FISH HEALTH MASTER CLASS

12-23 NOVEMBER 2007

BANGKOK

FINAL REPORT

Fish Health Master Class, Bangkok, 12-23 November 2007
Final Report

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Executive Summary

This Fish Health Master Class was funded by the ATSE Crawford Fund and the Australian Centre for International Agricultural Research, with additional sponsorship from Intervet Singapore.

The Master Class organising committee comprised Alan Lymbery, Phillip Nicholls, and Susan Kueh from Murdoch University, Brian Jones from the Department of Fisheries, Western Australia, Mohan Chadag from the Network of Aquaculture Centres in Asia Pacific (NACA) and Supranee Chinabut from the Department of Fisheries, Thailand. Paul Ferrar, Barney Smith, Richard Callinan, Teruo Miyazaki, Barbara Nowak and Peter Walker also gave invaluable advice in developing the course.

After much discussion during the planning stages, it was decided that the Master Class should focus on the histopathology of finfish. Participants were selected based on active involvement in a fish health laboratory or teaching, with a reasonable command of English. The Master Class was limited to 20 participants (although only 19 actually attended), as there was a requirement for each participant to have access to a light microscope and as much one-to-one contact with resource experts during practical sessions as possible. Kasetsart University campus, Bangkok, was selected as a venue, due to the strong support in fish health by NACA and the Aquatic Animal Health Research Institute (AAHRI). This proved critical to the networking to find suitable candidates from Asia, and the smooth running of the class, in particular the practical components.

Candidates were trained to read and interpret slides, have a good grasp of normal fish histology, the tissue pathological process, recognise artefacts and polish their disease investigative skills using their own case studies. Practical classes complemented lectures each day, which allowed continual assessment of the participants' level of understanding and reiteration of important points through recap sessions. There was also an official feedback session before the presentation of certificates, undertaken by John Edwards, Dean, School of Veterinary and Biomedical Sciences, Murdoch University and Supranee Chinabut, Department of Fisheries, Thailand.

The Master Class received very positive feedback from participants. Planned activities to reinforce and further develop the skills and contacts acquired during the Master Class include the establishment of a fish health internet group and specialised courses in other countries in the region.

Introduction

With increasing pressure on wild fisheries stocks throughout the world and a concomitant increase in aquaculture investment and production, there is a growing recognition of the importance of disease recognition, treatment and management in aquatic organisms. This recognition has highlighted a shortage of skills in aquatic animal health. The Fish Health Master Class was conceived as a direct response to this skill shortage in the South East Asian region.

After much initial discussion among the organisers of the Master Class, it was decided that the class should focus on the histopathology of finfish diseases. A detailed understanding of normal tissue histology and the pathological response to infectious and non-infectious diseases is an essential prerequisite to correct diagnosis, treatment and disease management. To this end, the Master Class focused on the theoretical and practical aspects of tissue sampling and preparation, histological processing and slide reading. The Class covered an understanding of normal tissue structure, the recognition of pathological responses to disease, and the major viral, bacterial, fungal, parasitic and non-infectious diseases of finfish in the South East Asian region.

Funding

The ATSE Crawford Fund and the Australian Centre for International Agricultural Research (ACIAR) provided funding for the Master Class. Murdoch University, Department of Fisheries Western Australia, Network of Aquaculture Centres in Asia Pacific (NACA), Aquatic Animal Health Research Institute (AAHRI), Department of Fisheries Thailand, University of Tasmania and Mie University contributed members of their staff to organise and run the course. Intervet Singapore also contributed towards the field trip to a hatchery and fish farm, and allowed a staff member to participate in the course, as well as give a presentation on Intervet's research and vaccine development.

Funds were transferred directly to either NACA or Murdoch University for disbursement. NACA dealt with disbursement of expenses incurred in Thailand such as hire of additional light microscopes, participants' travel expenses and their daily allowances, and accommodations/meals for participants and presenters. Travel expenses for Australian presenters were processed either through Murdoch University or directly with the Crawford Fund. Other expenses incurred at Murdoch included labour costs for additional staff during the Master Class, labour and material costs for slide preparation and digitisation, making of DVDs and printing of course brochures.

Administrative Organisation

The organising committee comprised Alan Lymbery, Phillip Nicholls, and Susan Kueh from Murdoch University, Brian Jones from the Department of Fisheries Western Australia, Mohan Chadag from NACA and Supranee Chinabut from AAHRI. The committee was established in late 2006. The organising committee received considerable guidance from Paul Ferrar, Crawford Fund, and Barney Smith, ACIAR, during all planning stages. Mrs Wella, NACA, dealt very efficiently with the many administrative details involved in running the Master Class in Bangkok.

Communications among the organising committee were mainly via emails. NACA, in consultation with the committee, arranged the invitation and selection of candidates and other logistics involved such as meals, accommodations and allowances. The course program and schedule was finalised by mid 2007. Murdoch University also coordinated the digitisation of selected histology glass slides from presenters, making of DVDs with selected histology images for participants and the course brochure. NACA and AAHRI took care of all logistics involved in the preparation of venues for lectures and practical sessions. Each participant had access to a light microscope for the slide reading sessions and a number of compatible PCs were also made available to view the DVDs.

All participants and teaching staff stayed at Kasetsart University (KU) Home, complete with buffet breakfast. Lectures were held at the NACA conference hall in Week 1 and at AAHRI in Week 2. All practical sessions were held at AAHRI facilities. KU Home was approximately 10 minutes walking distance to NACA or AAHRI. NACA and AAHRI were less than 5 minutes walking distance apart. Lunches were catered for at either NACA or AAHRI. Food courts, restaurants and a supermarket were less than 10 minutes walk from KU Home. Little time was thus wasted in moving from venue to venue, and the arrangements were very convenient.

Master Class Program

Full details of all lectures, practical classes and presenters are shown in the course schedule in **Annex 1**. Each day consisted of a morning of lectures and an afternoon of practical work. Impromptu breaks were held when lectures were 'too heavy' with information. Extra recap sessions were also held when required, as indicated by feedback and questions received during the practical sessions.

Practical sessions (Figure 1), corresponding with lecture materials, were invaluable in giving presenters a gauge of how much participants understood and pointing out any areas which needed reiteration. Practical sessions also allowed one to one interaction and slide reading, and were greatly appreciated by all participants (Figure 1)

Figure 1: Slide reading in practical classes

Participants

Invitations to attend the Master Class were sent to fisheries and aquaculture organisations in 13 countries in the region. Participants were selected based on active involvement in a fish health laboratory or teaching, with a reasonable command of English. Participants came from 12 countries, with the Malaysian candidate being unable to attend. The course was limited to 19 participants (originally 20, including the candidate from Malaysia; Figure 2). This limit was applied because it was recognised that each participant needed to have access to a light microscope and as much one to one time with resource experts during practical sessions as possible. The contact details of all participants are shown in **Annex 2**.

There was a good gender balance, with an approximately equal number of male and female participants. The participants were generally interactive with presenters as well as other participants, and frequently asked questions.

Figure 2: Participants and presenters at the Fish Health Master Class, Bangkok, 2007

Resource Experts

There was a good balance of experts from Australia and Asia, to ensure that the participants were provided with a well rounded presentation of the fish health problems experienced in the region. The CVs and contact details of experts as included in course brochure are attached as **Annex 3**.

Resource Materials

The course materials were either sent in advance to NACA for printing or printed before lectures for distribution. Brian Jones handed out brochures on fish disease investigations from the Department of Fisheries Western Australia. Barbara Nowak provided copies of CDs on fish histopathology from the European Association of Fish Pathologists. Participants also received three DVDs with digitised images of histology

glass slides grouped into normal histology, bacterial, viral, parasitic, fungal, and non-infectious diseases. CD copies of presentations by Teruo Miyazaki, Supranee Chinabut and Susan Kueh were distributed, as they contained coloured images which gave better resolution than printed copies. Relevant literature and websites were also provided to participants.

Field Trip

A one day field trip was organised on day 7. Participants were taken to nearby aquaculture farms, to see the implementation of simple and practical farm level health management plans (Figure 3). The first farm visited was a commercial tilapia hatchery, Chareon Farm, where participants were shown how eggs were hatched and fry were sex-reversed to create an all-male population. After lunch at a local restaurant, the participants were taken to a seabass and shrimp growout facility (Kovit Farm), where the farm manager gave a tour and a talk on farm management. The field trip was sponsored by Intervet Singapore.

Figure 3: Field trip visits to Chareon farm (A, B), Kovit farm (C, D) and a local restaurant for lunch (E)

Certificate Presentation

The Class closed with speeches by both John Edwards (Dean, School of Veterinary and Biomedical Sciences, Murdoch University), and Supranee Chinabut (Senior Advisor on Fish Diseases, Department of Fisheries, Thailand), and certificate presentation. The certificates were developed at Murdoch University, with final editorial corrections at NACA.

Feedback from Participants

Feedback was sought from participants by circulating a questionnaire for return by the end of the Class. A formal feedback session was also included in the program before the close of the class. This proved a very valuable exercise for future planning. A summary and analysis of the answers is given in **Annex 4**.

Future Activities

The organising committee recognised the importance of ongoing communication and follow-up activities with participants to ensure that knowledge and skills were retained after the Master Class was completed. To this end, we have developed an internet communication group, which enables all participants and presenters to share new information and exchange ideas on new fish disease cases. This group has been very active in the three months since the Master Class was completed. We have also begun to develop ideas for future classes in targeted countries (initially India and Indonesia), which will enable us to extend the Master Class learning activities to a wider audience.

Annex 1

Course Schedule

Day 1 (Monday 12 November)

Topic 1: Introduction to Fish Health

This covered both field and laboratory investigations of disease, in particular post mortem examinations of fish. Basic information on the aquatic environment and aquatic organisms, needed for sound disease investigations, were presented. A science-based approach towards sampling for disease investigation was reviewed. Histological processing and techniques, as well as a brief overview of other laboratory techniques commonly used in investigating aquatic animal diseases (routine bacteriological, virological, parasitological and molecular tests) were also covered.

Time	**Topic**	**Presenters**
0900-0930	Opening Address	Supranee Chinabut, Mohan
0930-1000	Overview of course and objectives	Brian Jones
1000-1030	**Morning Tea**	
1030-1130	1.1 Fish disease investigations – field and laboratory sampling; post mortem examinations	Susan Kueh
1130-1230	1.2 Laboratory techniques used in investigating aquatic diseases	Brian Jones
1230-1400	**Lunch**	
1400-1430	Fish disease investigations – *recap*	Susan Kueh
1430-1700	Practical – Post mortem examinations starting with live fish specimens, with emphasis on sampling for histology, wet mounts and smears, quick staining techniques, proper use of a light microscope	Brian Jones, Susan Kueh

Day 2 (Tuesday 13 November)

Topic 2: Normal Histology

The normal histology of major organs, such as skin, gills, gastrointestinal tract, cardiovascular system, muscular skeletal system, spleen, kidney, liver, brain and eye were covered. Familiarisation with normal organ tissue structure and cell morphology is critical towards making interpretations of abnormal tissue or cell pathology.

Time	Topic	Presenters
0900-1000	2.1 Normal histology I – skin, gills, intestines, swimbladder, pseudobranch	Susan Kueh
1000-1030	**Morning Tea**	
1030-1130	2.2 Normal histology II - spleen, kidney, thymus, thyroid, liver/pancreas	Brian Jones
1130-1300	**Lunch**	
1300-1400	Demonstration on how to use digitized images for teaching/learning	Susan Kueh
1400-1500	Normal histology I and II – *recap*	Brian Jones, Susan Kueh
1500-1700	Practical slide reading – normal histology	Brian Jones, Susan Kueh, Mohan

Day 3 (Wednesday 14 November)

Topic 2: Normal Histology

Time	Topic	Presenters
0900-1000	2.3 Normal histology III –heart, blood vessels, skeletal muscles, bones, mouth/teeth, olfactory organs in skull	Susan Kueh
1000-1030	**Morning tea**	
1030-1130	2.4 Normal histology IV - brain/spinal cord, eye, gonads	Brian Jones
1130-1300	**Lunch**	
1300-1400	Normal histology III and IV – *recap*	Brian Jones/Susan Keuh
1400-1700	Practical slide reading – normal histology	Brian Jones, Susan Kueh, Mohan

Day 4 (Thursday 15 November)

Topic 2: Normal Histology (class split into two groups)

Group 1

Time	Topic	Presenters
0900-1000	Normal Histology – *recap*	Susan Kueh
1000-1030	**Morning tea**	
1030-1230	Practical slide reading – normal histology	Susan Kueh, Supranee Chinabut
1230-1400	**Lunch**	
1400-1700	Histology processing - theory and practical. Trimming of fixed tissues into cassettes, wax blocking processed tissues, microtoming and histology slide preparation, including staining	Brian Jones

Group 2

Time	Topic	Presenters
0900-1000	Histology processing - theory and practical. Trimming of fixed tissues into cassettes, wax blocking processed tissues, microtoming and histology slide preparation, including staining	Brian Jones
1000-1030	**Morning tea**	
1030-1230	Histology processing - (continued)	Brian Jones
1230-1400	**Lunch**	
1400-1500	Normal Histology – *recap*	Susan Kueh
1500-1700	Practical slide reading – normal histology	Susan Kueh, Supranee Chinabut

Day 5 (Friday 16 November)

Topic 3: Pathological Responses

The four K's essential for scientific health management are: knowledge about the disease process; knowledge about the pathogen; knowledge about the host and knowledge about the environment. Understanding the pathogenicity mechanisms of the pathogens, disease resistance mechanisms of the host and the role of the environment are essential to appreciate the process of disease development. A pathogen can cause a clinical disease only when it can establish on or in the host, proliferate, overcome the non-specific and/or specific defense barriers of the host, produce the pathogenic factors, cause cellular and tissue damage, produce significant pathological changes, impair the function of the target tissue and cause mortality. Stress and environmental factors can accelerate this process.

Pathology tells us what is happening at the tissue level. Pathology is the outcome of three basic processes:

- cellular responses to pathogen induced injury (e.g. increased cellular activity, decreased cellular activity)
- inflammatory response exhibited by the host (e.g. acute inflammation and chronic inflammation)
- pathogenicity mechanisms of the pathogen

While using pathology for diagnostic purpose or understanding disease process, it is very important to appreciate what is true pathology and what is not (e.g. physiological changes, post-mortem changes, artifacts).

Time	**Topic**	**Presenters**
0900-1000	3.1 Pathological response of fish to disease I	Mohan
1000-1030	**Morning tea**	
1030-1130	3.2 Pathological response of fish to disease II	Mohan
1130-1300	**Lunch**	
1300-1400	Pathological response – *recap*	Mohan
1400-1700	Practical slide reading	Mohan, Brian Jones, Susan Kueh

Day 6 (Saturday 17 November)

Topic 4: Bacterial Diseases of Finfish

The pathology of major bacterial diseases of finfish and their associated clinical signs were covered. The primary focus was the use of histology as a diagnostic tool in bacterial disease. Confirmatory tests, where available, were mentioned.
Useful references:
Gibson-Kueh S., Crumlish M. and Ferguson H.W. (2004) A novel 'skinny pot-belly' disease in Asian seabass fry, *Lates calcarifer* Bloch. *Journal of Fish Diseases* **27**: 731-735.

Time	Topic	Presenters
0900-1000	4.1 Bacterial diseases of finfish I	Brian Jones
1000-1030	**Morning tea**	
1030-1130	4.2 Bacterial diseases of finfish II	Brian Jones
1130-1300	**Lunch**	
1300-1400	Bacterial diseases of finfish – *recap*	Brian Jones
1400-1700	Practical slide reading	Brian Jones, Susan Kueh

Day 7 (Sunday 18 November)

Field Trip **Sponsored by Intervet Singapore**

One day field trip to nearby aquaculture facilities was organized. This included visits to hatcheries and farms. Participants had an opportunity to see the implementation of simple and practical farm level health management plans.

Day 8 (Monday 19 November)

Topic 5: Fungal Diseases of Finfish

Major fungal diseases of finfish were covered, with a concentration on epizootic ulcerative syndrome (EUS). EUS is a very serious pandemic disease of freshwater and estuarine warm water fish in many countries in Asia, Australia, North America and Africa. It is synonymous with mycotic granuloma (MG), red spot disease (RSD) or ulcerative mycosis (UM). The principal causative agent of EUS is an oomycete fungus - *Aphanomyces invadans* (*A. piscicida*), which is a slow growing species. The gross appearance of EUS is an open dermal ulcer, which is similar to many other diseases. Confirmatory diagnosis requires histological demonstration of typical granulomas and invasive hyphae using haematoxylin and eosin or other general fungus stains. Typical histopathological changes observed in EUS are the extensive inflammation/hyperaemia associated with fungal hyphae and characteristic 'walling-off' by macrophages or granuloma formation. Severe necrotizing myofibrillar degeneration accompanies the response to the invading fungus.

Time	**Topic**	**Presenters**
0900-1000	5.1 Fungal diseases of finfish I	Teruo Miyazaki
1000-1030	**Morning Tea**	
1030-1130	5.2 Fungal diseases of finfish II	Teruo Miyazaki
1130-1230	5.3 Fungal diseases of finfish III - EUS	Supranee Chinabut, Teruo Miyazaki
1230-1400	**Lunch**	
1400-1500	Fungal diseases of finfish - *recap*	Supranee Chinabut, Teruo Miyazaki
1400-1700	Practical slide reading	Teruo Miyazaki, Supranee Chinabut, Barbara Nowak, Susan Kueh

Day 9 (Tuesday 20 November)

Topic 6: Viral Diseases of Finfish

This topic covered general virology, histopathology and electron microscopy of virus-infected fishes. The viral diseases examined included: infectious hematopoietic necrosis of salmonid fish; hirame rhabdovirus diseases of the Japanese flounder; viral nervous necrosis of seven band grouper; viremia associated ana-aki byo (corona-like virus) in koi; koi sleepy disease (pox-like virus); koi herpesvirus disease; herpesviral hematopoietic necrosis (CyHV-2) of goldfish; *Oncorhynchus maso* virus disease (SalHV-2) of yamabe; herpesviral dermatitis of the Japanese eel; megalocytivirus disease (include grouper sleepy disease); and lymphocystis disease of the Japanese flounder.

In addition, the predilection of iridoviruses for cells of mesothelial origin or fibroblastic cells at the light microscopic and electron microscopic level was presented. This knowledge helps in the detection and interpretation of the pathology associated with systemic iridovirus infections in fish.
Useful references include:
Gibson-Kueh S., Netto P., Ngoh G.H., Chang S.F., Ho L.L., Qin Q.W., Chua F.H.C., Ng M.L. and Ferguson H.W. (2003) The pathology of systemic iridoviral disease in fish. *Journal of Comparative Pathology* **129**: 111-119.

Time	Topic	Presenters
0900-1000	6.1 Viral diseases of finfish I	Teruo Miyazaki
1000-1030	**Morning Tea**	
1030-1130	6.2 Viral diseases of finfish II	Teruo Miyazaki
1130-1200	6.3 Viral diseases of finfish III - Mesotheliotropic nature of systemic iridoviruses of finfish	Susan Kueh
1200-1400	**Lunch**	
1400-1500	Viral diseases of finfish - *recap*	Teruo Miyazaki
1500-1700	Practical – Slide reading	Teruo Miyazaki, Supranee Chinabut, Barbara Nowak, Susan Kueh

Day 10 (Wednesday 21 November)

Topic 7: Parasitic Diseases of Finfish

Parasitic diseases such as sea lice, skin flukes and amoebic gill disease can cause significant losses in aquaculture. Their recognition in histological sections, host response (pathology), effects on industry and brief life cycles of major groups of parasites significant in aquaculture, fisheries and ornamental fish was discussed. Although the proper identification of parasites to species level requires expert knowledge, special preparation and fixation of specimens, histology can be useful, as in the diagnosis of amoebic gill disease. Useful references include:

Bruno, D.W., Nowak, B. and Elliott, D.G. (2006). Guide to identification of fish protozoan and metazoan parasites in stained tissue sections. *Diseases of Aquatic Organisms* **70**: 1-36.

Mansell, B., Powell, M.D., Ernst, I. and Nowak, B.F. (2005) Effects of gill fluke *Zeuxapta seriolae* and treatment with hydrogen peroxide on pathophysiology of kingfish *Seriola lalandi. Journal of Fish Diseases* **28**: 253-262.

Nowak, B.F., Dawson, D., Basson, L., Deveney, M. and Powell M.D. (2004) Gill histopathology of wild marine fish in Tasmania – potential interactions with gill health of cultured Atlantic salmon, *Salmo salar* L. *Journal of Fish Diseases*, **27**: 709-717.

Adams, M.B. and Nowak, B.F. (2004) Sequential pathology after initial freshwater bath treatment in cultured Atlantic salmon *Salmo salar* L. *Journal of Fish Diseases* **27**:163-173.

Adams, M. and Nowak, B.F. (2001) Distribution and structure of lesions in the gills of Atlantic salmon (*Salmo salar* L.) affected with amoebic gill disease. *Journal of Fish Diseases* **24**:535-542.

Time	Topic	Presenters
0900-1000	7.1 Parasitic diseases of finfish I	Barbara Nowak
1000-1030	**Morning Tea**	
1030-1130	7.2 Parasitic diseases of finfish II	Barbara Nowak
1130-1230	7.3 Gill pathobiology and histology, and overview of histology as a diagnostic tool	Barbara Nowak
1230-1400	**Lunch**	
1400-1500	Parasitic diseases of finfish - *recap*	Barbara Nowak
1500-1700	Practical slide reading and case studies	Barbara Nowak, Supranee Chinabut, Susan Kueh

Day 11 (Thursday 22 November)

Topic 8: Non-Infectious Diseases of Finfish

Diseases in farmed fish may be non-infectious and caused by environmental, nutritional or genetic factors. Such diseases can often be controlled by improving husbandry techniques. Diagnosis of these diseases requires good understanding and knowledge of case history, including environmental conditions and nutrition. Additional chemical analyses of fish tissues or environmental samples may be useful. Histopathology of a range of non-infectious diseases, including gas bubble disease, effects of exposure to toxicants, sun damage and some tumours were reviewed. Examples of conditions of uncertain aetiology were included. Useful references include:

Clark, A., Nowak, B., Handlinger, J., Munday, B.L. and Percival, S. (1997) Clubbing and necrosis gill (CNG) syndrome in sea-caged Atlantic salmon *Salmo salar* L in Tasmania: an initial report. *Journal of Fish Diseases* **20**:59-68.

Heidel, J.R., Nowak, B.F., Fischer, K.A., Watral, V.G. and Kent, M.L. (2002) Visceral nodular cartilagenous metaplasia in rockfishes (*Sebastes* spp.) in the eastern North Pacific Ocean. *Journal of Veterinary Diagnostic Investigation* **14**: 495-497.

Time	**Topic**	**Presenters**
0900-1000	8.1 Non infectious diseases of finfish I	Barbara Nowak
1000-1030	**Morning tea**	
1030-1130	8.2 Non infectious diseases of finfish II	Barbara Nowak
1130-1300	**Lunch**	
1300-1400	Non-infectious diseases of finfish – *recap*	Barbara Nowak
1400-1700	Practical slide reading and case studies	Barbara Nowak, Susan Kueh

Day 12 (Friday 23 November)

Topic 9: Case Studies

Time	Topic	Presenters
0900-1000	9.1 Diseases of finfish case studies with slide reading I	Barbara Nowak, Susan Kueh
1000-1030	**Morning tea**	
1030-1230	9.2 Diseases of finfish case studies with slide reading II	Barbara Nowak, Susan Kueh
1230-1400	**Lunch**	
1400-1500	Feedback session	Susan Kueh, Barbara Nowak
1500-1630	Closing address and presentation of certificates	John Edwards, Supranee Chinabut

Annex 2

List of Participants

Country	Address
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Annex 3

Presenters

Dr Supranee Chinabut

Dr Supranee Chinabut received her BSc from the Fisheries Faculty, Kasetsart University, M.Sc. on fisheries parasitology from Auburn University and Ph.D. on fish pathology from Stirling University in 1989. She has over 30 years of experience in research, disease diagnosis and teaching at both national and international levels, in aquatic animal health. Supranee has authored or co-authored more than 100 technical publications and 50 general fisheries articles between 1970 and 2005. She was the Chairperson of Fish Health Section/Asian Fisheries Society from 2001-2003. She is at present a Senior Advisor on Fish Diseases for the Department of Fisheries, Thailand and Chairperson of the Advisory Group for NACA.

Contact details: Department of Fisheries, Thailand
Email: supraneecb@yahoo.com

Dr Brian Jones

Dr Brian Jones obtained a PhD in Zoology from Victoria University, Wellington, New Zealand in 1975. He worked from 1975 - 1995 as a fish pathologist, Ministry of Agriculture and Fisheries in New Zealand. His current appointment is as Principal Fish Pathologist and Supervising Scientist of the Aquaculture group, Department of Fisheries, Western Australia; and Adjunct Professor at Murdoch University School of Veterinary and Biomedical Sciences. He is also an appointed member of Executive Committee, Fish Health Section, Asian Fisheries Society (2005-8); Scientific Advisory Committee, Fisheries Research and Development Committee (FRDC) Fish Health Subprogram; Risk Assessment Panel for Biosecurity Australia on marine bivalves and freshwater crayfish, and various national fish/shellfish health committees and working groups. Brian's main research interests are diseases and parasites of fish, crustaceans and mollusks (particularly pearl oysters); taxonomy of parasitic Copepoda, and Import Risk Assessment methodology. Brian has authored or co-authored over 100 scientific papers and technical reports and has broad international experience with both freshwater and marine fisheries and aquaculture, covering such diverse areas as aquaculture, pelagic fish stock assessment, satellite remote sensing and the environmental impacts of fishing. His primary interest has always been fish pathology.

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Susan Gibson-Kueh

Susan Gibson-Kueh graduated with a B.V.Sc (Sydney) in 1990, obtained her M.Sc (Aquatic Veterinary Studies, University of Stirling, UK) in 2001 and is currently pursuing her PhD on 'Diseases of Asian seabass & barramundi'. She worked as a small animal clinician in Singapore from 1991-95 and was Head/Aquatic Animal Health Branch, AgriFood & Veterinary Authority of Singapore as well as focal disease reporting person for aquatic animal diseases to NACA/OIE for Singapore from 1997-2007. She currently also teaches part-time at the School of Veterinary and Biomedical Sciences, Murdoch University. Her experience is mainly in the control, management and diagnosis of disease, developing disease surveillance programmes, management of laboratory diagnostic services and conducting training for industry in aquatic animal health.

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Professor Teruo Miyazaki

Teruo Miyazaki is a Professor in the Graduate School of Bioresources, Mie University, a position he has held since 1994. From 1973 to 1975 he was Assistant Professor at the Faculty of Fisheries, Mie Prefectural University, from 1975 to 1984 Assistant Professor at the Faculty of Fisheries, Mie University, from 1984 to 1987 Associate Professor in the Faculty of Fisheries, Mie University, and from 1987 to 1994 Associate Professor in the Faculty of Bioresources, Mie University. He was born in 1949. He gained a Bachelor of Fisheries (1971) in Mie Prefectural University, a Master of Agriculture (1973) in the University of Tokyo, and a Ph. D. (1979) also in the University of Tokyo.

His research is focused on histopathological features of major bacterial, fungal, parasitic, nutritional and viral diseases of cultured marine and freshwater fishes. His work has also involved demonstrating the ultrastructural features of major viral diseases by TEM. He has published over 100 papers in international journals and two books entitled " Color Atlas of Fish Histopathology; Volumes 1 & 2". He is also involved in supervision of many Japanese and foreign students for doctorate and master degrees.

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Dr CV Mohan

Dr Mohan has a BFSc, MFSc (Mangalore) and PhD in aquatic animal pathology from the Institute of Aquaculture, University of Stirling, UK in 1990. He was Professor of Fish Pathology at the College of Fisheries, Mangalore, India where he was teaching from 1982 until March 2003. In his current position with the Network of Aquaculture Centres in Asia-Pacific (NACA) as the Regional Aquatic Animal Health Specialist, he coordinates regional aquatic animal health programmes in 21 countries in the Asia-Pacific region. NACA's regional programs serve to "Reduce risks of aquatic animal disease impacting on livelihoods of aquaculture farmers, national economies, trade and human health" in partnership with governments, industry, NGO's, donors, development agencies, regional advisory groups and training programs. His expertise includes fish and shrimp pathology, epidemiology, surveillance and risk management. He has authored or co-authored over 60 papers in peer reviewed international journals and participated in over 30 international scientific meetings, workshops and conferences as an invited expert/resource person.

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Dr Barbara F. Nowak

Dr Barbara Nowak has an MSc, PhD and DSc in aquatic animal health. She is an Associate Professor at the School of Aquaculture, University of Tasmania where she has been teaching since 1991. Her main research areas in aquatic animal health include parasitic diseases in aquaculture, host-pathogen interactions, aquatic toxicology and histopathology. She has done extensive research on amoebic gill disease in cultured Atlantic salmon. She has authored or co-authored over 128 scientific papers in international peer reviewed journals. She is the Aquafin CRC Health Program Leader.

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Annex 4

Feedback Summary

Immediate post-course participants' survey
This part of the survey assessed the course delivery and the knowledge acquired during the Crawford Fund Course

A Quality of the Course:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Relevant
(1) **The content of the training course was directly related to my field of work at time of completion**	√ (13)	√ (7)				
(2) **I was provided with adequate supporting material**	√ (14)	√ (5)	√ (1)			
(3) **The trainers/ mentors were knowledgeable and provided lectures/information of a good quality**	√ (15)	√ (5)				
(4) **The content was easy to understand**	√ (4)	√ (12)	√ (3)	√ (1)		
(5) **The level of English used was too difficult** (No response x1)		√ (3)	√ (5)	√ (6)	√ (5)	
(6) **There was sufficient time allowed for the training event to get a good understanding of the content** (No response x1)	√ (4)	√ (10)	√ (4)	√ (1)		
(7) **The training course had too much theory**		√ (1)	√ (8)	√ (7)	√ (4)	
(8) **The course was well balanced between theory and practice**	√ (5)	√ (11)	√ (4)			

(9) **Other: Please specify**

(1) Feels need for more time to practise because in some cases difficult to understand. A project to follow up would be good.

(2) Well organised course, though some overlap between lectures. Good opportunity to network. Feels need for follow-up program with more case studies & time for discussion & information exchange between countries. Website to facilitate case studies would be useful.

(3) Suggests use of multi-headed light microscopes to show tissue lesions to participants. DVDs with digitised images done by Murdoch good tool for identification of histological differences.

(4) If microbiological & molecular methods were included in course, it would become a complete course on disease diagnosis.

(5) Training will enhance my capability on fish disease diagnosis at the Central Fisheries Lab.

(6) Case studies can be discussed with resource experts before they are presented in class.

(7) Would like a longer course to have more time to read slides. Suggest a regular course to be run.

B Knowledge Gained:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Relevant
(1) **The training increased my knowledge of international trends/activities**	√ (9)	√ (8)	√ (1)			
(2) **I increased my capacity to conduct research**	√ (5)	√ (12)	√ (1)			
(3) **I better understand issues and principles in my field**	√ (9)	√ (7)	√ (2)			
(4) **I acquired new technical skills**	√ (3)	√ (13)	√ (2)			
(5) **I acquired new ways to approach work problems**	√ (2)	√ (10)	√ (4)			
(6) **I learned techniques for managing and organising people and projects**	√ (2)	√ (8)	√ (5)	√ (1)		√ (3)
(7) **I learned new or improved ways to communicate with networks within my field of expertise (eg farmers, donors, research organisations, government) (2 ticks x1)**	√ (4)	√ (9)	√ (2)			√ (2)

(8) **Other: Please specify**
(1) Knowledge obtained can be applied in own country
(2) Strongly support a follow-up course to same participants next year, to verify application of master class training, compare notes on problems encountered in application of histopathology and further develop this skill
(3) Knowledge obtained invaluable both for disease diagnosis & research. Networking with other participants & experts. Hope Crawford fund will support follow-up on participants to improve upon their knowledge
(4) Networking should be established between participants and resource persons in updating developments in fish health management.
(5) Class glass slide sets provided were very helpful in learning slide interpretation. Murdoch DVDs with digitised histology glass slides will be a great help to take back to work. Food & logistics were adequate. Training program was enjoyable!
(6) Activities and networking should continue between participants
(7) The resource experts are great and accommodating. Networking with them and with participants would be a good way to resolve difficult cases in the future.
(8) 2 weeks is only enough time to understand basic histology. Hope for follow up classes, to expand knowledge and communicate.

Other feedback that came up during the feedback sessions or pointers noted by resource persons:

1. Language appeared to be a major hindrance to a couple of participants.

2. Participants found the DVDs with digitised glass slide images to take back very useful, especially to share with their colleagues. They would welcome a follow up distance learning program employing glass slides and digitised images.

3. A website to facilitate learning and exchange of information on disease diagnosis would be helpful.

4. Participants hoped for continued networking and communication among the group to build skills. They hope that there will continued reinforcement of their skills in fish histopathology by funded programs such as this one.

5. Some felt that three weeks instead of two would be better.

6. Participants would have liked more normal tissues of different fish species in the class histology glass slide sets.

7. Overall, participants were happy with course content, resource experts and resource materials available.