaldo Vega	Albay and Catanduanes	
Mr. Prudencio Bongalos Mr. Roberto Borbe	Bulan and Matnog Sorsogon	
Mr. Raul Tosoc	Camarines Norte	
Mr. Wilfredo Bustamante Mr. Jesus Badillo	Masbate	
Mr. Francisco Ombao	Camarines Sur	
Ms. Irmí Mora	Fisheries Diagnostic Laboratory	
Mr. Hitler S. Seville-CFQO Mr. Edwin Javier Ms. Leni Janco Ms. Amedeo Alvaniz	FQS-Region-wide	VI Tel. (033) 337-0265 (033) 336-6748 Fax (033)336-9432
Mr. Ronald Articulo Mr. Roque Leonoras Mr. Nestor Bandada Mr. Alfredie Manosa	Iloilo City Seaport	
Mr. Salvador Herbona	Bacolod City-Seaport	
Mr. Nimrod John Faicol	Bacolod City-Airport	
Mr. Egnér Javier	Aklan Seaport & airport	
Mr. Jose Marie Ascona	Roxas City Seaport and airport	
Mr. Jeffrey D. Cortes	Regional office No. VII	

Table 6 (continuation)

Name	Area of Assignment	RegionTel/Fax No.
Mr. Randolph M. Corrales	Cebu Intl Port & Cebu Domestic Seaports	VII Tel. (032)256-2775 Fax (032)256-2773
Mr. Juanito Villordon	Cebu outports and sub-ports	
Mr. Anacleto Talagon Ms. Cynthia Makinano Mr. Alexander Montuya	Mactan-Cebu International Airport	
Mr. Leonardo Aro	Port of Dumaguete, Negros Oriental	
Mr. Warren S. Inao	Port of Siquijor	
Mr. Allan Poquita	Port of Tagbilaran, Bohol	VIII Tel. (053)321-4801 Fax (053)325-3113
Ms. Vicitacion Elmido	Isabel Port, Isabel Leyte	
Ms. Romualda Pelen	Tacloban Seaport, Tavloban City	
Ms. Rosalinda Cañas	Ormoc Port, Ormoc CityAlbuera Port, Albuera Leyte	
Ms. Rosella G. Contreras Mr. Abdulgamar S. Mohamad	FQS- Regional	
Mr. Pedling S. Munap Mr. Abdulbasar S. Cuevas	Sea Port Area	IX Tel. (062)992-5071 Fax (062) 993-2046
Mr. Abelardo M. Francisco	Airport Area	
Mr. Joseph C. Florig	Dipolog City	
Mr. Mateo O. Cabillo	Dapitan Roxas Zamboanga del Norte	
Ms. Estrella C. Macapobre	Ipil Sibugay	
Ms. Merly Q. Pao	Pagadian City	
Ms. Mona T. Macabuat	Isabela City, Basilan Province	
Mr. Teodoro B. Bacolod, Jr. Mr. Socrates C. Quibalat	Regional Office No. X & Port of Cagayan de Oro	
Mr. Vivencio Garfin	Port of Cagayan de Oro	
Mr. Lauro Galindo	Lumbia Airport, Cagayan de Oro	
Mr. Nerio Piola	Port of Ozamis	
Mr. Marnito Piloton	Port of Benoni	
Mr. Raul C. Millana Mr. Noel L. Manalo Mr. Eric D. Ria	Regionwide	
Mr. Alberto L. Escabarte Mr. Pepto F. Origenes Ms. Mary Ann Cuario Mr. Zaharudin L. Abdulrasid	Davao Fish Port Complex	

Table 6 (continuation)

Name	Area of Assignment	Region/Tel/Fax No.
Mr. Dennis Mascarino Mr. Edwin W. Cabalud	Davao International Airport	XII Tel. (064)421-89-31 Fax (064)429637
Mr. Joel S. Garcia Mr. Marlon A. Teves	Sasa Wharf	
Mr. Date N. Dimerin	Regionwide	XIII Tel. (086)2325435 Fax (085)3412044
Ms. Ruth Bagalogos	Port of Iligan	
Ms. Regina P. Benban Mr. Radzqari A. Abdua	Port of General Santos City	
Mr. Cesar G. Mapula	Intl Airport, General Santos City	
Mr. Antonio Boiser	Surigao City	
Mr. Hedjarah M. Manding	Bancasi Airport, Butuan City	
Mr. Edgardo Bangahon	Nasipit Port, Butuan City	
Mr. Mansueto Cadeliña	Lipata Port, Surigao City	
Ms. Paz Rizalei Lansilay	Port Surigao City	CAR Tel. (074)4436716 Fax (074)4436716
Ms. Prescilla Maramba Ms. Petra Gayatgay	FQS-RegionFish Health Officer	
Mr. Abdhulhan S. Sabdani Mr. Bonifacio B. Boglosa Mr. Alonto D. Jualhal Mr. Nilo S. Katada Mr. Terry Posadas Mr. Jerusalem B. Abdulahim Mr. Eduardo E. Arboleda Mr. Macmod D. Mamalangkap	Regional Office	ARMM Tel. (064)4211248 Fax (064)421-1234
Mr. Sukarno B. Anayatin Mr. Salik A. Biruar Ms. Gloria C. Ramillano	Maguindanao Province	
Mr. Faizal A. Nahul Mr. Muin Noor Mr. Ibnu Imlah Mr. Rudy S. Canizares Mr. Aynun Racelis	Bongaso, Tawi-tawi Province	
Mr. Gamal S. Tawasil Mr. Said O. Abud Mr. Idlasan G. Ijira Mr. Alano A. Alihuddin Jr.	Jolo Sulu Province	
Mr. Subaer Gandamra Mr. Tingcal Salic	Lanao del Sur Province	

- v. The quarantine and inspection requirements shall be based on the decision of the BFAR IRA Panel which may require a quarantine period of 24-28 days on a case to case basis after the release of the shipment from the airport to the BFAR quarantine facility, with costs to be borne by the importer.
- 3) For high risk species
 - i. Duly accomplished application form;
 - ii. Duly accomplished proposal form with emphasis on health, ecological and genetic impacts of the proposed importation;
 - iii. Import risk analysis by the IRA Panel;
 - iv. Health certificate from the competent authority of the country of origin to be presented upon arrival of the consignment at the NAIA or other designated ports of entry. On a case to case basis, BFAR may specify certification requirements for individual species and/or shipments to ensure freedom from specified diseases as deemed necessary; and
 - v. Quarantine and inspection until the first generation (F1) offspring. This will be imposed after release of the shipment from the airport to the BFAR quarantine facilities, with costs to be borne by the importer.

d. Inspection

For security purposes, live fish and fishery/aquatic products are subjected to inspection requirements upon arrival at the NAIA, the only allowed point of entry for live fish and fishery/aquatic products. The importer is required to submit documents (original copy of the import permit, photocopies of pro-forma invoice, packing list, and airway bill or bill of lading) to the BFAR Fisheries Quarantine Officer.

For medium and high risks species, a copy of health certificate is required. Consignments not accompanied by import permit and/or health certificate shall be confiscated and destroyed. The Fisheries Quarantine Officer shall check the species identity and conduct visual inspection. If the fish is clearly unhealthy, the quarantine officer will require treatment of the shipment in the importer's holding facility under the supervision of a fish health officer. If the unhealthy fish poses high risk of contaminating healthy stocks, the shipment shall be confiscated and destroyed. Laboratory examination of samples obtained from the shipment shall be conducted by the BFAR Fish Health Officer at the expense of the importer.

IV-3. List of Quarantinable Diseases of Aquatic Animals in the Philippines

The Philippines uses the existing list in the Quarterly Aquatic Animal Disease Report (Asia and the Pacific) jointly published by NACA and FAO, and the list of diseases in the International Aquatic Animal Health Code of the OIE.

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis and Surveillance of Diseases of Aquatic Animals

a. Current Research Activities

Most of the researches on diseases of fish are being implemented by the Southeast Asian Fisheries Development Center. Table 7 shows the list of agencies, departments and universities doing research on fish disease in the Philippines.

Table 7. List of the agencies, departments, and universities that conduct fish disease research

Universities	
National Institute of Molecular Biology and Biotechnology, University of the Philippines Los Baños Laguna Tel. No. (049) 5360587 c/o Dr. Veronica Migo	National Science Research Institute, University of the Philippines Tel. No. (02)-920-7730 c/o Dr. Auxilia T. Siringan
College of Fisheries, Central Luzon State University Tel. No. (044) 456-0681 c/o Dr. Paul Yambot	Division of Biological Sciences College of Arts and Sciences University of the Philippines in the Visayas, Miag-ao, Iloilo c/o Dr. James L. Torres
International	Government Agency
Fish Health Section, SEAFDEC Aquaculture Department, Tigbauan, Iloilo Tel. No. (033) 511-9171 c/o Dr. Gilda Lio-Po	Fish Health Section Bureau of Fisheries and Aquatic Resources Tel. No. 372-5055 c/o Ms. Simeona E. Regidor
Private Laboratory	
Negros Prawn Producers Marketing Cooperative, Inc. G/F JTL Building, North Drive, Bacolod City Tel. No. (034) 433-2131 c/o Ms. Roselyn C. Usero	

b. Recent Publications on Viral Diseases of Fishes and Shrimps

Following are the publications on viral diseases from 1998-2003:

1. Albaladejo JD, Tapay LM, Migo VP, Alfafara CG, Somga JR, Mayo SL, Miranda RC, Natividad KD, Magbanua PO, Itami T, Matsumura M, Nadala Jr ECB, Loh PC. 1998. Screening of shrimp viruses in the Philippines. *In*: TW Flegel (ed). *Advances in Shrimp Biotechnology*. National Center for Genetic Engineering and Biotechnology, Bangkok, Thailand, p. 251-254
2. Catap ES, Traviña RD. 2005. Experimental transmission of hepatopancreatic parvovirus (HPV) infection in *Penaeus monodon* postlarvae. *Diseases in Asian Aquaculture V* (in press)
3. Catap ES, Lavilla-Pitogo CR, Maeno Y, Traviña R. 2003. Occurrence, histopathology and experimental transmission of hepatopancreatic parvovirus (HPV) infections in *Penaeus monodon* postlarvae. *Dis. Aquat. Org.* 57:11-17

4. Lio-Po GD. 1998. Studies on several viruses, bacteria and fungus associated with Epizootic Ulcerative syndrome (EUS) of several fishes in the Philippines. Ph.D. Dissertation, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, Canada, 247 p
5. Lio-Po GD. 2001. Viral diseases. *In*: Lio-Po GD, Lavilla CR, Cruz-Lacierda ER (eds) Health Management in Aquaculture. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines, p. 9-24
6. Lio-Po GD, Cruz-Lacierda ER, de la Peña LD, Maeno Y, Inui Y. 2002. Progress and current status of diagnostic techniques for marine fish viral diseases at the SEAFDEC Aquaculture Department. *In*: Inui Y, Cruz-Lacierda ER (eds) Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques. Proceedings of the Seminar Workshop organized by SEAFDEC-AQD and OIE; 2-6 December 2001; SEAFDEC, Iloilo, Philippines. p. 97-106
7. Lio-Po GD, Traxler GS, Albright LS. 1999. Establishment of cell lines from catfish (*Clarias batrachus*) and snakehead (*Ophicephalus striatus*). *Asian Fish. Sci.* 12:345-349
8. Lio-Po GD, Traxler GS, Albright LS, Leaño EM. 2000. Characterization of virus obtained from snakehead (*Ophicephalus striatus*) with epizootic ulcerative syndrome (EUS) in the Philippines. *Dis. Aquat. Org.* 43:191-198
9. Lio-Po GD, Albright LS, Traxler GS, Leaño EM. 2001. Pathogenicity of the epizootic ulcerative syndrome-(EUS) associated rhabdovirus to snakehead *Ophicephalus striatus*. *Fish. Pathol.* 36:57-66.
10. Lio-Po GD, Albright LS, Traxler GS, Leaño EM. 2003. Horizontal transmission of the EUS rhabdovirus in stimulated natural conditions. *Dis. Aquat. Org.* 57:213-220
11. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2002. Nodavirus infection in hatchery-reared orange-spotted grouper, *Epinephelus coioides*: First record of viral nervous necrosis (VNN) in the Philippines. *Fish Pathol.* 37:87-89
12. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2003. Development of control methods for factors suppressing sustainable production of aquaculture species: Experimental transmission of piscine nodavirus-induced viral nervous necrosis to the orange-spotted grouper *Epinephelus coioides*. *In*: Ogawa Y, Ogata HY, Maeno Y, Shimoda T, Fujiioka Y, Fukuda Y (eds) Proceedings of the 2nd Workshop of the JIRCAS International Collaborative Research: "Studies on Sustainable Production Systems of Aquatic Animals in Brackish Mangrove Areas" Dec. 2-3 2002, Penang, Malaysia. JIRCAS, Tsukuba, Japan and Department of Fisheries, Kuala Lumpur, Malaysia. p. 89-94
13. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2004. Susceptibility of cultured marine fish species to piscine nodavirus from orange-spotted

- grouper, *Epinephelus coioides*, in the Philippines. Fish Pathol. (in press)
14. Maeno Y, de la Peña LD, Cruz-Lacierda ER. 2004. Mass mortalities associated with viral nervous necrosis in hatchery-reared sea bass *Lates calcarifer* in the Philippines. Japan Agricultural Research Quarterly 38:69-73
 15. Magbanua PO, Natividad KD, Migo VP, Alfafara CG, de la Peña FO, Miranda RO, Albaladejo JD, Nadala Jr ECB, Loh PC, Tapay LM. 2000. Prevalence of white spot syndrome virus (WSSV) in cultured *Penaeus monodon* in the Philippines. Dis. Aquat. Org. 42:77-82
 16. Natividad KDT, Magbanua FO, Migo VP, Alfafara CG, Albaladejo JD, Nadala Jr ECB, Loh PC, Tapay LM. 2002. Prevalence of yellow-head virus in cultured black tiger shrimp (*Penaeus monodon* Fabricus) from selected shrimp farms in the Philippines. In: Lavilla-Pitogo CR and Cruz-Lacierda ER (eds) Diseases in Asian Aquaculture IV. Fish Health Section, Asian Fisheries Society, Manila Philippines. p. 45-55
 17. de la Peña LD, Lavilla-Pitogo CR, Namikoshi A, Nishizawa T, Inui Y, Muroga K. 2003. Mortality in pond-cultured shrimp *Penaeus monodon* in the Philippines associated with *Vibrio harveyi* and white spot syndrome virus. Fish Pathol. 38: 59-61

c. Training and Training Needs

There are two agencies that conduct fish disease training in the Philippines. SEADDEC Aquaculture Department conducts training for local and international participants such as AquaHealth Online, an internet-based training, and hands-on training for important viruses affecting fish and shrimp. BFAR conducts trainings for Fish Health Officers and Fishery Quarantine Inspectors, as well as private participants.

The Fish Health Staff of BFAR has availed of training programs on quarantine, fish disease diagnosis, and surveillance developed by the International Development Council (IDRC) of Canada, Network of Aquaculture Centers in Asia-Pacific (NACA), Food and Agriculture Organization of the United Nations (FAO), Aquatic Animal Health Research Institute (AAHRI), and the Southeast Asian Fisheries Development Center (SEAFDEC). Likewise, the Fisheries Quarantine Officers at NAIA have availed of the training programs developed by BFAR-Fish Health Section, SEAFDEC, NACA and FAO.

With increasing risks of spread of transboundary pathogens and diseases, there is a need to enhance the diagnostic capability for TSV, KHV, and other important diseases for the Fish Health Officers in the laboratory and for the Fishery Quarantine Officers at ports of entry.

References

- Magbanua PO, Natividad KD, Migo VP, Alfafara CG, de la Peña FO, Miranda RO, Albaladejo JD, Nadala Jr ECB, Loh PC, Tapay LM. 2000. Prevalence of white spot syndrome virus (WSSV) in cultured *Penaeus monodon* in the Philippines. *Dis. Aquat. Org.* 42:77-82.
- Tapay LM, Nadala CB, Loh PC. 1999. A polymerase chain reaction protocol for the detection of various geographical isolates of white spot virus. *J. Virol. Methods* 82: 39-43.

Current Status of Transboundary Fish Diseases in Singapore: Occurrence, Surveillance, Research and Training

Ling Kai Huat¹, Susan Kueh² and Poh Yew Kwang³

Agri-Food and Veterinary Authority of Singapore

¹*Aquaculture Services Centre, Aquaculture Branch, Sembawang Research Station*

Lorong Chencharu, Singapore 769194

²*Aquatic Animal Health Branch, Animal & City Veterinary Laboratory*

60 Sengkang East Way, Singapore 548596

³*Wildlife Regulatory Branch, Sembawang Research Station,*

Lorong Chencharu, Singapore 769194

Introduction

Any significant disease of aquatic animal such as koi herpesvirus (KHV) and spring viremia of carp virus (SVCV) is of concern to Singapore. Import and export of ornamental fishes in Singapore are carried out by licenced traders under the Accredited Ornamental Fish Exporters Scheme (AOFES). Under this Scheme, the exporters have to get their premises approved according to guidelines set by the Agri-Food and Veterinary Authority of Singapore (AVA), which include the provision of designated quarantine area, packing area and disease treatment area. These approved premises are inspected monthly by AVA inspectors. As part of routine fish disease surveillances conducted by AVA, regular fish samples are taken from each exporter premise once every six months for laboratory examinations in the absence of any significant disease. Additional samples are taken for laboratory examination should any significant disease outbreaks occur in these premises. Any significant results from these surveillances are reported in the *Quarterly Aquatic Animal Disease Report (Asia and Pacific Region)*, which is submitted to the OIE and NACA. Since surveillance for KHV started in January 2003, no positive cases have been detected to date.

There are 68 ornamental fish farms and 103 ornamental fish exporters in Singapore. The local farms produced about 44% of the total export with a value of S\$72.8 million (US\$42.3 million) in 2003. Shrimp farming is not popular in Singapore and there are only 2 shrimp farms using traditional earthen ponds for culture of tiger shrimp and Pacific white shrimp. The farms apply intensive culture system with regular water exchanges. Total annual production

from these two farms is about 100 metric tons (MT). So far there is no report of white spot syndrome virus (WSSV) and Taura syndrome virus (TSV) of shrimps in Singapore.

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

a. Production of Common Carp

Owing to very small market demand of common carp, there is no commercial farming of common carp in Singapore. There is limited number of wild common carp thriving in reservoirs and lakes in Singapore. These are for leisure and to control pest and not for human consumption. No export record of the species to other countries exists. Singapore imported less than 50 MT of common carp yearly for the last 3 years, mainly from Malaysia, for use in offerings during various special festivals. Data for the past 3 years are summarized in Table 1.

Table 1. Import of live common carp in Singapore for 2001-2003

Country of Origin	2001 (MT)	2002 (MT)	2003 (MT)
Malaysia	32.68	43.26	41.03
Hong Kong			0.02
Taiwan	0.50		
Total	33.18	43.26	41.05

b. Production of Koi

There are 4 koi farms and 40 koi importers and exporters in Singapore. The activities of koi farms are mainly in the import of fingerlings and nursing them into bigger size for local sale or export. The koi farms also provide hotel services for koi hobbyists. The local production is negligible. Importers and exporters with holding and quarantine facilities, import fish from different sources, quarantine them for a period of 3 weeks, or hold them for a longer period before exporting to other countries. The sources of spawners, broodstock or fingerlings are Japan, Malaysia, Thailand, and China.

The import figures of koi for the last 3 years are shown in Figures 1- 4. The main supplier of koi to Singapore is Malaysia, which supplied more than 90% of the total quantity imported. This is followed by Japan (about 2 %) and China (1.5%).

Singapore exports about 2.4 million pieces of koi annually to other countries. The major importers of koi from Singapore are the United Kingdom, Germany, United States and Malaysia. Export figures for the past 3 years are summarized in Figures 5-8.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

Presently, Singapore is free from KHVD. Since reports were made on KHVD as a significant disease of koi in Israel, Europe and United States in 1998, and the occurrence of koi mass mortality syndrome in Indonesia in 2002, ornamental fish traders dealing with koi in Singapore have been showing concern over this emerging disease. To address the concerns, AVA held a dialogue session with the Singapore koi traders in June 2003 in order to maintain industry awareness of the disease and to promote measures to prevent import and export of KHVD-infected fish. Since the reports of KHVD outbreak in Japan in October 2003, AVA has instituted compulsory inspection, testing and quarantine of all koi consignments imported from Japan and Indonesia. Quarantine is for a minimum period of 3 weeks. Koi samples from a particular consignment, or sentinel koi, are cohabitated with imported koi, and are subjected to testing for KHV by tissue culture. Only koi that tested negative for KHVD will be released from quarantine. KHVD-positive koi consignments are to be destroyed, and the premises disinfected accordingly.

II. Current Status of Viral Diseases in the Production of Shrimps and Prawns

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

There are only two shrimp farms in Singapore and they using traditional earthen ponds to culture tiger shrimp. The farms apply intensive culture system with regular water exchange. Below is the annual production for the last 3 years:

Year	Quantity (MT)
2001	106.00
2002	91.82
2003	31.33

There was a drastic decrease in production in year 2003. As a result, one of the shrimp farms adopted crop rotational farming practice and switched to culture seabass in 2003. The spawners, broodstock and postlarvae are imported from Malaysia. Presently, no live export record to any country exists for shrimp and production remains not sufficient for local demand.

b. Production of Pacific White Shrimp (*Litopenaeus vannamei*)

There are only 2 shrimp farms in Singapore using traditional earthen ponds to culture of Pacific white shrimp *L. vannamei*. Annual production for the last 3 years is tabulated below:

Year	Quantity (MT)
2001	8.00
2002	23.00
2003	15.70

The sources of postlarvae is mainly Taiwan and China.

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

There is no freshwater prawn culture activity in Singapore and a small quantity of freshwater prawn is imported from Malaysia and Thailand for local consumption.

II-2. White Spot Syndrome Virus (WSSV)

There is no recent report on WSSV in Singapore.

II-3. Taura Syndrome Virus (TSV)

There has been no report of TSV in shrimp culture in Singapore.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

The contact persons and responsible facilities that conduct diagnosis and inspection services are the following:

- (i) Aquatic Animal Health Branch, Central Veterinary Laboratory
60 Sengkang East Way, Singapore 548596
Email: susan_kueh@ava.gov.sg
- (ii) Aquaculture Services Centre, Aquaculture Branch
Sembawang Research Station, Lorong Chencharu, Singapore 769194
Email: ling_kai_huat@ava.gov.sg
- (iii) Epidemiology and Surveillance Branch
Email: Chang_Siow_Foong@AVA.gov.sg
- (iv) Wildlife Regulatory Branch, Import & Export Division
Email: Poh_Yew_Kwang@AVA.gov.sg

These facilities conduct surveillance and monitoring for diseases of aquatic animals regularly.

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

a. Definition of Levels of Diagnosis

- Level I: Diagnostic activity limited to observation of animal and the environment, and clinical examination (On Site or Field Diagnosis).
- Level II: Diagnostic activity includes Parasitology, Bacteriology, Mycology, and Histopathology (Laboratory Diagnosis).
- Level III: Diagnostic activity includes Virology, Electron microscopy, Molecular biology and Immunology (Laboratory Diagnosis).

Based on the classification, there are laboratories that can conduct Level II and III diagnosis.

	Name of Laboratory	
	Aquatic Animal Health Branch	Aquaculture Services Centre
Address	Central Veterinary Laboratory 60 Sengkang East Way, Singapore 548596	Sembawang Research Station Lorong Chencharu, Singapore 769194
Level of Diagnostic Capability	Level III	Level II
Telephone Number	65-63862181	65-67519851
Fax Number	65-63863572	65-67523242
Email address	Susan_kueh@ava.gov.sg	Ling_kai_huat@ava.gov.sg

b. List of All Economically-Important Diseases of Aquatic Animals

Name of Disease or Agent	Affected Animals (Scientific Name)	Level of Diagnosis
<i>Tetrahymena</i>	Guppy (<i>Poecilia reticulata</i>)	Level II
<i>Hexamita</i>	Discus (<i>Symphysodon</i> spp.) Angelfish (<i>Pterophyllum</i> spp.)	Level II
White spot disease	All species	Level II
Velvet disease, <i>Oodinium</i>	All species	Level II
Ulcer disease and hemorrhagic septicemia	Koi (<i>Cyprinus carpio</i>) and Goldfish (<i>Carrasius auratus</i>)	Level II
Viral encephalopathy and retinopathy	Marine foodfish including seabass (<i>Lates calcarifer</i>) and groupers (mainly <i>Epinephelus</i> spp.)	Level III
White spot syndrome viral disease of shrimps	Shrimp (<i>Penaeus monodon</i>)	Level III
Systemic iridoviral disease	Marine foodfish including groupers (mainly <i>Epinephelus</i> spp.) and mullet (<i>Mugil cephalus</i>)	Level III
<i>Streptococcus iniae</i>	Marine foodfish including seabass (<i>L. calcarifer</i>)	Level III
Gill flatworms	Marine foodfish including groupers (mainly <i>Epinephelus</i> spp.)	Level II

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

The responsible facilities for quarantine of aquatic animals are the following:

- (1) Wildlife Regulatory Branch, Agri-Food and Veterinary Authority of Singapore
- (2) Epidemiology and Surveillance Branch, Agri-Food and Veterinary Authority of Singapore
- (3) Aquaculture Services Centre, Agri-Food and Veterinary Authority of Singapore

Quarantine and inspection are carried out at the importer's premises when live aquatic animals arrive in the country. The responsible persons conducting quarantine and inspection services are:

- (1) Mr Poh Yew Kwang
- (2) Mr Iyu Ching Ka
- (3) Mr Teo Siang Hong

Levels I and II diagnosis are employed at quarantine stations.

IV-2. Procedures and Requirements for Importation

Licensed importers from Singapore must apply for an inward declaration permit for an incoming consignment. Based on the species declared during permit application, certain species such as koi from specified countries can only be imported on the condition that the fish are quarantined at the importer's premise upon arrival and a sample from the consignment must be submitted to the inspecting officers for lab analyses stipulated by AVA. The importers are to quarantine the fish pending outcome of the lab tests.

On the day of arrival, there will be a follow-up inspection by AVA officers, as well as collection of samples from the newly imported batch for lab testing on specific diseases, e.g. koi herpesvirus. This activity is covered by law under the Singapore Animals and Birds Act, but no certificates are currently required.

IV-3. List of Quarantinable Diseases of Aquatic Animals

- a. Viral diseases: SVCV, KHVD
- b. Bacterial diseases: none
- c. Fungal diseases: epizootic ulcerative syndrome (EUS)
- d. Parasitic diseases: none
- e. Other diseases: none

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

Current research is geared towards establishment of diagnostic tests for aquatic animal disease agents. Research is conducted at local universities and polytechnic schools. Significant fish disease work is conducted at the National University of Singapore. Following are major publications on viral diseases of fishes and shrimps:

Gibson-Kueh S, Netto P, Ngoh GH, Chang SF, Ho LL, Qin QW, Chua FHC, Ng ML, Ferguson HW. 2003. The pathology of systemic iridoviral disease in fish. *J. Comp. Pathol.* 129:111-119.

Chang SF, Ngoh-Lim GH, Kueh LFS, Qin QW, Seng EK, Sin YM. 2002. Initial investigations into two viruses isolated from marine food fish in Singapore. *Veterinary Record* 150:15-16.

Chang SF, Ngoh GH, Kueh LFS, Qin QW, Chen CL, Lam TJ, Sin YM. 2001. Development of a tropical marine fish cell line from Asian seabass (*Lates calcarifer*) for virus isolation. *Aquaculture* 192:133-145.

Training on Fish Diseases are conducted by the following:

- (1) Aquaculture Services Centre, Sembawang Research Station, Lorong Chencharu, Singapore 769194
- (2) Aquatic Animal Health Branch, Central Veterinary Laboratory, 60 Sengkang East Way, Singapore 548596

Topics covered in these training are on basic animal health course. Responsible personnel have gained experience from local and overseas seminars/workshops, and have earned postgraduate degrees. In order to support the needs for surveillance, monitoring and diagnosis, an inter-laboratory and agency attachments are necessary to disseminate and enhance hands on experience.

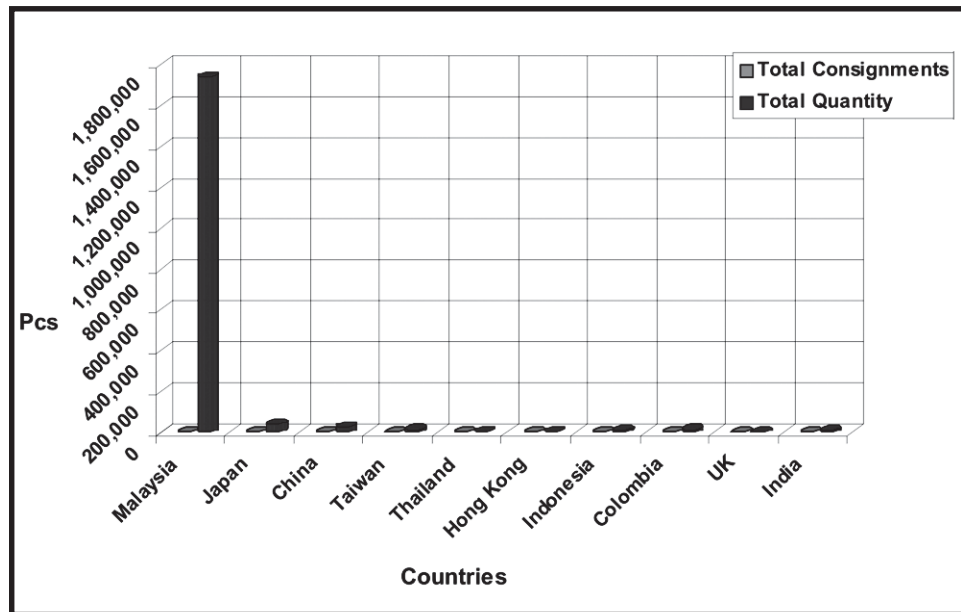


Fig. 1. Koi import from various countries in year 2001

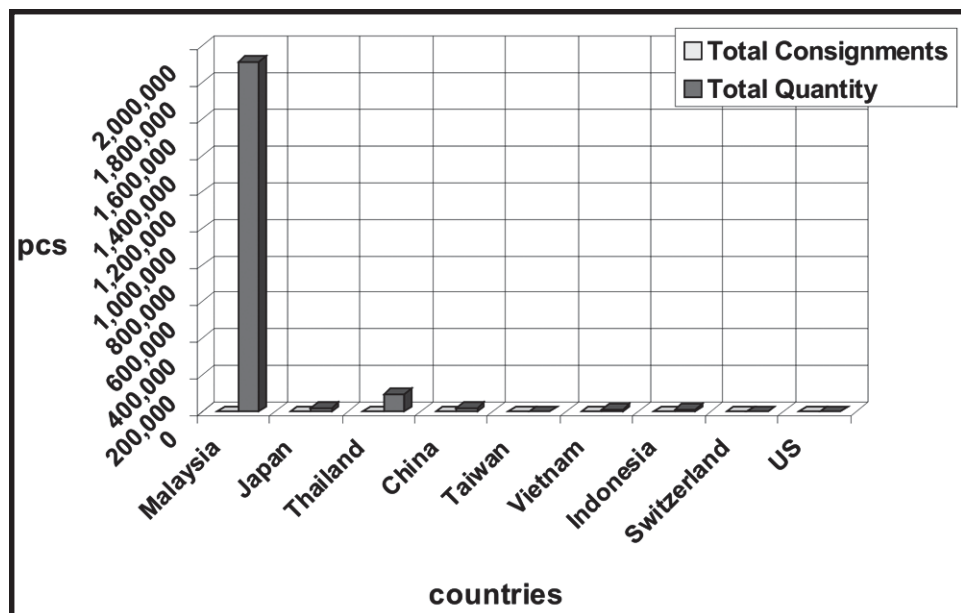


Fig. 2. Koi import from various countries in year 2002

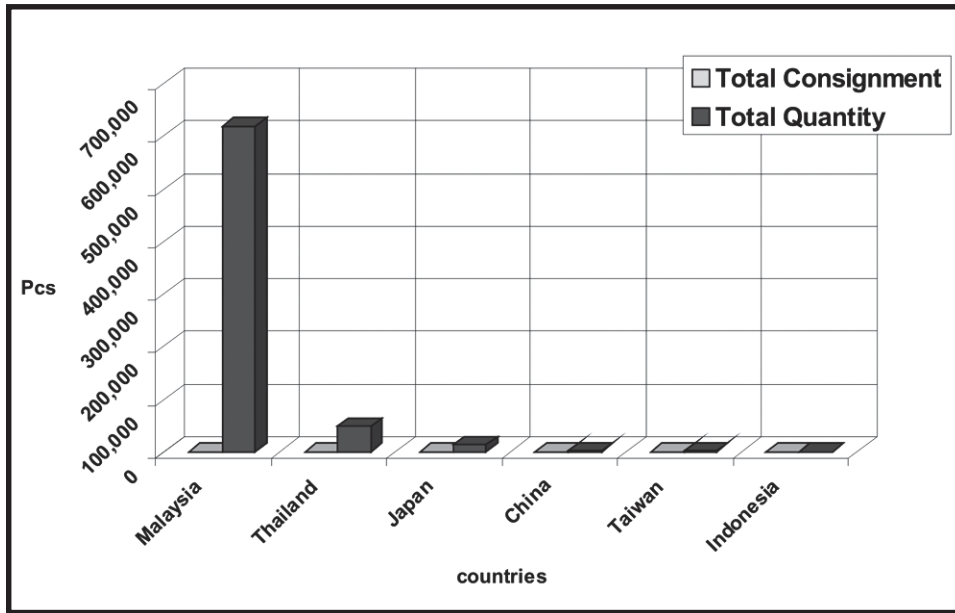


Fig. 3. Koi import from various countries in year 2003

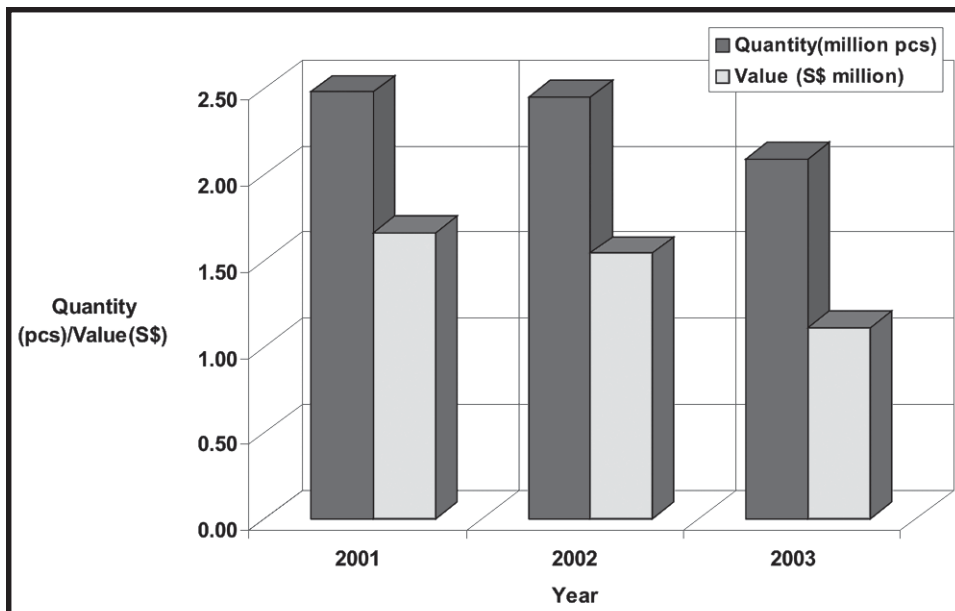


Fig. 4. Koi export statistics from 2001-2003

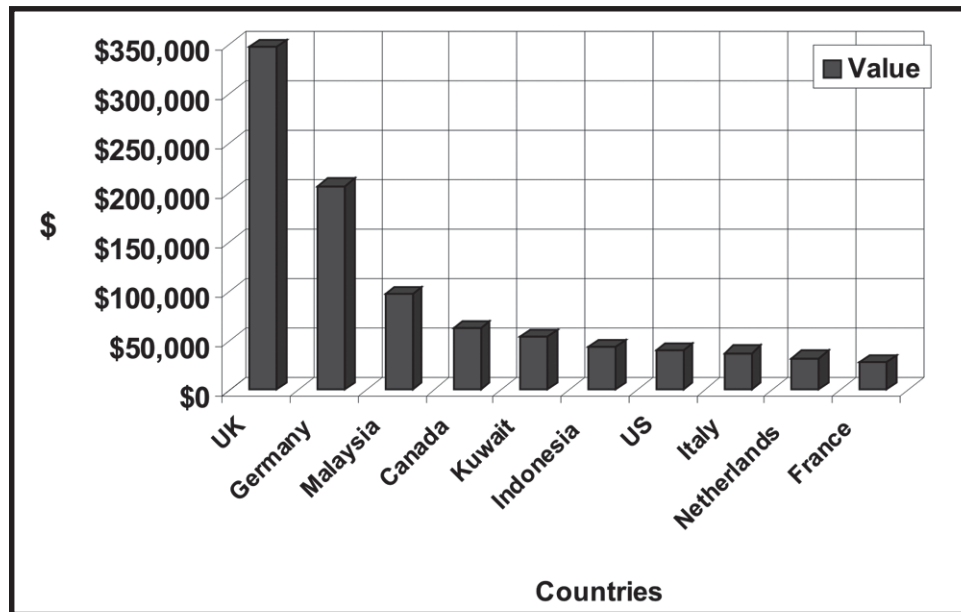


Fig. 5. Top 10 importing countries of koi from Singapore in year 2003

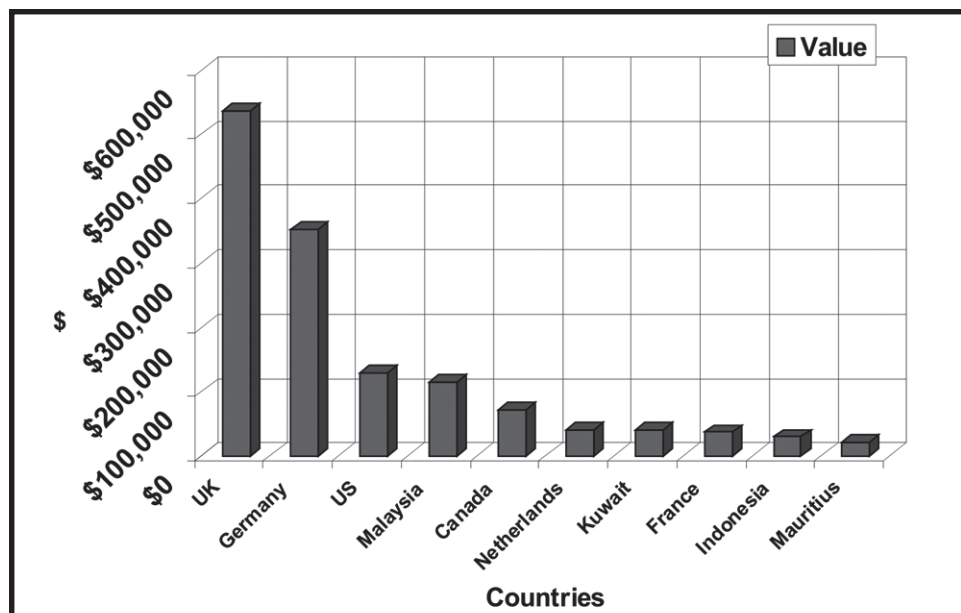


Fig. 6. Top 10 importing countries of koi from Singapore in the year 2002

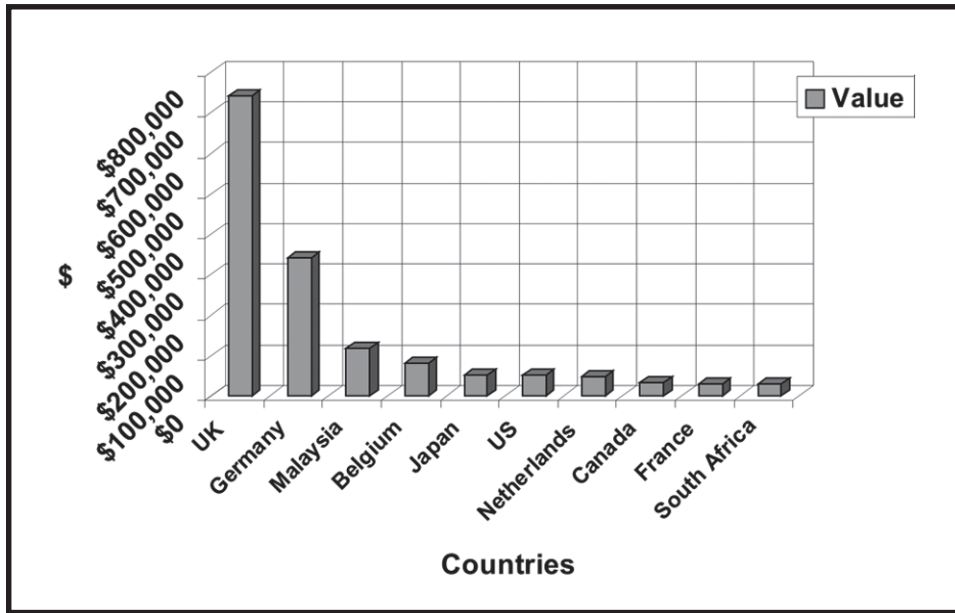


Fig. 7. Top 10 importing countries of koi from Singapore in year 2001

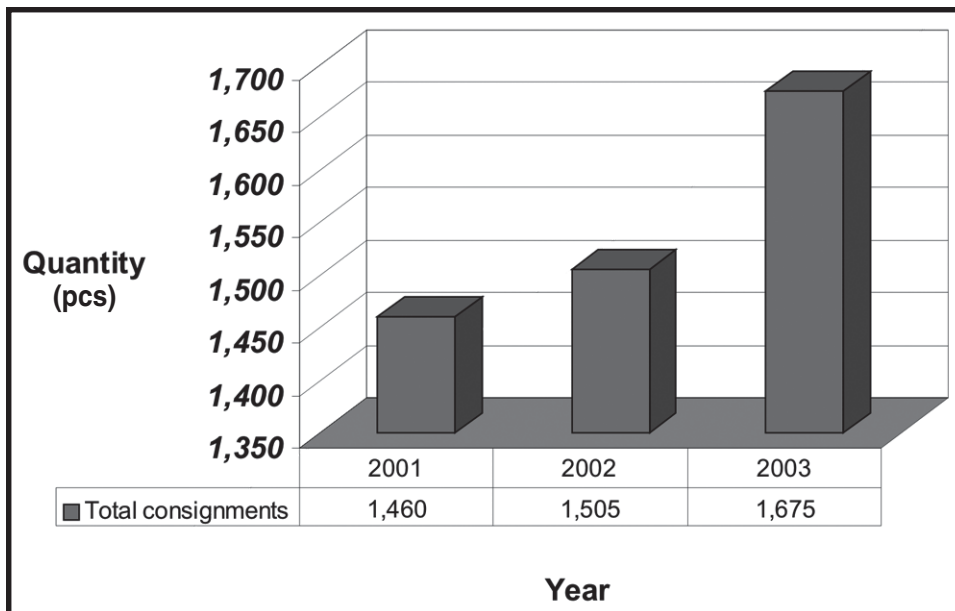


Fig. 8. Koi consignments imported from 2001-2003

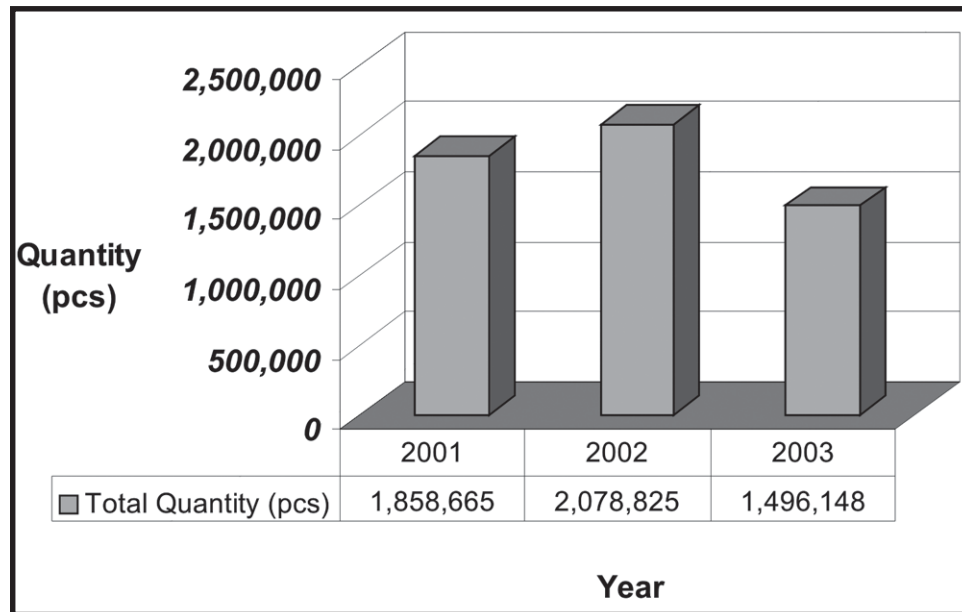


Fig. 9. The quantity of koi imported from 2001-2003

Current Status of Transboundary Fish Diseases in Thailand: Occurrence, Surveillance, Research and Training

Somkiat Kanchanakhan

*Disease Control and Diagnosis Research Unit
Inland Aquatic Animal Health Research Institute
Department of Fisheries, Jatuchak, Bangkok 10900
Thailand*

Introduction

Movement of live aquatic animals has been generally recognized as an activity coupled with high risk of transferring diseases and pathogens from one area to another. A review from a scientist indicated that international fish trade has spread diseases to many countries for years (Håstein, 2000). In case of Thailand, an introduction of Chinese carps (*Hypophthalmichys molitrix*, *Ctenopharyngodon idellus*, *Aristichthys nobilis*) for food fish culture in the past also introduced the parasite *Lernaea* into the aquatic ecosystem. Importation of ornamental fishes also introduced many new pathogens such as *Hexamita*, *Tetrahymena*, and Ranavirus. Some pathogens have wide host ranges including food fish and ornamental fish. The susceptible hosts exhibit clinical signs, disease and death. However, resistant hosts or fish that has recovered from the disease will possibly serve as reservoir or carriers of the disease. Awareness of aquatic animal disease spread through international trade has been increasing since the first edition of *Aquatic Animal Health Code* was published by the Office International des Epizooties (OIE) in 1995. As part of the regional effort to control disease in aquatic animals, the “*Thailand National Strategy for Control of Aquatic Animal Diseases*” have been developed after seminars among staff of the Department of Fisheries (DOF), Department of Livestock Development, universities, private sector representatives and farmers were held in Bangkok in May 2001.

The components of the national strategic plan are as follows: (1) law and legislation; (2) import/export regulation; (3) disease surveillance, monitoring and control systems; (4) aquatic animal diseases, research and development; (5) diagnosis units and capability building; (6) technology/knowledge transfer; (7) public awareness; (8) contingency plan to control disease outbreak; and (9) funding support. The strategic plans have been implemented with good progress.

I. Current Status of Koi Herpesvirus Disease (KHVD) and in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

There are 3 culture systems for common carp: pond, ditch and cage systems. For pond culture system, farmers normally raise the carp with other fish species (poly-culture system) or with other animals (integrated culture system). For paddy-field culture system, farmers culture carp in the rice paddy fields during the rice cropping season. For ditch culture system, carp is cultured in the ditch that supplies water to fruit farms. According to Fishery Statistics Analysis and Research Group (2001), the total number of freshwater aquaculture farms recorded in Thailand is 389,374 (pond culture = 355,624 farms; paddy field culture = 14,829 farms; ditch = 7,165 farms, cage culture 1,207 farms). The total freshwater aquaculture production is 279,696 metric tons (MT) valued at 9,279.8 million Baht. There were approximately 17,465 common carp culture farms (pond culture = 15,693 farms; paddy-field culture = 1,723 farms; ditch culture = 49 farms) recorded in year 2001. Ninety percent of common carp farms used pond culture system and there was no record of common carp cage culture in Thailand in 2001. The common carp production in year 2001 was 4,773 MT (pond culture = 4,026 MT; paddy-field culture = 736 MT, ditch culture = 10 MT) valued at 146,658 Baht.

The common carp can now be found in the wild (canals and rivers). There is no statistical record for wild caught carp since the quantity and value is very low. Generally, fish farmers obtain carp seeds from government or private hatcheries. Thailand introduced common carp from China about 100 years ago. There is no record of common carp exportation out of Thailand. The common carp is popular among the Chinese for consumption. The pituitary glands of common carp are used to artificially induce gonadal maturation and spawning in fish hatcheries. In the past 20 years, the pituitary gland of carp is in high demand in fish hatcheries. However, since the supply of synthetic hormones became common and gave similar stimulation on gonad maturation, the demand for pituitary gland of carp reduced.

Koi production in Thailand increased in the past 3-5 years. Since Thailand is located in the tropics and the average water temperature is warm throughout the year, Koi rapidly grow and have relatively lower risk against cold-water diseases such as spring viraemia of carp virus (SVCV) and koi herpesvirus (KHV). Koi are cultured in earthen ponds, concrete ponds and cages. The koi brooders are from local sources as well as imported from Japan. Thailand exports koi to many countries. Since the outbreak of SVCV in China, and KHV in Indonesia and Japan, koi exportation from Thailand to other countries is getting higher.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

Thailand started its KHVD monitoring program since August 2002 and is still free from KHVD up to now. The DOF also developed a rapid response team and gave high priority to investigate any disease cases reported by the

fish farmers or by the fishery officers related to mass mortality or unusual death of koi. At the moment, KHVD survey is being conducted using virus isolation in KF-1 and BF2 cell lines, and through PCR detection.

II. Current Status of Viral Diseases and in the Production of Shrimps and Prawns

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

Tiger shrimp culture can be classified as extensive, semi-intensive and intensive culture systems. The number of farms and the amount of productions are shown in the Tables 1-2.

Tiger shrimp brooders are collected from the wild in the Andaman Sea, Gulf of Thailand and South China Sea. Live exportations of marketable-size shrimps were mainly to Hong Kong for human consumption.

b. Production of Pacific White Shrimp (*Litopenaeus vannamei*)

The Pacific white shrimp was introduced between March 1, 2002 and February 28, 2003. The Pacific white shrimp farms are mainly of intensive culture type. The most recent fishery statistics of the DOF covers up to year 2001 only. However, during the year 2002-2003, white shrimp production is estimated to reach 40% of the total culture shrimp production of the country or 120,000 MT. Pacific white shrimp brooders imported from the USA were specific-pathogen-free (SPF). Some illegal importation of brooders and various stages of white shrimp have been recorded as originating from Taiwan and Malaysia.

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

According to the Fishery Statistics Analysis and Research Group (2001), there were 2,627 giant freshwater prawn culture farms in year 2001. The giant prawn production during year 2001 was 13,310 MT valued at 1,587 million Baht. The prawn brooders were mainly collected from the wild and culture ponds within the country. Both government and private hatcheries

Table 1. Number of shrimp farms by type of culture from 1997-2001

Number of shrimp farms by type of culture					
Type of culture	1997	1998	1999	2000	2001
Extensive	2,837	2,984	2,509	2,689	1,524
Semi-intensive	8,941	1,069	832	1,036	976
Intensive	19,992	21,924	24,671	31,254	19,339
Total	23,723	25,977	28,012	34,979	31,839

(Fishery Statistics Analysis and Research Group, 2001)

Table 2. Production of shrimp farms by type of culture from 1997-2001

Number of shrimp farms by type of culture					
Type of culture	1997	1998	1999	2000	2001
Extensive	3,867	4,487	3,305	3,845	3,829
Semi-intensive	1,941	2,477	2,363	2,434	3,009
Intensive	221,752	245,767	269,876	303,593	273,169
Total	227,560	252,731	275,544	309,862	280,007

(Fishery Statistics Analysis and Research Group, 2001)

supply the prawn postlarvae to farmers. There is no record of giant freshwater prawn importation into Thailand.

II-2. White Spot Syndrome Virus (WSSV)

An outbreak of WSSV first occurred in Thailand in 1993 and caused losses of over US\$500 million. WSSV usually causes problem in shrimp farms during the dry season in Thailand (November to February). Normally during the dry period, the water salinity is high and induces stress to cultured shrimps resulting in severe infection with WSSV. Viruses may come from different sources such as infected postlarvae, carriers and contaminated water. The extreme environmental changes in pH, temperature and salinity can trigger the virulence of the WSSV infection. The DOF has 11 laboratory facilities with the capability to detect viruses using polymerase chain reaction (PCR) to service to the shrimp farmers and screen shrimp postlarvae prior to stocking in the ponds. Of a total 22,235 samples that had been tested, 513 samples were recorded as PCR positive or about 2.5%. The positive samples were recommended for destruction by using disinfectants.

II-3. Taura Syndrome Virus (TSV)

TSV was first reported in Central America and Latin America in 1991 with losses reaching over 1,000 million US\$. Pacific white shrimp with sizes between 0.1 - 5 g are most susceptible to the disease. TSV also infects many species of shrimp including *P. stylirostris*, *P. aztecus*, and *P. setiferus*. Affected areas recorded in the Americas are Ecuador, Peru, Columbia, El Salvador, Guatemala, Brazil, Nicaragua, Hawaii, Florida and Mexico. In 1999, TSV appeared and caused severe mortality to Pacific white shrimp cultured in Taiwan. For Thailand, the DOF had given temporary import permit of Pacific white shrimp for one year (March 2002 – February 2003). During that time, 97,752 SPF shrimp brooders were imported into the registered hatcheries. Since Thailand has over 2,000 km of shoreline and is connected by land to nearby countries, there were some illegal importations of Pacific white shrimp. Because of un-controlled shipments, Thailand experienced TSV outbreak for the first time in year 2003. The TSV diagnosis had been confirmed at the Inland Aquatic Animal Health Research Institute

(AAHRI) using RT-PCR and gene sequencing. Since then, TSV has established in the shrimp farms and hatcheries. The TSV survey during January – March 2004 showed that 21 of 561 (3.7%) shrimp samples from hatcheries and grow-out farms were tested positive for the virus. The positive batches of postlarvae were not allowed for stocking in grow-out farms. The contingency plan to eradicate TSV infected shrimp or disease carrier shrimp in the ponds or grow-out farms has been drafted and intensively discussed in the DOF.

II-4. Significant and Emerging Viral Diseases of *Macrobrachium rosenbergii*

There is no record of viral disease in giant freshwater prawn in Thailand. One viral research project is being planned to re-investigate the white muscle syndrome of the giant freshwater prawn in Thailand.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

Two main research institutes, the Inland Aquatic Animal Health Research Institute (AAHRI) and the Coastal Aquatic Animal Health Research Institute, are designated as Central Laboratories of the DOF. The DOF also has another 11 PCR-capable laboratories that are based in 11 Coastal Fishery Research and Development Centers. These two main research institutes and 11 PCR laboratories are responsible for diagnosis and inspection services. Below is the complete contact information for the two main institutes:

- Inland Aquatic Animal Health Research Institute (AAHRI)
Bureau of Inland Fishery Research and Development
Department of Fisheries
Paholyothin Rd., Jatuchak, Bangkok 10900, Thailand
e-mail: aahri@fisheries.go.th
- Coastal Aquatic Animal Health Research Institute
Bureau of Coastal Fishery Research and Development
Pawong, Muang District
Songkhla Province, 90100, Thailand

Fishery Biologists conduct diagnosis and inspection services under supervision of the Directors of Inland and Coastal Aquatic Animal Health Research Institutes, and the Directors of 11 Coastal Fishery Research and Development Centers where PCR laboratories are located. Surveillance and monitoring for diseases of aquatic animals are conducted regularly.

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

Laboratories of the DOF have capabilities for Level II and III diagnosis. University-based laboratories can also diagnose diseases at Levels II and III. Specifically, they are based at the following universities:

- Faculty of Science, Mahidol University, Bangkok
- Faculty of Veterinary Medicine, Chulalongkorn University, Bangkok
- Faculty of Veterinary Science, Kasetsart University, Kampangsang Campus, Nakornpathom Province
- Faculty of Agricultural Science, Prince of Songkhla University, Songkhla Province

Many private laboratories and shrimp farms have PCR laboratory to detect viral diseases in shrimp. Feed manufacturers and dealers also offer PCR diagnostic services to shrimp farmers.

Table 3. List of economically important diseases of aquatic animals

Name of disease	Affected animals	Level	Note
Epizootic haematopoietic necrosis	Fish and frog	III	Not found
Spring viraemia of carp	Carp	III	Not found
Viral encephalopathy and retinopathy	Grouper	III	
Epizootic ulcerative syndrome (EUS)	About 40 fish species	II	
Epitheliocystis	Cichlids	II	
Grouper iridoviral disease	Grouper	III	
Infection with koi herpesvirus	Common carp and koi	III	Not found
Taura syndrome	Pacific white shrimp	III	
White spot disease	Tiger shrimp, Pacific white shrimp	III	
Yellowhead disease (YH virus, gill-associated virus)	Tiger shrimp	III	
Spherical baculovirus (<i>Penaeus monodon</i> -type baculovirus)	Tiger shrimp	II	
Infectious hypodermal and haematopoietic necrosis virus	Pacific white shrimp	III	

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Facility, Agency and Personnel

The DOF is responsible for quarantine of aquatic animals. When live aquatic animals arrive in the country, they will be quarantined at the importing company's facilities that passed the quarantine standard. A Fish Health Inspector will inspect the animals at the quarantine zone. Fish samples will be taken and sent to the laboratory for pathogen detection.

The Fish Quarantine Inspector conducts quarantine and inspection services at the port of entry, while a Fish Health Inspector conducts inspection at the quarantine zone of the importing company. The Fish Health Inspectors

are Fishery Biologists or Fish Pathologists working at the Inland or Coastal Aquatic Animal Health Research Institutes, and the Coastal Fishery Research and Development Centers. Level III diagnosis is used on fish for shipment at the quarantine zone of the importing premises.

IV-2. Procedures and Requirements for Importation

Steps for live aquatic animal importation into Thailand:

1. Pre-arrival of the aquatic animals. The importer must have a certificate indicating that the quarantine facilities have been inspected and passed the standard biosecure requirements.
2. Animal arrival at the port of entry. Fish shipment must be accompanied by a health certificate. Fish will be inspected and examined for any possible pathogens. The quarantine officer will check all documents and check fish health using Level I diagnosis. The quarantine officer will order the fish to be quarantined at the certified quarantine zone and notify the fish health inspector to checking the fish at the importing company.
3. Post-arrival of the aquatic animals. The inspector at the port will order the fish to be quarantined at any of the following places: at the quarantine area of the port of entry, at the quarantine area of the importer's premises, or at the place where the Head of the port is assigned.

During 2-3 weeks of quarantine, a Fish Health Inspector will visit and take fish samples back to the laboratory for disease diagnosis. If the fish are free from listed diseases, the importation procedures are completed. If diseases are found, fish will be destroyed or sent back to the country of origin. The DOF uses Animal Epidemic Act and Fisheries Act to regulate the importation. The box contains requirements for importation of aquatic animals into Thailand (completed draft).

IV-3. List of Quarantinable Diseases of Aquatic Animals

- a. Viral diseases: Epizootic haematopoietic necrosis, Spring viraemia of carp, Viral encephalopathy and retinopathy, Grouper iridoviral disease, koi herpesvirus, Taura syndrome, White spot disease, Yellowhead disease, and Infectious hypodermal and haematopoietic necrosis virus
- b. Bacterial diseases: none
- c. Fungal diseases: none
- d. Parasitic diseases: none

Requirements for Importation of Aquatic Animals into Thailand for Culture Purpose

The Department of Fisheries (DOF) has set up a new regulation to prevent and control aquatic animal diseases through importation. The imported aquatic animals are subject to quarantine at the approved quarantine zone of the importing companies for at least of 15 days. Health inspectors will inspect the animals in the quarantine zone and will take samples for laboratory tests.

A health certificate must be presented at the port of entry together with the aquatic animal shipment. The health certificate must be issued by competent authority, signed by veterinarian or authorized officer, and must contain information as follows;

1. Name and address of consignee
2. Name and number (scientific and common name) of aquatic animals
3. Origin of the aquatic animals exported.
4. The aquatic animals must come from a country, a zone or a farm establishment where they are submitted to a health supervision set up to operate according to the procedures described in the *Diagnostic Manual for Aquatic Animal Diseases* from Office International Des Epizooties (OIE) and that this country, zone, or farm establishment is recognized officially unaffected by the OIE listed diseases. If the test methods of any diseases are not designated in most recent edition of the OIE Diagnostic Manual, test methods of the disease which having been published in international science journals shall be used and must be state in the certificate.
5. The exported animals must not come from the sources that had an unusual mortality during the previous 3 months, which the causation could not be explained.
6. Before exportation, the animals must be quarantined for 7-10 days and treated with chemicals to remove all external parasites.
7. The exported animals must be certified as indicated in the following table:

Type of aquatic animals and their gametes to be exported.	Type of diseases or pathogens
Freshwater fish	Epizootic haematopoietic necrosis virus or EHNV Iridovirus disease or Ranavirus disease Viral haemorrhagic septicaemia or VHS Spring viraemia of carp virus or SVCV Koi herpesvirus disease
Marine and estuarine fish	Red sea bream iridovirus disease or RSIV Viral encephalopathy and retinopathy or VER
Mollusks	Bonamiosis MSX disease Marteliosis Mikrocytosis Perkinsosis
Crustaceans	Taura syndrome virus White spot syndrome virus Yellowhead virus Infectious hypodermal and haematopoietic necrosis virus Crayfish plague disease
Amphibians	Iridovirus disease or Ranavirus disease Epizootic haematopoietic necrosis virus
Reptiles	Iridovirus disease or Ranavirus disease Poxvirus

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

AAHRI has trained 2 groups of DOF staff on topics related to surveillance, monitoring and diagnosis of fish diseases. Group one was composed of Fishery Biologists based at the Fisheries Research and Development Centers and they received Level II training course program. Group two was composed of Provincial Fishery Officers based at the Provincial Offices and they received Level I training course program.

References

- Fishery Statistics Analysis and Research Group 2001. *Freshwater Fishfarm Production 2001*. Fishery Information Technology Center, Technical Paper No. 10/2003, Department of Fisheries, Bangkok. 65 p.
- Håstein, T. 2000. Principles of prevention and control of aquatic animal diseases. 68th General Session of the International Committee, May 22-26, 2000, Paris. Office International Des Epizooties, Paris. 31 p.

Current Status of Transboundary Fish Diseases in Vietnam: Occurrence, Surveillance, Research and Training

Kim Van Van

Research Institute for Aquaculture No. 1

Dinh Bang, Tu Son, Bac Ninh

Vietnam

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

a. Production of Common Carp

Common carp is a fish species which can be found in natural water bodies like rivers (Red, Gam, Day, Duong rivers) and lakes (Thac Ba, Hoa Binh, Nui Coc lakes). The production of common carp harvested in wild habitats is declining due to over harvesting and use of destructive methods like electric shock. However, data of wild common carp harvest are unavailable.

Common carp is usually cultured in polyculture system with other carps such as grass carp, Indian carp (Rohu and Mrigal), silver carp and black carp in ponds, rice fields, or reservoirs using extensive or semi-intensive methods. By these culture methods, common carp can grow to 800-1500 grams in the first year. We have no information about annual production of common carp.

Most broodstocks belong to government hatcheries and some of them belong to private hatcheries, but common carp fingerling production is usually done by private farms. Recently, cultured common carp is classified as a hybrid between Hungary cross Indonesia with Vietnamese common carp. Presently, Vietnam hybrid common carp is exported to Lao PDR, Thailand, India and Bangladesh.

b. Production of Koi

Information about koi culture in Vietnam is not available.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

There is no information about KHVD of common carp and koi in Vietnam.

II. Current Status of Viral Diseases and in the Production of Shrimps and Prawn

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

Tiger shrimp is cultured in brackishwater farms all over country using 3 methods: extensive, semi-intensive, and intensive systems. Depending on the culture method, production ranges from 200 kg in extensive system to 6000 kg (sometimes up to 12 tons/ha/cycle) in intensive system per cycle. Different areas have different cycles. In northern Vietnam (from Hue up to Quang Ninh) there is often only one cycle that starts culture in April and harvests in August. In central and southern Vietnam, there can be more than one cycle. In 2001, the whole country had 230,000 ha for *P. monodon* culture with total production of 155,000 metric tons (MT). In 2003, the shrimp culture area increased to 575,137 ha (with 476,528 ha in southern provinces; 16,499 ha in central provinces; and 39,142 ha in northern provinces) producing more than 200,000 MT. Of this, 15,534 ha was for intensive culture (2.84%), 20,116 ha for semi-intensive culture (3.67%), and the remaining area for extensive and improved extensive culture.

Spawners and broodstocks are caught by fishing vessels from coastal areas in Vietnam, but some of them are imported from Thailand, Indonesia, Taiwan, China and Singapore. Postlarvae are produced mainly by private hatcheries located in central and southern Vietnam. In 2002, Vietnam produced 18 billion postlarvae from more than 4,000 hatcheries. In 2003, the number of hatcheries increased to 5,017 of which 1,282 are in Khanh Hoa, 1,200 in Ninh Thuan, 850 in Ca Mau, and 253 in Ba Ria Vung Tau and other places. These hatcheries produced 25.17 billion postlarvae.

There is no information on importation record of various stages of *P. monodon*. Most live export records are of marketable shrimp and some live stock records are stocked to Cambodia. In 2003, Vietnam exported 500,000 MT of shrimps to the United States, an increase of 17.5% compared with 2002 record.

b. Production of Pacific White Shrimp (*Litopenaeus vannamei*)

Vietnam started importing this species in 2002 through Asia Hawaii Ventures Ltd. This company has cultured Pacific white shrimp at very high density and produced 17 tons/ha/cycle that runs only for 3 months. At present, this species is cultured in both freshwater and brackishwater ponds.

Initially, postlarvae were imported from China and Taiwan. Afterwards, broodstocks and spawners were brought into Vietnam. Presently, broodstock is cultured and matures in ponds in Vietnam.

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

In 1997, the Ministry of Fisheries imported *M. rosenbergii* from China for prawn culture in northern Vietnam. In that region, prawn is stocked in April and harvested in November. For monoculture system, production is 1-1.2 tons/ha/cycle in semi-intensive system, and 1.7-3.0 tons/ha/cycle in intensive system. In polyculture system with carp and tilapia, the production is 0.6-0.8 tons of prawn/ha/cycle. Prawn is cultured in both ponds and rice fields. The stocking density is 15 individuals/m² with one cycle lasting for 5 months.

In 2000, there were only 4 hatcheries in northern Vietnam that produced 22 million postlarvae. In 2003, the whole country had 70 hatcheries producing 92 million postlarvae. Of these postlarvae, 40 million came from Can Tho, 14 million from An Giang, 15 million from Hai Phong, and 7 million from Ninh Binh. Some postlarvae of *M. rosenbergii* were imported from China.

II-2. White Spot Syndrome Virus (WSSV)

- a. In the last five years, outbreaks of WSSV often occurred in many places affecting all stages of shrimp. Species of shrimp that were infected were *Penaeus monodon*, *P. indicus*, *P. japonicus*, *P. merguensis* and *L. vannamei*. Shrimps usually got infected at 40 days of culture after attaining 2.5 g/individual. Mortality rates in affected stocks reached up to 100% within 3-10 days.
- b. Clinical signs of WSSV-affected shrimp include swimming on the water surface and staying near the dike. Feeding is reduced and shrimp show empty intestine. White spots appear in the carapace with sizes ranging from 0.5-2 mm. Some affected shrimp have pink to reddish discoloration.
- c. Most often, diagnosis is based on clinical signs, but histopathology and PCR are also used.
- d. Economic losses due to WSSV: In some cases, losses of up to 100% were recorded, but there are no estimates on their monetary equivalent.
- e. Importation record and country of origin is mentioned in section II-1b.

II-3. Taura Syndrome Virus (TSV)

Little information about dates and locations of outbreaks of TSV is available in Vietnam. In May 2004, the laboratory of the Research Institute for Aquaculture No. 1 inspected three positive samples of postlarvae of *L. vannamei*. Diagnosis was based on clinical signs, histopathology and PCR analysis.

II-4. Significant and Emerging Viral Diseases of *Macrobrachium rosenbergii*

There is no information on viral diseases affecting *M. rosenbergii*.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

III-1. Responsible Facility and Personnel

a. The Responsible Facilities and Their Locations

1. Research Institute for Aquaculture No. 1 (RIA1)
Dinh Bang–Tu Son–Bac Ninh, Vietnam
Tel: 0084 8780102, Fax: 00 84 8785748
email: ria1@hn.vnn.vn
2. Research Institute for Aquaculture No. 2 (RIA2)
116 Nguyen Dinh Chieu District 1–Ho Chi Minh City, Vietnam
Tel: 00 84 8 8299592, Fax: 00 84 8 8226807
3. Research Institute for Aquaculture No. 3 (RIA 3)
33 Dang Tat–Nha Trang–Khanh Hoa, Vietnam
Tel: 00 84 58 831138, Fax: 00 84 58 831846
email: ttncs3@dng.vnn.vn
4. Nha Trang Fisheries University
2 Nguyen Dinh Chieu–Nha Trang–Khanh Hoa, Vietnam
5. College of Aquaculture and Fisheries
Can Tho University, Campus 2, 3/2 Street, Can Tho City, Vietnam
Tel: 00 84 71 830961, Fax: 00 84 71 830247
6. National Fisheries Quality Assurance and Veterinary Directorate (NAAFIQAVED) 10 Nguyen Cong Hoan–Ba Dinh, Ha Noi, Vietnam
Tel: 00 84 4 8354966, Fax: 00 84 4 8317221
email: nafiqacen@hn.vnn.vn

b. The Contact Persons in These Laboratories

1. Mrs. Phan Thi Van (RIA1)
2. Mrs. Ly Thi Thanh Loan (RIA2)
3. Mr. Vo Van Nha (RIA3)
4. Dr. Do Thi Hoa, Nha Trang Fisheries University
5. Nguyen Tu Cuong NAAFIQAVED

c. Surveillance and Monitoring

These activities are done by RIA 1, 2 and 3.

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals

Based on the agreed-upon levels of diagnosis, the capability of the laboratories is upper Level II, but under Level III because Level II plus PCR method are employed. Virology work and cell line culture is just starting.

a. Definition of Levels of Diagnosis

Level I: Diagnostic activity limited to observation of animal and the environment, and clinical examination (On Site or Field Diagnosis).

Level II: Diagnostic activity includes Parasitology, Bacteriology, Mycology, and Histopathology (Laboratory Diagnosis).

Level III: Diagnostic activity includes Virology, Electron microscopy, Molecular biology and Immunology (Laboratory Diagnosis).

b. List of Fish Health Laboratories

No.	Name of Laboratory	Diagnostic Level	Addresses
1	RIA 1 Health Laboratory	Upper II and under III	Dinh Bang–Tu Son–Bac Ninh, Vietnam phanvan@hn.vnn.vn Tel: 00 84 4 8785748
2	RIA 2 Health Laboratory	Upper II and under III	116 Nguyen Dinh Chieu District 1 Ho Chi Minh City, Vietnam Tel: 00 84 8 8299592 Fax: 00 84 8 8226807, disaqua@hcm.vnn.vn
3	RIA 3 Health Laboratory	Upper II and under III	33 Dang Tat–Nha Trang–Khanh Hoa; Tel: 00 84 58831298, Fax: 00 84 58 831846 nharia3@yahoo.com
4	Can Tho University Health Laboratory	Level II	Campus 2, 3/2 Street, Can Tho City, Vietnam ntphuong@ctu.edu.vn; Tel: 00 84 71 830961 Fax: 00 84 71 830247
5	Nha Trang Fisheries University	Level II	Aquaculture Department, 2 Nguyen Dinh Chieu–Nha Trang – Khanh Hoa
6	Provincial Health Laboratories	Levels I and II	

c. List of Economically-Important Diseases of Aquatic Animals

No.	Name of Disease	Affected Animals	Level of Diagnosis
1	Grass carp diseases	<i>Ctephanogodon idella</i>	II and III
2	VNN	Grouper	II and III
3	WSSV	<i>Penaeus monodon</i> and other shrimps	III
4	YHD	<i>P. monodon</i> and other shrimps	III
5	TSV	<i>Litopenaeus vannamei</i>	III
6	MBV	<i>P. monodon</i> and other shrimps	II

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Facility Agency and Personnel

a. Responsible Facility

The National Fisheries Quality Assurance and Veterinary Directorate (NAFIQAVED) is responsible for quarantine of aquatic animals. When live aquatic animals arrive in the country, RIA1, 2 and 3 are conduct quarantine and inspection service.

b. Responsible Persons

Nguyen Tu Cuong
General Director,
NAFIQAVED
10B Nguyen Cong Hoan - Ba Dinh district - Hanoi City

Nguyen Nhu Tiep
Head of Aquatic Veterinary Department
NAFIQAVED
10B Nguyen Cong Hoan - Ba Dinh district - Hanoi City

Levels I, II and III are used for diagnosis at quarantine stations.

IV-2. Procedures and Requirements for Importation of Live Aquatic Animals**a. Importers : Procedures and Requirement for Importers**

- For species that are normally-traded for aquaculture, application form and quarantine certification should be submitted.
- For high risk species, photos or drawing to describe the species to be imported should be given together with information about biological characteristics and economic effect of the species.

b. Quarantine Officers or Inspectors

When live aquatic animals arrive in the country, inspectors will look for the accompanying application form, check the quantity of aquatic animals being shipped, and observe their behavior. Sample will be collected for analysis and the aquatic animals will be maintained in a separate place for observation for 2-3 weeks, or up to the time when the species can be classified as of high or low risk.

c. Laws and Regulations

At the moment, a decree of the government created in 1993 is in force. In the future, a new decree will be carried formulated.

IV-3. List of Quarantinable Diseases of Aquatic Animals

- a. Viral diseases: MBV, TSV, WSSV, YHD and VNN
- b. Bacterial diseases: None
- c. Fungal diseases: None
- d. Parasitic diseases: *Myxobolus*, *Ichthyophthirius*, larvae of fluke worm: *Clonorchis*, *Opisthorchis*

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

a. Research

- a. Current research activities
Research on shrimp diseases, mudcrab diseases, grouper diseases, and grass carp diseases are being conducted.
- b. Agencies, department or universities that conduct fish disease research
RIA 1, 2 and 3, Nha Trang Fisheries University and Can Tho University are the agencies that conduct fish disease research.

Most reports are written in local language:

- a. Nguyen TP, Ng. M. Hau & D.T.H. Oanh, 2003 “WSSV & MBV infected rate in *P. monodon* cultured in Cuu long Delta”. In: National conference on Aquaculture, Nov 24-25, 2003.
- b. Nguyen V. H., L. H. Phuoc, L. T. Loan, D. Q. T. Vuong, Ng. V. Dung, C. t. Trung, T. H. Viet & L. H. Tai, 2003. “Normal diseases on *P. monodon* cultured in Cuu Long Delta”. In: National conference on Aquaculture, Nov 24-25, 2003.
- c. Phan T. V, P. M. Yen, K. V. Van, Ng. T. Ha, T. T. K. Chi & P. V. Khang, 2003. “Research infected causative pathogens on grass carp” In: National conference on Aquaculture, Nov 24-25, 2003.

b. Training

The agencies that conduct training are:

1. RIA 1
Dinh Bang–Tu Son–Bac Ninh, Vietnam
Tel & Fax: 00 84 4 8785748
ria1@hn.vnn.vn, phanvan@hn.vnn.vn
2. College of Aquaculture and Fisheries
Can Tho University, Campus 2, 3/2 Street, Can Tho City
Tel: 00 84 71 830961; Fax: 00 84 71 830247
3. Nha Trang Fisheries University, 2 Nguyen Dinh Chieu–Nha Trang–Khanh Hoa

c. Staff Training

Fish Health staff have gone through various academic and practical training to do quarantine, diagnosis and surveillance of aquatic animals. MSc. Aquatic Veterinary Courses, Aquatic Animal Health Management Course in AIT, Australia, Diagnostic Aquatic Animal Diseases in AAHRI, SEAFDEC training AquaHealth Online, aquatic animal diseases in fisheries universities, the CARD project of Australian for surveillance of aquatic animals.

d. Training Requirement

At the moment, Vietnam still lacks human resources to conduct diagnosis at Level III in research institutes. There is also lack of staff in aquatic animal health management.

DISCUSSION SUMMARY

Session I. Experiences and Country Reports on Koi Herpesvirus Disease (KHVD)

1. Experience on Koi Mass Mortality in Indonesia

After Dr. Agus Sunarto's presentation, the following clarifications were made in response to questions from the body.

Screening of broodstock is being done in Indonesia. For KHV detection, two protocols are being used namely those of Gilad's (9/5 primers) and Gray's (sph I-5 primers). From running water system (cages), infected fish are transferred to earthen ponds where they survive, probably due to lower stocking density in ponds. The recovery percentage is not known but when the fish are moved back to running water culture system, outbreaks recur. Currently, KHVD is still expanding or spreading to other areas. Quarantine for 2-3 weeks is recommended before introduction in ponds or other culture areas. Apparently healthy fish are kept for sometime but KHVD positive fish are eventually destroyed. Secondary infections such as *Flexibacter columnaris* occur in high prevalence with KHVD while prevalence of *Argulus* is low. *Aeromonas* is quite common in culture systems.

Exportation to Singapore is not very active as there is a temporary ban on koi export.

2. Experience on Common Carp Mass Mortality in Japan

Dr. Motohiko Sano had no specific information on how KHV was introduced to Japan. Regarding the outbreaks that occurred in 2004 despite the Japanese government's effort to control the movement of infected fish from one area to another, he explained that it is possible that some farmers unknowingly released some infected fish in the river thus it is difficult to control infection in wild populations. However, infections in pond systems have been controlled. He added that there has been no reported KHVD on koi due to the use of underground water.

Dr. Gilda Lio-Po asked if there are indications of vertical transmission for KHV. Dr. Sano replied that newly-hatched larvae appear not to be susceptible to KHVD and there is no sufficient information on its occurrence in eggs at present. If the larvae are hatched in the river already contaminated with KHV, outbreaks/infections occur in juveniles. It is a mystery, though, that juvenile dead fish have not been observed in the wild. He further said that he does not have any information on the presence of neutralizing antibodies among broodstock.

3. Current Status on Koi Herpesvirus Disease in Taiwan

Dr. Richard Arthur asked about the state of knowledge on KHV survivors, whether they are possible carriers for life or whether some mechanisms exist to rid themselves of the virus. Dr. Chien Tu replied that survivors can become carriers but there is no scientific basis on how long they can carry the virus. Asked how KHV was introduced to Taiwan, Dr. Tu replied that according to official documents all koi are imported from Japan, but since Taiwan had outbreaks earlier than Japan it is highly possible that it was introduced through

illegal importation from an unknown source and country. Since most KHVD outbreaks are in northern Taiwan Dr. Tu said that they have warned farmers in southern Taiwan not to buy fish from northern Taiwan. Dr. Lio-Po relayed information from Dr. Ronald Hedrick that they experienced very high mortality with koi in the USA (South Carolina) that came from Taiwan, and it is highly possible that these came from northern Taiwan. Occurrence of other pathogens (as agents of secondary infection) in KHVD-infected fish is not significant.

Mr. Kim Van Van asked why fewer occurrences of the disease were observed in ponds and if the kind of food/feed had to do with it. Dr. Tu replied that fish farmers use artificial feed and it is believed that temperature, instead, has a role in bringing about KHVD outbreaks. Dr. Sano agreed that temperature can be the main predisposing factor, but cautioned that other factors may also be involved. Dr. Sunarto related that there was a study wherein mortality of infected fish was observed in three different temperature ranges. Very high mortality occurred when fish were exposed to 26-30°C and lower mortality was observed when fish were exposed to 20-25°C and at 32°C or higher.

4. Discussion: Country Reports

After the presentation of the country reports, some suggestions and reactions from the participants include the following:

Dr. Kazuya Nagasawa raised a question on the presence of KHVD in Malaysia. There is information that a Malaysian university scientist detected KHV using PCR such that confirmation is needed. Ms. Faazaz Abd. Latiff said that very few universities in Malaysia do research on fish health but she will try to contact some colleagues to confirm this. Dr. Lio-Po added the information from Dr. Hedrick regarding the isolation of KHV from some infected fish, which came from Malaysia. Ms. Latiff replied that there is no monitoring of KHVD in Malaysia at present but they will start working on it.

An issue was also raised whether the Indonesian case can now be called KHVD or still a case of koi mass mortality. Dr. Sunarto replied that based on the information presented to the Center for Environment, Fisheries and Aquaculture Science (CEFAS) scientists, they believe that the Indonesian koi mass mortality can be classified as KHVD. However, Dr. Michael Phillips said that at present, koi mass mortality should be used until the Asia Regional Advisory Group on Aquatic Animal Health (AG) meet in Bangkok in November 2004 to decide on the correct term for the outbreak. It seems that there is still no final decision since the histopathological signs are not consistent.

Dr. Phillips was glad to note from the country reports that programs have been put in place in many countries to manage and monitor problems about KHVD. The main issues to be resolved include standardized diagnosis of the disease. In relation to this, Dr. Sunarto, said it is important to establish a link with Dr. Hedrick to standardize the PCR method for KHVD detection. Dr. Leobert de la Peña explained that SEAFDEC/AQD would optimize the procedure (based on Gray's) and provide training, which will be supported by the Government of Japan Trust Fund (GOJ TF). In addition, a disease card on KHVD is now being developed (c/o Dr. Sano) to set a guideline for disease reporting (e.g. Quarterly OIE/NACA disease reporting system).

Dr. Nagasawa raised concerns regarding the unconfirmed report on carp mortality in Lao PDR since the Mekong River runs through four different countries namely, Lao PDR, Cambodia, Thailand and Vietnam. It was suggested that a SEAFDEC/AQD surveillance team be dispatched if there is problem with disease diagnosis. Dr. Somkiat Kanchanakhan, and Dr. Sunarto could assist in investigating Lao PDR cases. Dr. Kanchanakhan volunteered that they could provide KHV positive control if there is a need for such.

Reacting to Dr. Nagasawa's comment that Lao PDR is a "KHVD-positive country", Dr. Phillips suggested that the country should be categorized instead under countries where further research is necessary, along with Malaysia. Also, the term "KHV-free countries" classification should be changed to countries with "no report or information available" as suggested by Dr. Arthur.

Mr. Bun Racy expressed that Cambodia needs support in terms of diagnosis to confirm KHVD. Mr. Junichiro Okamoto reiterated the role of SEAFDEC in supporting member countries, especially in disease diagnosis. He added that aside from KHVD, SEAFDEC/AQD should identify mechanisms to respond if one of the member countries has specific concerns about aquatic animal diseases.

Dr. Tu inquired about the status of KHVD in terms of its inclusion as an OIE notifiable disease. Dr. Yoshiyuki Oketani replied that if ever there are cases of carp mortality, it should be reported to the OIE head office in Paris, but at present there is still no consensus as to its status as a notifiable disease. OIE is a democratic institution; it accepts all opinions but it follows international standards and systematic procedures. The OIE Aquatic Animal Health Standards Commission holds a general assembly to determine whether KHVD can be considered a notifiable disease. Since OIE was a sponsor of the KHVD meeting in Yokohama, OIE Tokyo is aware of the significance of the disease. It is clear that with the Indonesian carp mortality, along with the cases in US, UK, and Japan, KHVD is a positive agent of the outbreaks, and thus could be considered as an OIE notifiable disease. Noting that KHVD is important in SEA, Japan, UK and the US, Dr. Oketani urged each country to make a strong case, so that discussion could be done in the general assembly. The purpose of the list of diseases is to warn other countries.

Session 2: Lecture and Country Reports on White Spot Syndrome Virus (WSSV) and Taura Syndrome Virus (TSV) of Shrimps

1. Lecture on Transboundary Shrimp Viral Diseases with Emphasis on WSSV and TSV

Dr. Lio-Po asked why despite the presence of white spot syndrome virus (WSSV) positive shrimps from farms in Bohol Island, Philippines, survey of wild stocks showed negative result. Dr. de la Peña replied that data gathered in the surveillance of WSSV in wild and cultured populations of shrimps from various regions of the Philippines do not show correlation of occurrence. On the production of *Litopenaeus vannamei* in the Philippines, Dr. Arthur asked what the estimate is. The estimated production of *L. vannamei* in the Philippines

is 3-6% of total and the possibility of increase may be unlikely because of heightened Bureau of Fisheries and Aquatic Resources (BFAR) crackdown on illegal shipments at ports of entry and augmented regulations to combat the entry of exotic species.

Dr. Jurgenne Primavera pointed out an observation among farmers that mass mortalities of crustaceans happen during the cold months of the year. According to Dr. de la Peña, results of their extensive sampling shows a season-related higher prevalence of viruses in the dry season in the Philippines which correlates with the cold months of December to February.

2. Discussion: Country Reports

Brunei has facilities for viral detection, but staff availability is inadequate. Following this comment was an interesting discussion about IHHNV and *L. stylirostris*, and the biosecurity of broodstock facilities in Brunei. Ms. Hamid assured the group that the Broodstock Development Center in Brunei is “biosecure”, but offered no further details.

With Indonesia’s report on the occurrence of Taura syndrome virus (TSV), a question about its source was asked, but according to Dr. Sunarto, the source of TSV is now difficult to trace since *L. vannamei* culture was already recorded in 1999, 2 years before its official importation in 2001. The TSV outbreak was reported in 2003. Furthermore, WSSV has caused mortalities in *L. vannamei* cultured in Indonesia, but TSV has not yet been reported in *P. monodon*. Despite the problems cropping up in the culture of *L. vannamei*, farmers still continue farming the species. Dr. Celia Lavilla-Pitogo commented that the rapid development of *L. vannamei* culture did not happen the same for *L. stylirostris*, which has been in Asia for several years with no disease reports.

The group discussion also pointed out that included among imported batches of exotic shrimps were postlarvae (PLs) for direct stocking in ponds, in violation of existing ICES guidelines on introduction of exotic species. The group recognized that the guideline is not legally binding, thus each importing country needs to do risk assessment to weigh the advantages and disadvantages of importations.

After Myanmar’s report by U Saw New Year that shrimp PLs are imported from Thailand, Dr. Kanchankhan informed the body that shrimps imported from Thailand are accompanied by certificate from the Director General of the Department of Fisheries. Exports without this document are illegal or not approved. Dr. Lavilla-Pitogo asked about precautionary measures that the Philippine BFAR adopted in allowing importation of *Macrobrachium rosenbergii* since there was no diagnosis for viral pathogens. Ms. Simeona Regidor replied that BFAR allowed the importation based on the accompanying Health Certificate from the exporting country, which was Thailand.

In discussing the country report of Thailand, IHHNV was again the focus of discussion. Dr. Kanchanakhon mentioned that the virus is reported in apparently healthy shrimp and widespread in *P. monodon*. It may be associated with populations that exhibit slow growth.

The group recognized that despite the availability of PCR analysis to determine the virus carrier status of shrimp postlarval batches prior to marketing

and stocking, not all WSSV-positive PLs are destroyed. There are farmers that are not meticulous about the health status of PLs that they purchase and stock in ponds. This is most especially among farmers who have had good harvests despite diagnosed virus-positive initial stocks.

There are countries in SEA with no or relatively small shrimp culture industry like Lao PDR and Singapore. Countries like Singapore and Brunei can watch their industry closely, while there are countries, like Cambodia, that need assistance to develop or upgrade their capability or facilities for shrimp viral disease diagnosis.

Important information that need to be gathered include the possible “jump” of exotic pathogens to local species of shrimps, the effect of IHNV on shrimps, and to determine the presence of *L. vannamei* in the wild.

During the General Discussion, the group discussed transparency in disease reporting, and in control and preventive measures. When disease first occurs in a country, concerned countries should send samples to OIE reference laboratory. Thailand has been transparent with disease reporting with its publication of quarterly reports, which its trading partners value.

Dr. Nagasawa maintained that WSSV is different from newly introduced cases like TSV and KHV since the virus has now established in culture farms and in the wild. Therefore, there is now a need to identify measures to control and prevent WSSV. Dr. de la Peña related that the Philippines has put in place several measures to prevent WSSV in the grow-out phase such as adherence to codes of conduct and best-practice methods. Dr. Kanchanakhan declared that in Thailand, the measures depended on policy. Difficulty in controlling the problem is due to infected broodstock (*P. monodon*). With private sector agreement, the use of *L. vannamei* has become widespread. Thailand now has a program to develop SPF stocks for all 4 shrimp viruses. Two companies are engaged in it and are planning to distribute postlarvae from breeders obtained from Florida and Hawaii in the USA. The SPF status, however, should be maintained through a genetics program. Dr. Tu observed that there have been some problems with SPF broodstock in Taiwan due to low productivity after a few generations, and suggested that there should be genetic experts who will work on selecting best growing ones from postlarvae reared in ponds in Thailand, and consequently used as breeders.

Session 3: Lecture and Country Reports on Quarantine Services of Diseases of Aquatic Animals

1. The Role of Quarantine in Preventing the Spread of Serious Pathogens of Aquatic Animals in Southeast Asia

It was noted that most quarantine programs in the region are not effective. This could be partly due to the lag time between disease emergence, first recognition and development of diagnostic techniques, limited funding and personnel capability. Regarding originally imported stock of SPF *L. vannamei*, Dr. Lavilla-Pitogo asked if there are any agreed upon guidelines or treaty on what to do with the stock if disease outbreak occurs. Dr. Arthur replied that

there is none and it depends on the capability of the importing country to conduct accurate diagnosis and maintain biosecurity. He also recommended importing eggs instead of SPF broodstock because eggs are less likely to contain a number of pathogens, easier to disinfect, and the number of potential pathogens are certainly reduced by moving eggs instead of juveniles or older animals. Dr. Phillips added that if SPF stocks are brought in and placed in an environment which is not controlled, they breed and are also known as SPF but in growing the second generation, they may pick up white spot or Taura syndrome, and thus lose their SPF status. Also, there are countries importing SPF stocks with certificates that are not valid. Importing countries should be careful, and make sure that exporting countries have the competence and transparency to guarantee that what they have are really SPF stocks. Dr. Kanchanakhan declared that the Department of Fisheries of Thailand approved the importation of SPF for some hatcheries provided they have a genetic improvement program and biosecure facilities to maintain the SPF status of the next generations. He said many requests are received from private hatcheries. Their quarantine facilities inside the hatcheries are inspected and their genetic programs are screened. Ms. Hamid related Brunei's experience with SPF, which started in late 2001. From SPF broodstock imported from Mexico, first generation PLs were reared to broodstock, which were used to produce 2nd and 3rd generation PLs. A consultant is looking at their SPF program but the findings and status are not presently available. Dr. Arthur expressed interest in Brunei's experience since he is carrying out import risk analysis of *L. stylirostris* for Fiji and one of the issues is the health status of the shrimp. Dr. Lavilla-Pitogo commented that from scientific literature, IHHNV, which is native to Asia, is a serious pathogen of *L. stylirostris* because it wiped out broodstocks in Hawaii a decade ago. She said that Brunei must be rearing them in really biosecure facilities but if it is the same strain as that which was wiped out a decade ago, then it may not last long in ponds in Asia. Ms. Hamid assured that a big broodstock development center with capability for screening of viruses, and good production exists in Brunei at present. She said Brunei's shrimp production increased dramatically with *L. stylirostris* with exports to USA and Japan. Farmers are now happy with *L. stylirostris* and do not want to culture *P. monodon* any longer.

2. Quarantine Requirements for Importation of Aquatic Animals into Taiwan, ROC

Dr. Tu said Taiwan's quarantine program for postlarvae and spawners of crustacean was implemented in March/April of 2004 according to the information from the Bureau of Animal Quarantine. Dr. Kanchanakhan asked why Taiwan is monitoring EHNV in perch noting that it is a disease of a different species of perch in Australia and not of *Lates calcarifer*. Dr. Tu replied that monitoring is done because the disease is very severe. Originally from Australia, the disease is now in Southeast Asia, and the government is afraid of its possible introduction into Taiwan. Regarding its diagnosis, the PCR assay is adequate. Dr. Kanchanakhan volunteered information that, in Thailand, they monitor EHNV for 2 years already but since sea bass stays in

brackishwater, they were unable to detect EHNV. He said it might be possible to detect it in freshwater if the OIE protocol is used. Mr. Kim asked whether quarantine is being done for VNN in grouper. Dr. Tu replied that quarantine for VNN is not included because the government thinks that it is not much of a risk factor, but added that Taiwan is positive for VNN.

3. Discussion: Country Reports

In Brunei, Ms. Hamid said that they use Level I and PCR for their quarantine inspection. Cambodia on the other hand has no quarantine program and cannot issue a health certificate. Also, Lao PDR cannot issue a health certificate since only zoonotic diseases are being checked. Noting that Dr. Sunarto listed luminous bacteria as introduced species, Dr. Lavilla-Pitogo clarified that vibrios are not in the disease list because they are ubiquitous in the environment. About Indonesia's diagnostic capability for detection of parasites, particularly protozoans, Dr. Sunarto acknowledged that they have a pressing problem regarding expertise to diagnose parasitic diseases and that they needed support to enhance their diagnostic capability. Dr. Arthur added that support for conventional diagnostic methods, e.g. taxonomy for parasites, should be encouraged.

Asked about the species affected by the listed diseases, Dr. Sunarto replied that they are both from ornamental and cultured fish. He added that there are two categories for the list of quarantined fish in Indonesia: treatable and non-treatable. Some diseases, like those cause by bacteria, can be treated and if the fish is free of the disease after treatment, then it can be released, but if it cannot be treated, then it is refused. Since Indonesia has a long list of diseases and some may not be found in the OIE list, Dr. Phillips suggested that import risk analysis be done to have a science-based argument on why importation of certain species are not allowed even though they are not in the OIE list.

In Thailand, Dr. Kanchanakhan disclosed that both live aquatic animal and fishery products are subjected to quarantine. Upon arrival, raw and frozen shrimp are quarantined in the importer's cold storage (2-3 weeks) where the shipments are verified and analyzed for bacteria that are harmful to humans, as well as drug residues. The quarantine system will get very stringent and will be done by species and by disease. The quarantine officer will receive instructions from the Department of Fisheries on which animals should be quarantined and which disease needs to be checked. At the moment *L. vannamei* importation will push through. Dr. Primavera asked if aquarium fish goes through the Bureau of Fisheries and Aquatic Resources noting that Philippine authorities seem to be inconsistent with its inspection scheme (e.g., in the importation of aquarium fish and *Cherax* sp.). Ms. Regidor replied that there is adequate legislation but the implementing guidelines are often not in place. For quarantine of soft-shelled turtle in Vietnam, Mr. Kim said that the animal is checked using Level I diagnosis at the border. Dr. Tu added that in case a fish farm wants to export some fish in Taiwan, monitoring of the facility is done 4 times a year.

Dr. Lio-Po observed that even with quarantine services and policies present, there is still spread/occurrence of diseases. Dr. Sunarto replied that there is a need to improve capability of quarantine inspectors, and that they should be properly armed with enough knowledge and information. He said that in Indonesia, quarantine service has been there for 20 years but no significant achievements have been done. Dr. Lio-Po related that the Philippine quarantine service has been successful in delaying the entry of WSSV through the ban in importation of crustaceans, and is now running after *P. vannamei*. Dr. Kanchanakhan avers that Thailand cannot ban importation without scientific basis.

Dr. Nagasawa noted that Vietnam has included *Diphyllbothrium* in the list. He suspects it may be *Diplogonoporus* since *Diphyllbothrium* tapeworms are mostly subarctic or temperate species. The list need revision as well as Singapore's where gill flatworms of genus *Dactylogyrus* are reported to infect marine fish but are in fact freshwater parasites.

Session 4: Lecture and Country Reports on Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals

1. OIE's Role in Animal Health Improvement Including Aquatic Animals

The discussion focused on representation to OIE meetings and in-country coordination among the livestock and fisheries sectors. Dr. Kanchanakhan proposed that not only livestock but fishery officers must also be involved in OIE meetings in Paris. He said that there are also many experts in fisheries and sometimes it takes time to get the message from the livestock to the fisheries department. Dr. Oketani said he realized that many Asian countries have separate livestock and fisheries departments. Many countries in the world also have separate livestock and fisheries departments but they maintain good coordination. Participation in OIE meetings is possible but there is only one national delegate with the right to vote. A few countries participate irregularly on observer status in the OIE general assembly. Mr. Okamoto said that in-country coordination should be improved because in almost all countries, the veterinary authorities are the national representatives to OIE meetings, which has been the practice since the OIE started. Referring to the proposed draft of the Code of Aquatic Animal Health Dr. Oketani said each member country had been informed regarding the draft code for them to be involved in its development. But he acknowledged that fisheries authorities may not have been properly informed about the process and there may be a need to manage the in-country coordination between the veterinary and fisheries authorities. Dr. Lavilla-Pitogo volunteered that during the OIE regional meeting in Noumea, New Caledonia in November 2003, a document entitled "Update on Developments in Aquatic Animal Diseases" was presented by Dr. Eva Maria Bernoth, president of the OIE Aquatic Animal Health Standards Commission. The paper discussed the coordination between authorities responsible for aquatic animal health and livestock, disease reporting and cooperation with OIE of 14 OIE member countries in the region.

Dr. Phillips remarked that every country in the Asia-Pacific region does have a designated coordinator for aquatic animal health that has a responsibility for coordinating with OIE and NACA regarding aquatic animal health disease reporting. They would have been informed of the outcome of the Regional Aquatic Animal Health Advisory Group that met in November and meets every year now. There is some reference to the need to improve communication at all levels, i.e., between veterinary and fisheries authorities, as well as within fisheries authorities). During the regional meeting last November, there was a recommendation to disseminate OIE standards and to send all aquatic animal report to all levels because many feel that the documents go to the veterinary office and do not find their way to the fisheries office. Dr. Oketani asserted that aquatic animal health reports and manual is distributed through the national delegate and the draft code and manual is distributed through the OIE delegate website. Fisheries people can get the draft and make a comment. Relatively good relations are maintained between veterinary and fishery authorities in Asia, so they can easily make requests and comments to reflect the Asian voice. But he notes that Asian countries are silent. Dr. Primavera asked if it is difficult to have both representatives to OIE considering that terrestrial animals have no overlap with aquatic animals. Dr. Oketani explained that the OIE constitution states that OIE should keep direct contact with highest-ranking veterinary officer. So, all OIE national delegates are veterinary officers. The constitution also declares that OIE cannot touch the domestic system of its member countries.

2. Discussion: Country Reports

Dr. Lio-Po asked about the regularity of sampling in the KHV survey in Indonesia. Dr. Sunarto replied that sampling every 3 months was planned but they could not implement it due to lack of manpower. About the questions covered in the questionnaire and the measures undertaken to ensure that respondents correctly record the disease, Dr. Sunarto explained that the questionnaire has three parts: (1) formal letter; (2) questions regarding the farm and presence or absence of KHV and (3) attached brochure/photo guide to help respondents identify the disease, and questions regarding first occurrence to determine disease progression or spread. He cautioned that some inaccuracies might exist as only clinical signs (Level I) were used to identify the disease. He then asked Dr. Arthur's idea on how to conduct a surveillance program in a country with limited resources and yet produce results that are scientifically acceptable. Dr. Arthur replied that epidemiologists could probably help in this respect. He recalled that as part of the FAO project there was a surveillance project set up in Indonesia headed by Dr. Angus Cameron. It was not based on advanced diagnostic techniques but on field observations. He suggested using such a program to carry out the initial screening before applying Level II or Level III diagnostic techniques. Noting that it takes a certain period of time for the pathogen to accumulate, Dr. Kanchanakhan thinks disease has spread too rapidly in Indonesia and Japan compared to EUS, which took 2-3 years to appear in a new country. Dr. Arthur thinks the difference probably is that EUS spread was through movement of wild fish, whereas in the case of KHV in

Indonesia it was human mediated, through people carrying fish in airplanes and trucks.

The discussion then shifted to diagnostic levels and the diseases being placed in the watch list in different countries. It was agreed that if diagnosis requires only histopathological changes to be examined, it is considered Level II, but if gene probe is used (e.g. *in situ* hybridization), which is a molecular technique, the diagnostic level is Level III. Dr. Nagasawa asked why isopodiasis is included in the list of economically important diseases in the Philippines despite being present only in Lake Taal. Ms. Regidor replied that they have to watch it and put it in the list owing to a possibility for the disease to spread to other parts of the country. Dr. Nagasawa commented that since there are few parasitologists who can identify the molluscan parasites in the Southeast Asian region, especially protozoans, there is a need to train more parasitologists working on protozoan parasites of mollusks. Dr. Kanchanakhan mentioned that IHHNV is carried by *P. monodon* and *L. vannamei*. It is in the monitoring list because during quarantine, a certification is required that shrimps are free of the disease. Emergency measures are being developed but the target is TSV because *L. vannamei* is newly introduced in the region and importers want the postlarvae to be free of infectious viral disease.

Mr. Kim raised concern about diagnostic techniques. He said there are diagnostic labs in the provinces without equipment, they cannot do Level II diagnosis, but they have a PCR machine. He asked how such labs should be classified. Dr. Sunarto said he uses a different approach. He puts Level I plus PCR, or Level II plus PCR. He stressed that sometimes people are confused what diagnostic levels or laboratory levels mean. He said that classification should not be put on the laboratory but rather on the technique. Regarding diagnostic levels, Dr. Lavilla-Pitogo related that there was a long debate about it during the Advisory Group meeting at NACA last November 2003 because it is giving people some impression that if one is using Level III of diagnosis then he is doing really good diagnosis which is not the case.

Session 5: Research and Training on Diseases of Aquatic Animals

1. Research and Training on Aquatic Animals in Southeast Asia

The discussion centered on the need to develop epidemiology in the region and how this might be accelerated. Dr. Elena Catap inquired if there was a follow-up to the epidemiology workshop in Australia last November 2002. Dr. Phillips replied that the level of awareness has gone up but there is still a need to develop the expertise further. Dr. Lavilla-Pitogo suggested that to fast track the increase in capability in epidemiology, veterinarians should be invited to participate in these workshops. On Dr. Phillip's comment to incorporate epidemiology in AQD's AquaHealth Online course, she said that, although absent in the current module, epidemiology could be included if there is an expert to prepare and mentor the module. The issue of lack of funding was also raised. Noting that research and training is recognized to be essential in disease control, Dr. Kanchanakhan asked how lack of funding could be overcome in

the region. Dr. Phillips replied that Japan and other donors have helped in capacity building but observed that other countries may have other priorities. He suggested that countries with international trade activity should invest in disease control programs.

2. Discussion:Country Reports

Regarding the extent of government support for research and training needs in Indonesia, Dr. Sunarto said that some research projects have FAO funding and although the government funds routine projects, the funding is not enough to invite experts. Dr. Lavilla-Pitogo commented that some private companies give funds for research. Dr. Arthur noted, however, that companies claim proprietary rights and important information may be withheld. Mr. Okamoto observed that majority of the member countries has a comprehensive list of training needs. From SEAFDEC's point of view, AQD has the role to answer/support these needs. But AQD should identify priority training needs it will support.

3. Research and Training on Fish Diseases at the Aquaculture Department of the Southeast Asian Fisheries Development Center in 2000-2004: A Review

Regarding the GOJ TF Project, Dr. Nagasawa said that the focus of Phase 1 was on shrimp and fish disease while Phase 2 which will start in August or September will include mollusk disease specifically parasites of mollusks. The study can be done in the Philippines and Thailand. Concerning the need for a long course on histopathology, Dr. Lavilla-Pitogo said that histopathology workers should be immersed in their work because it takes a long time to really learn it. Dr. Nagasawa added that it is similar with fish parasitology, wherein a trained eye is important.

Elaborating on AQD AquaHealth Online course, Dr. Lavilla-Pitogo explained that the course was conceived and implemented due to lack of funds for the regular hands-on course. Successful on-line trainees can take the hands-on course, which can be done in other laboratories, e.g. AAHRI. Mr. Kim who was an online student, volunteered that he enjoyed the on-line course. Besides being inexpensive, there is no need to travel, and one can perform regular work aside from doing the course. Dr. Nagasawa, who offers to fund the course, said that former participants were from ASEAN countries but participants from other countries are also welcome. Dr. Phillips revealed that they have sent people from India for the on-line course. He said that NACA would be glad to co-work on the development of other modules needed by the region. To spread the impact of the training, he supports the idea of doing the hands-on in other countries. Other countries may also use the module to have a wider impact. Noting that trainees usually come from different backgrounds, Dr. Lavilla-Pitogo added that the modules could be tailored to fit the need of the trainee. But since module specialists also do research and mentoring part is time-consuming, trainees who have basic knowledge may skip the basic parts. Dr. Nagasawa projected that elearning can also contribute to the establishment of future networking in fish surveillance.

Dr. Nagasawa observed that some participants mentioned no research activity in their country reports, but understood the financial constraints besetting most Southeast Asian countries. He said that although budget is limited, the GOJ TF Fish Disease Project is for the region and he intends to invite other institutes to collaborate with SEAFDEC/AQD.

Dr. Lio-Po inquired about the occurrence of the emerging disease spring viremia of carp and grass carp hemorrhagic viral disease, which was mentioned only by Vietnam, although included as one of the notifiable diseases in Thailand. Dr. Kanchanakhan replied that spring viremia was added in their monitoring list because they issue health certificate similar to Singapore's and they needed to make sure that they certify based on scientific background. Monitoring is done with the use VF2 cell line but so far no virus has been isolated. If they find one they will follow it up with RT-PCR to confirm for spring viremia of carp (SVC). It was clarified that SVC is not yet in Asia. As for the grass carp hemorrhagic septicemia, it is found only in Vietnam and China. In Thailand, Reovirus occurs in snakehead but it is different from the Reovirus described in the literature.

Dr. Sano raised the issue of proper disease identification for its monitoring and surveillance. He asked whether grouper iridovirus could be distinguished from red sea bream iridovirus (RSIV) in grouper. Dr. Kanchanakhan replied that there are at least 2 different grouper iridoviruses in Thailand and they are different from RSIV. Since the primer used for RSIV did not give positive results for grouper iridovirus, he claimed differentiating the viruses is not difficult. Dr. Sano clarified that he mentioned only Ranavirus in the disease card of grouper iridovirus. Reacting to Dr. Kanchanakhan's statement that Ranavirus is a similar virus to RSIV, he inquired whether it could in fact be RSIV. Dr. Kanchanakhan replied that Singapore scientists reported Ranavirus in marine fish, but said Ranavirus is never found in marine fish in Thailand. Dr. Sunarto declared he uses the RSIV primer and it detects the iridovirus in sea bass and grouper very well. Dr. Sano stressed that laboratories should distinguish between RSIV and iridovirus infection in grouper. He thinks that they are some similar viruses to RSIV. However, since the OIE manual claims that the primer for RSIV does not work for similar viruses, it may be necessary to modify the manual. Also, he is not aware of any evidence for two types of RSIV in Asia. He requests the body if they have evidence, to send a report to OIE reference laboratory so a revision can be made. He believes RSIV infected a variety of marine fishes. Reacting to Dr. Kanchanakhan's comments Dr. Ling Kai Huat disclosed that a Chinese scientist working in Singapore did the research. He is not sure how Ranavirus came to infect marine fish in Singapore. He said he will try to find out about it when he goes back. Dr. Lio-Po added that there are two iridoviruses reported in Singapore. One is grouper iridovirus and another is Singapore iridovirus. Dr. Phillips hoped that Dr. Sano and Dr. Kanchanakhan could work together to revise the disease card if there is a need to do it.

Dr. Primavera suggested that, from an ecological point of view and if funds are available, it might be good to do a regular sampling on wild populations for the presence of *L. vannamei*. A sampling protocol can be developed and

see what penaeid species can be collected and also their pathogens because no matter how farms are kept biosecure there will be escapees. Dr. Phillips disclosed that in Thailand, the Department of Fisheries has done an extensive review of *L. vannamei* and one of the strong recommendations was to do an ecological monitoring of penaeid fisheries. *L. vannamei* has been appearing in wild catches in many countries in the region but whether they are breeding is a big question. In Brazil a lot of exotic species have been introduced but they do not apparently breed. There is also research being done on the susceptibility of other crustacean species to TSV apart from *P. monodon*. Some species are certainly more susceptible than others. This is an area that needs more research and caution since TSV certainly affects other species although it does not affect *P. monodon* as much as *L. vannamei*. Dr. Kanchanakhan added that the Thai government has spent millions of baht to do risk analysis for introduction of *L. vannamei* and consultation with all stakeholders. After it came out with the risk analysis, it introduced a limited number of breeders for a certain period of time, and proposed introduction with genetic improvement, which is what is being done at the moment.

ANNEXES

247

List of Participants and Observers

251

Program of the Meeting

254

List of Acronyms

Annex 1. List of participants and observers

PARTICIPANTS

- 1 Mrs. Hajah Laila Haji Abd Hamid
Fisheries Officer
Department of Fisheries
Ministry of Industry and Primary Resources
Jalan Menteri Besar Berakas BB3910
Brunei Darussalam
Tel. No.: (673-2) 770234, 772230
Fax No.: (673-2) 382069, 770237
Email: laila_hamid@fisheries.gov.bn
- 2 Mr. Bun Racy
Chief of Laboratory
Inland Fisheries Research and Development
Institute
Department of Fisheries
Norodom Blvd. Phnom Penh,
Cambodia
Tel. No.: (855-16) 710780
Fax No.: (855-23) 210565
Email: racymoly@yahoo.com
- 3 Mrs. Thongphoun Theungphachanh
Head, Animal Production of Quality Control
Department of Livestock and Fisheries
National Animal Health Center
P.O. Box 811
Vientiane, Lao PDR
Email: theungphachanh@yahoo.com
laonach@laotel.com
Tel. No.: (856-21) 241581, 416932
Fax No.: (856-21) 240896
or
Living Aquatic Research Resource Center
P.O. Box 9108
Vientiane, Lao PDR
Tel. No.: (856-21) 215015
Fax No.: (856-21) 415674
- 4 Dr. Agus Sunarto
Fish Health Research Laboratory
JL. Ragunan 20, Pasar Minggu, Jakarta
Indonesia
Tel. No.: (62-21) 7805052
Cell no.: (62) 8131061167
Fax No.: (62-21) 7815101
Email: agussunarto@hotmail.com
- 5 Ms. Faazaz bte Abd. Latiff
Senior Fisheries Research Officer
National Fish Health Centre (NaFISH)
Fisheries Research Institute
11960 Batu Maung, Penang
Malaysia
Tel. No.: (60-4) 626 3922
Fax No.: (60-4) 626 3977
Email: faazaz88@yahoo.com
- 6 U Saw New Year
Assistant Director
Department of Fisheries
Sinn Min Road
Ahlone Township
Yangon, Myanmar
Tel. No.: (95-1) 211 575 , 211 375
Fax No.: (95-1) 228 258
Email: DOF@mptmail.net.mm
- 7 Ms. Simeona R. Regidor
Chief, Fish Health Section
Department of Agriculture
Bureau of Fisheries and Aquatic Resources
860 Quezon Avenue, Quezon City
Metro Manila 1103, Philippines
Tel. No.: (02) 372-5055
Fax No.: (02) 372-5055
Email: simeona03@yahoo.com
- 8 Dr. Ling Kai Huat
Head, Aquaculture Services Centre (ASC)
Sembawang Research Station
Loring Chencharu,
Singapore 769194
Tel No.: (65) 67519852
Fax No.: (65) 67523243
Email: ling_kai_huat@ava.gov.sg
- 9 Dr. Somkiat Kanchanakhan
Head/Fish Virologist Disease Control and Diagnosis
Research Unit
Inland Aquatic Animal Health Research Institute
(AHHRI)
Department of Fisheries
Jatuchak, Bangkok 10900, Thailand
Tel No.: (662) 579 6803
Fax No.: (662) 561 3993
Mobile No.: 667 034 0802
Email: somkiatk@fisheries.go.th
kanchanakhan@yahoo.com

- 10 Mr. Kim Van Van
Researcher
Research Institute for Aquaculture No. 1
Dinh Bang Tu Son, Bac Ninh,
Vietnam
Tel No.: (84-4) 878 5748
Home Tel.: (84-4) 878 1571
Fax No.: (84-4) 827 3070, 878 5748
Email: kimvanvan@hn.vnn.vn
- 11 Dr. J. Richard Arthur
Consultant
P.O. Box 1216
Barriere, British Columbia
V0E 1E0
Tel No.: (1-250) 425 2287
Fax No.: (1-250) 425 0045
Email: trichodinella@yahoo.com
- 12 Dr. Yoshiyuki Oketani
Deputy Regional Representative
Office International Des Epizooties (OIE)
East 311, Shin-Aoyama Bldg.
1-1-1 Minami-Aoyama, Minato-ku
Tokyo 107-0062, Japan
Tel No.: (81-3) 5411 0520
Fax No.: (81-3) 5411 0526
Email: oietokyo@tky.3web.ne.jp
- 13 Dr. Motohiko Sano
Diagnosis and Training Center
Aquatic Animal Health Division
National Research Institute of Aquaculture
Fisheries Research Agency
224-1 Hiruta, Tamaki, Mie 519-0423
Japan
Tel No.: (81) 596 58 6411
Fax No.: (81) 596 58 6413
Email: sanogen@fra.affrc.go.jp
- 14 Dr. Michael J. Phillips
Environment Specialist
Network of Aquaculture Centres in Asia-Pacific
(NACA)
Suraswadi Building, Department of Fisheries
Kasetsart University Campus
Ladyao, Jatujak, Bangkok 10900
Thailand
Tel No.: (66-2) 561 1728 ext 115
Fax No.: (66-2) 561 1727
Email: michael.phillips@enaca.org
- 15 Dr. Chien Tu
DVM, Fish Health Laboratory
Department of Biological Research
Animal Health Research Institute
376 Chung-Cheng Road
Tanshui 251, Taiwan
Republic of China
Tel No.: (886-2) 26212111 ext 203
Fax No.: (886-2) 26225345
Email: ctu@mail.nvri.gov.tw
- 16 Mr. Junichiro Okamoto
Deputy Secretary-General
Southeast Asian Fisheries Development Center,
Secretariat(SEAFDEC Secretariat)
P.O. Box 1046
Kasetsart Post Office
Bangkok 10903
Thailand
Tel No.: (662) 9406326 to 29
Fax No.: (662) 9406336
Email: secretariat@seafdec.org
- 17 Dr. Rolando R. Platon
Chief, Southeast Asian Fisheries Development
Center, Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 511 9171, 511 9174
Fax No.: (63-33) 335 1008, 336 2891
Email: aqdchief@aqd.seafdec.org.ph
- 18 Dr. Jurgenne H. Primavera
Head, Research Division
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 511 9070, 336 1008
Email: jhprima@aqd.seafdec.org.ph
- 19 Dr. Kazuya Nagasawa
Fish Disease Expert
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 511 8878
Fax No.: (63-33) 511 8878, 336 1008
Email: nagasawa@aqd.seafdec.org.ph
- 20 Dr. Gilda D. Lio-Po
Head, Fish Health Section
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 336 1008, 511 9070
Email: liopo@aqd.seafdec.org.ph
- 21 Dr. Erlinda R. Cruz-Lacierda
Fish Health Section
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 336 1008, 511 9070
Email: eclacier@aqd.seafdec.org.ph

- 22 Dr. Celia R. Lavilla-Pitogo
Fish Health Section
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 336 1008, 511 9070
Email: celia@aqd.seafdec.org.ph
- 23 Dr. Leobert D. dela Peña
Fish Health Section
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 336 1008, 511 9070
Email: leobertd@aqd.seafdec.org.ph
- 24 Dr. Edgar C. Amar
Fish Health Section
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 336 1008, 511 9070
Email: eamar@aqd.seafdec.org.ph
- 25 Dr. Elena S. Catap
Fish Health Section
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 336 1008, 511 9070
Email: esc@aqd.seafdec.org.ph
- 26 Ms. Gregoria E. Pagador
Fish Health Section
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No.: (63-33) 336 1008, 511 9070
Email: gep@aqd.seafdec.org.ph

OBSERVERS

- 27 Mr. Nguyen Nhu Tiep
Chief
Veterinary Division
National Fisheries Quality Assurance
And Veterinary Directorate
(NAFIQAVED)
Vietnam Ministry of Fisheries
Vietnam
Tel No.: (63-33) 511 8878, 336 2965,
511 9171
Fax No.: (63-33) 511 8878, 336 1008,
Email: haivan12av@yahoo.com
- 28 Dr. Joselito R. Somga
Fish Health
Department of Agriculture
Bureau of Fisheries and Aquatic Resources
860 Quezon Avenue, Quezon City,
Metro Manila 1103
Philippines
Tel No.: (63-2) 372 5057, 372 5061
Fax No.: (63-2) 372 5055
Email: jsomga@bfar.da.gov.ph
- 29 Ms. Mercedita A. Bantaya
Fish Health
Department of Agriculture
Bureau of Fisheries and Aquatic Resources
860 Quezon Avenue, Quezon City,
Metro Manila 1103
Philippines
Tel No.: (63-2) 372 5057, 372 5061
Fax No.: (63-2) 372 5055
Email: mbantaya@bfar.da.gov.ph
- 30 Mr. Felipe I. Santamaria
Fisheries Quarantine Officer
Quarantine Office
Ninoy Aquino International Airport
(NAIA)
Tel No: (63-2) 832 2982
Fax No.: (63-2) 8771 3053
- 31 Mr. Mario Trio
Fisheries Quarantine Officers
Quarantine Office
Ninoy Aquino International Airport
(NAIA)
Tel No.: (63-2) 832 2982
Fax No.: (63-2) 8771 3053
- 32 Mr. Edwin B. Alesna
Fisheries Quarantine Officers
Quarantine Office
Ninoy Aquino International Airport
(NAIA)
Tel No.: (02)372 7453
Email: edwin_alesna@yahoo.com

AQD SUPPORT STAFF

- 33 Mr. Isidro T. Tendencia
Training and Information Division
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 336 2965, 336 2891
Fax No: (63-33) 336 2891, 336 1008,
Email: ittendencia@aqd.seafdec.org.ph
- 34 Ms. Nanette C. Bantillo
Office of the Fish Disease Expert
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo
Philippines
Tel No.: (63-33) 511 8878, 336 2965,
511 9171
Fax No: (63-33) 511 8878, 336 1008,
Email: ncbantillo@aqd.seafdec.org.ph
- 35 Mr. Stephen B. Alayon
Data Bank
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD)
Tigbauan, 5021 Iloilo, Philippines
Tel No.: (63-33) 336 2965, 511 9171
Fax No: (63-33) 336 1008, 511 9070
Email: sbalayon@aqd.seafdec.org.ph

Annex 2. Program of the meeting

The Meeting on
Current Status of Transboundary Fish Diseases in Southeast Asia:
Occurrence, Surveillance, Research and Training
Traders Hotel, Manila, Philippines
23-24 June 2004

DAY 0	Arrival (distribution of kits and filling out of registration forms)
DAY 1	23 June 2004 (Wednesday)
08:030-09:00	Registration
08:30-08:35	Welcome Address (Dr. R. Platon, SEAFDEC AQD, Philippines)
08:35-09:10	Opening of the Meeting (Mr. J. Okamoto, SEAFDEC Secretariat, Thailand)
08:40-08:45	Identifying Meeting Objectives and Rationale (Dr. K. Nagasawa, SEAFDEC AQD, Philippines)
08:45-12:00	Experiences and Country Reports on Koi Herpesvirus Disease (KHVD) (Moderator: Dr. K. Nagasawa, Rapporteur: Dr. E. S. Catap, SEAFDEC AQD, Philippines)
<i>Session 1:</i>	<ol style="list-style-type: none"> 1. Experience on Koi Mass Mortality in Indonesia (Dr. A. Sunarto, Fish Health Research Laboratory, Indonesia) 2. Experience on Common Carp Mass Mortality in Japan (Dr. M. Sano, National Research Institute of Aquaculture, Japan) 3. Current Status on Koi Herpesvirus in Taiwan (Dr. C. Tu, Animal Health Research Institute, Taiwan) 4. Report on the International Symposium on Koi Herpesvirus Disease held in Yokohama, Japan, March 13, 2004 (Dr. G. D. Lio-Po, SEAFDEC AQD, Philippines) 5. Brunei Darussalam 6. Cambodia 7. Lao PDR 8. Malaysia 9. Myanmar 10. Philippines 11. Singapore 12. Thailand 13. Vietnam Discussion
12:00-13:00	Lunch
13:00-15:00	Lecture and Country Reports on White Spot Syndrome Virus (WSSV) and Taura Syndrome Virus (TSV) of Shrimps (Moderator: Dr. E. R. Cruz-Lacierda, Rapporteur: Dr. C. R. Lavilla-Pitogo, SEAFDEC AQD, Philippines)
<i>Session 2:</i>	<ol style="list-style-type: none"> 1. Lecture on Transboundary Shrimp Viral Diseases with Emphasis on WSSV and TSV (Dr. L. D. de la Peña, SEAFDEC AQD, Philippines) 2. Brunei Darussalam

3. Cambodia
 4. Indonesia
 5. Lao PDR
 6. Malaysia
 7. Myanmar
 8. Philippines
 9. Singapore
 10. Thailand
 11. Vietnam
- Discussion

15:00-15:30 Coffee Break

15:30-17:30

Session 3:

Lecture and Country Reports on Quarantine Services of Diseases of Aquatic Animals (Moderator: Dr. E. C. Amar, Rapporteur: Dr. L. D. de la Peña, SEAFDEC AQD, Philippines)

1. Lecture on the Role of Quarantine in Preventing the Spread of Serious Pathogens of Aquatic Animals in Southeast Asia (Dr. J. R. Arthur, Canada)
 2. Quarantine Requirements for Importation of Aquatic Animals into Republic of China (Dr. C. Tu, Animal Health Research Institute, Taiwan)
 3. Brunei Darussalam
 4. Cambodia
 5. Indonesia
 6. Lao PDR
 7. Malaysia
 8. Myanmar
 9. Philippines
 10. Singapore
 11. Thailand
 12. Vietnam
- Discussion

DAY 2

24 June 2004 (Thursday)

09:00-10:30

Session 4:

Lecture and Country Reports on Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals (Moderator: Dr. J. H. Primavera, Rapporteur: Ms. G. Erazo- Pagador, SEAFDEC AQD, Philippines)

1. Lecture on OIE's Roles in Animal Health Improvement Including Aquatic Animals (Dr. Y. Oketani, Office International des Epizooties [OIE], Japan)
 2. Brunei Darussalam
 3. Cambodia
 4. Indonesia
 5. Lao PDR
 6. Malaysia
 7. Myanmar
 8. Philippines
 9. Singapore
 10. Thailand
 11. Vietnam
- Discussion

10:30-11:30 Coffee Break

11:30-12:30

Session 5:

Lecture and Country Reports on Research and Training on Diseases of Aquatic Animals (Moderator: Dr. E. S. Catap, Rapporteur: Dr. E. R. Cruz-Lacierda SEAFDEC AQD, Philippines)

1. Lecture on Research and Training on Diseases of Aquatic Animals in Southeast Asia (Dr. M. J. Phillips, Network of Aquaculture Centres in Asia-Pacific [NACA], Thailand)

	2. Brunei Darussalam
	3. Cambodia
	4. Indonesia
	5. Lao PDR
	6. Malaysia
	7. Myanmar
	8. Philippines
	9. Singapore
	10. Thailand
	11. Vietnam
	12. SEAFDEC/AQD
12:30-14:00	Lunch
14:00-15:30	Country Reports on Research and Staff Training on Diseases of Aquatic Animals (contd.) Discussion
14:00-15:30	General Discussion (Moderator: Dr. G. D. Lio-Po, Rapporteur: Dr. E. C. Amar, SEAFDEC AQD, Philippines)
15:30-16:00	Coffee Break
16:00-17:30	Country Reports on Research and Staff Training on Diseases of Aquatic Animals (contd.) Presentation of Discussion Outputs (Moderator: Dr. C. R. Lavilla-Pitogo, SEAFDEC AQD, Philippines)
17:30	Closing Remarks (Dr. K. Nagasawa, SEAFDEC AQD, Philippines)

Annex 3. List of Acronyms

AAHRI	Aquatic Animal Health Research Institute
APEC	Asia-Pacific Economic Cooperation
AQIS	Australian Quarantine and Inspection Service
ARMM	Autonomous Region of Muslim Mindanao
ASEAN	Association of Southeast Asian Nations
AVA	Agri-Food and Veterinary Authority of Singapore
BARFI	Bohol Aquaculture Research Foundation, Inc.
CEFAS	Centre for Environment, Fisheries and Aquaculture Science (UK)
CITES	United Nations Convention on International Trade in Endangered Species
DFID	Department of International Development
FAO	Food and Agriculture Organization of the United Nations
FCG	Fisheries Consultative Group
FRA	Fisheries Research Agency of Japan
GOJ	Government of Japan
ICES	International Council for the Exploration of the Sea
IRA	Import Risk Analysis
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Sciences
LARReC	Department of Livestock and Living Aquatic Resources Research Center
MAFF	Ministry of Agriculture, Forestry and Fisheries of Japan
MFRD	Marine Fisheries Research Department (of SEAFDEC)
NACA	Network of Aquaculture Centres in Asia-Pacific
NGO	Non-government organization
NPPMCI	Negros Prawn Producers Marketing Cooperative Incorporated
ODA	(British) Overseas Development Agency
OIE	Office International des Epizooties
PCAMRD	Philippine Council for Aquatic and Marine Research and Development
SEAFDEC	Southeast Asian Fisheries Development Center
SEM	Scanning Electron Microcopy
TEM	Transmission Electron Microscopy
SPS	Sanitary and Phyto-sanitary Agreement
UPLB	University of the Philippines at Los Baños
UPM	University Putra Malaysia
USAID	United States Agency for International Development
WTO	World Trade Organization

The Southeast Asian Fisheries Development Center (SEAFDEC), a regional treaty organization based in Bangkok, Thailand was established in December 1967 to promote fisheries development in the region. Its member countries are Japan, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, the Socialist Republic of Vietnam, Union of Myanmar, Indonesia and Cambodia. The Council of Directors who represents SEAFDEC Member Countries is the policy-making body of the organization.



SEAFDEC does research on appropriate fisheries technologies, trains fisheries and aquaculture technicians, and disseminates fisheries and aquaculture technologies. Four departments were established to pursue these objectives

- The Training Department (TD) in Samut Prakan, Thailand (1967) for marine capture fisheries training
- The Marine Fisheries Research Department (MFRD) in Singapore (1967) for fishery post-harvest technology
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines (1973) for aquaculture research and development
- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia (1992) for the development and management of marine fishery resources in the exclusive economic zones (EEZs) of SEAFDEC Member Countries

SEAFDEC/AQD is mandated to

- Promote and undertake aquaculture research that is relevant and appropriate for the region
- Develop human resources for the region
- Disseminate and exchange information on aquaculture

The Aquaculture Department in the Philippines maintains four stations: in Iloilo Province, the Tigbauan Main Station and the Dumangas Brackishwater Substation; in Guimaras, the Igang Marine Substation; and in Rizal, the Binangonan Freshwater Station.



Tigbauan Main Station



Dumangas Brackishwater Substation



Igang Marine Substation



Binangonan Freshwater Station

AQUACULTURE DEPARTMENT (AQD)

5021 Tigbauan, Iloilo
Philippines
PO Box 256, 5000 Iloilo City
Philippines
Tel: (63 33) 335 1009; 336 2891;
336 2937 336 2965
Cable: seafdec iloilo
Fax: (63 33) 335 1008; 336 2891
E-Mail: aqdchief@aqd.seafdec.org.ph
<http://www.seafdec.org.ph>

TRAINING DEPARTMENT (TD)

PO Box 97
Phrasamutchedi
Samut Prakan 10290
Thailand
Tel: (66 2) 425 8040 to 5
Fax: (66 2) 425 8561
E-Mail: td@seafdec.org
<http://www.seafdec.org>

MARINE FISHERIES RESEARCH DEPARTMENT (MFRD)

2 Perahu Road off Limchukang Road
Singapore 718915
Tel: (65) 790 7973
Fax: (65) 790 7963, 861 3196
E-Mail: mfrdlibr@pacific.net.sg
<http://www.asean.fishnet.gov.sg/mfrd.html>

MARINE FISHERY RESOURCES DEVELOPMENT AND MANAGEMENT DEPARTMENT (MFRDMD)

Fisheries Garden, Chendering
21080 Kuala Terengganu
Malaysia
Tel: (609) 617 5135
Fax: (609) 617 5136
E-Mail: seafdec@po.jaring.my
<http://www.agrolink.moa.my/dof/seafdec.html>

SEAFDEC SECRETARIAT

Suraswadi Building
Department of Fisheries Compound
Kasetsart University Campus
Chatukchak, Bangkok 10900
Thailand
Tel: (66 2) 940 6326 to 940 6329
Fax: (66 2) 940 6336
E-Mail: secretariat@seafdec.org
<http://www.seafdec.org>