

# Trans-boundary aquatic animal diseases: Focus on Koi herpes virus (KHV)

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Chris Baldock of Ausvet (Australia) defined 'trans-boundary animal diseases' (TADs) as epidemic diseases which are highly contagious or transmissible, with the potential for very rapid spread irrespective of national borders and cause serious socio-economic and possibly public health consequences<sup>1</sup>. Some of the most serious problems currently faced by the sector are those pathogens and diseases spread and introduced through movements of hatchery produced stocks, new species for aquaculture and development and enhancement of the ornamental fish trade. Aquaculture is faced with what is known as trans-boundary aquatic animal pathogens/diseases (TAAPs/TAADs), similar to the TADs in the livestock sector. Minimizing the risks of introduction and spread of TAAPs/TAADs through responsible movement of live aquatic animals has been the main subject of technical support and regional/international cooperation when the regional aquatic animal health management program of FAO/NACA<sup>2-4</sup> started since 1999. The program received enhanced support from a number of regional/international organizations such as the Australian Centre for International Agricultural Research (ACIAR), the Asia-Pacific Economic Cooperation (APEC)<sup>5,6</sup>, the Association of Southeast Asian Nations (ASEAN), the Officer International des Epizooties (OIE) and the Southeast Asian Fisheries Development Center (SEAFDEC)<sup>7</sup>.

The OIE<sup>8</sup> lists some 30 pathogens/diseases of finfish, molluscs and crustaceans as either 'Notifiable' or 'Significant' fitting the criteria of being of socio-economic and/or public health importance and significant in the



*Melba Reantaso presenting KHV information during the National Strategy Development Workshop, June 2002. On right is Ahmed Rukyani.*



*Attentive participants during the National Strategy Development Workshop, Bogor, Indonesia, June 2002.*

international trade of aquatic animals and aquatic animal products. These diseases are known and affect the most commonly traded species such as salmonids, catfish, oyster and shrimps. The Asia-Pacific Quarterly Aquatic Animal Disease Reporting System (QAAD), established in late 1998 by FAO/NACA/OIE-Tokyo, covers the OIE listed diseases and an additional six diseases deemed important to the Asia-Pacific region<sup>9,10</sup>. In addition to the OIE-listed and the NACA/FAO listed diseases, there are many more diseases of regional and national interests which have impacted Asian aquaculture<sup>11</sup> and some are newly emerging in the region.

In early January 2002, during NACA's 12<sup>th</sup> Governing Council Meeting (GCM-12, Langkawi, Malaysia), a Hungarian colleague, Andreas Peteri, asked whether I was aware of some Koi Herpes Virus (KHV) report in Asia. I wasn't fully cognizant of this disease at that time! During the World Aquaculture Society (WAS) meeting in Beijing in April, I chanced upon Dr. Ra'anani Ariav, one of my fish disease teachers who spoke about Koi

herpes virus (KHV) experience in Israel. He predicted that it will only be a matter of time when the disease will spread to the Asian region.

In June 2002, while arranging for a mission to assist in the development of Indonesia's National Strategy on Aquatic Animal Health<sup>12</sup>, Dr. Rukyani of Indonesia's Ministry of Marine Affairs and Fisheries (MMAF) consulted regarding an on-going disease outbreak affecting common and koi carps. Based on the clinical signs described, patterns of mortality and specificity to koi and common carp, I strongly suspected Koi Herpes Virus (KHV). During the National Strategy Development workshop, a small session regarding the current disease outbreak was held where Dr. Rukyani and I made presentations, my presentation was based on materials kindly provided by Dr. Ariav with additional information from the scientific literature. There was no doubt from both presentations that we were talking about a very similar disease. Most of the participants during the workshop were convinced

that that the on-going mass mortality in Indonesia was similar to KHV.

The pattern of mortality, rapid spread, specificity to koi and common carps and clinical signs were characteristics of the outbreaks of KHV reported in 1999 in mid-Atlantic and in 1998 and 1999 in Israel<sup>13,14</sup>. Clinical signs from the current Indonesian outbreaks were characterized by severe branchial hemorrhage and necrosis, and hemorrhages on the body surface. The affected populations, limited to koi and common carps, were also suffering from non-specific secondary infections of bacterial, parasitic and fungal origin. Internally, the kidney and liver

consistently showed abnormal conditions and extensive abdominal adhesions. The disease, reportedly first observed in April 2002 affecting East Java, had subsequently spread to West and Central Java where many koi and common carp farms were affected. Losses were estimated at US\$ 5.5 M (50 B Rupiah, 1 US\$ = 9,000 Indonesian Rupiah conversion rate at the time of the outbreak).

Immediate positive responses were received from the ACIAR, the Aquatic Animal Health Research Institute (AAHRI, Thailand), Intervet Norbio (Singapore), University of California, (UC Davis, California, USA), and the

Institute of Aquaculture of the University of Stirling (IA, Stirling University, Scotland). The Food and Agriculture Organization of the United Nations (FAO) and OIE (Tokyo) provided valuable advice to the organization and development of the terms of reference of the Task Force and also pledged support to follow-up actions.

The Local Task Force was headed by Dr. Rukyani with staff members from the Fish Health Research Laboratory, Central Research Institute for Aquaculture (Jakarta, Indonesia) and the Directorate of Fish Health and Environment, Directorate General of Aquaculture (Jakarta, Indonesia), both of the MMAF, and researchers/scientists from the Fish Disease Laboratory and Faculty of Veterinary Medicine, Bogor Agricultural University (Bogor, Indonesia).

Field visits were undertaken from 8-12 July and laboratory examination of collected samples followed shortly. The focus of the Task Force investigation was to assess the disease situation, determine the possible involvement of KHV<sup>13,14</sup>, and provide advice and recommendations to the Government of Indonesia on how to control the epizootic. The scope of the investigation included field observations (i.e. field visits, local/district officials and farmer interviews) and collection of samples for laboratory examinations (e.g. histopathology, virology, polymerase chain reaction (PCR) and electron microscopy (EM)).

The Task Force findings revealed that an infectious agent/s is involved in the outbreak (from previous and recent epidemiological observations of sudden onset, rapid spread, specificity to koi and common carp, analogy with KHV outbreaks), that the disease was introduced to Indonesia through fish importation and spread into other areas through fish movements. This national epizootic, which occurred in ponds, raceways, and floating cages in open waters has spread both north and southward directions creating significant concern for a real international epizootic which may affect several neighboring countries.

The clinical signs, consistent in all cases, include branchial hemorrhage, necrosis and focal dermal ulceration.



*Koi and common carps showing clinical signs of the disease, i.e. branchial haemorrhage and necrosis, focal dermal hemorrhages on body surface.*



Common carps exhibiting typical signs of branchial necrosis.



Koi carp showing typical signs of necrotic gills.

The level of morbidity and mortality reported by farmers ranged from 50 to 100%; water temperatures during the outbreak period ranged from 19-23°C. Water temperature has been suggested to be a principal environmental factor influencing the onset and severity of KHV infection<sup>15</sup>.

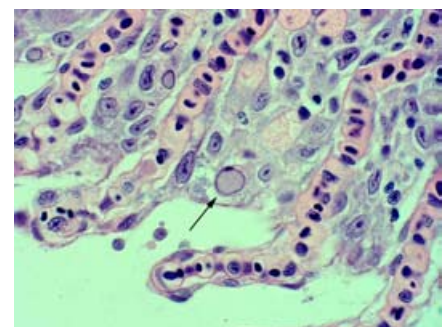
While the Task Force recognized the important role that KHV played in the outbreak (based on the detection of viral DNA through PCR<sup>16,17</sup> from all case samples), there was no confirmation whether the agent responsible was KHV (due to absence of typical KHV pathology, failed viral isolation and non-observance of

typical EM virions). Because this is a first time diagnoses of a disease problem of significant magnitude, it is essential that all available diagnostic techniques be used in order to confirm the involvement of KHV. A careful diagnosis is required and this is currently the subject of future follow-up work under an FAO project as a matter of priority. The Task Force findings recommended that this serious outbreak of koi and common carp be called '**Mass mortality of koi and common carp**' until a clear association with KHV or any other specific disease can be established.

This suspected KHV introduction to Indonesia presents a huge trade implication for the high value ornamental koi carp and the regionally important food fish common carp. KHV is a serious disease condition causing significant losses and has been reported from countries such as Israel<sup>13,14</sup>, the United Kingdom, Germany, Netherlands, Belgium, Denmark<sup>18,19</sup> and the United States<sup>13</sup>. It is now clear that unregulated trade in ornamental fish is responsible for the escalating global spread of the disease<sup>15</sup>.

Most recently, carp populations in two major lakes in Japan (Lake Kasumigaura and Lake Kitaura) were affected by this devastating disease with losses estimated at 150 M yen (approximately US\$ 1.4 M) (Pro-Med News, November 4, 2003). Japan's Ministry of Agriculture, Forestry and Fisheries is considering suspension of carp exports (<http://www.practicalfishkeeping.co.uk/pfk/pages/item.php?news=119>). Outbreaks, which have reached epizootic proportions during the past two months, have been reported by 22 prefectures since May 2003 (<http://www.practicalfishkeeping.co.uk/pfk/pages/item.php?news=139>).

Barry Hill (of the Centre for Environmental, Fisheries and Aquaculture Sciences (CEFAS) and OIE's Aquatic Animal Health Standards Commission), was correct when he said during his plenary talk at the Fifth Symposium on Diseases in Asian Aquaculture in Queensland, Australia in November 2002, that one of the possible reasons for the emergence of a new disease in a country is 'slow



KHV gill pathology. Hyperplasia and fusion of secondary gill lamellae; intranuclear inclusion (arrow) in the branchial epithelium (gill section stained with hematoxylin and eosin). Photo courtesy of Prof. R. Hedrick, UC Davis.



Farmers administer antibiotic treatment (tetracycline) with poor success.

awareness on emerging diseases by the exporting country', citing KHV as an example. This is an important lesson.

The Government of Indonesia was advised to temporarily restrict the movement of koi and common carps and a Ministerial Circular took effect in July 2002. Intensive information dissemination was also undertaken to raise awareness and inform the public sector about relevant information, including risks to human health, available at that time.

Since the completion of the Task Force work and perhaps due to the impacts of the Japanese outbreak as well as increasing KHV reports from many countries, concerted actions from various stakeholders are now taking place.

In October 2002, FAO responded immediately and positively by providing an emergency assistance through a Technical Cooperation Project (TCP) "Health management in freshwater aquaculture" to further assist Indonesia in finding resolution to this emergency situation.

The First Meeting of NACA's Regional Advisory Group on Aquatic Animal Health held in November 2002

recommended the inclusion of 'Koi mass mortality' under the category 'Unknown diseases of serious nature' of the Quarterly Aquatic Animal Disease report (QAAD) of NACA/FAO and OIE<sup>20</sup>. Several countries (e.g. Hong Kong SAR, Japan and Thailand) now have an on-going surveillance for KHV using Levels II, I and III diagnostics<sup>4</sup>, respectively<sup>20</sup>. The disease is not currently listed under OIE's 'Notifiable Diseases', however, an emergency notification was provided to OIE by the Indonesian Government in June 2002 as suggested by NACA. This mass mortality of koi and common carp is currently being reported by at least 21 countries in Asia-Pacific under the Asia-Pacific QAAD.

Japan's largest koi-grading show scheduled to be held in January 2004 has been cancelled by the All Japan Nishikigoi Promotion Association (<http://www.practicalfishkeeping.co.uk/pfk/pages/item.php?news=139>).

Later during 2004, FAO is proposing to hold a regional workshop on "Emergency Preparedness and Response to Aquatic Animal Diseases in Asia" (R.P Subasinghe, FAO, pers. comm.). The Workshop will review the regional experiences in responding to disease emergencies, including the work accomplished through an FAO TCP project in Indonesia aimed at providing technical assistance to improve national capacity to respond to the ongoing carp disease epizootic.

The Workshop envisages to improve the national and regional understanding and knowledge on the importance of preparedness and response to diseases emergencies, discuss approaches for reducing such risks to cultured and wild aquatic fauna, and to establish an action plan to provide guidance and assistance to the countries in the region to move forward on this important issue.

The experience on emergency response in dealing with this recent epizootic provided some valuable insights<sup>21</sup>: (a) the importance of regional and international cooperation; (b) the need to increase awareness on emerging diseases in other parts of the globe and the risks of it's spreading to the Asian region; (c) the need to improve diagnostic capabilities at both national and regional levels; (d) proactive reporting of serious disease outbreaks as a mechanism for early warning; (e) the need to have contingency plans both at national and regional levels; (f) the need to improve compliance and implementation of policies reached at regional and international levels; (g) emergency preparedness as a core function of government services; and (h) financial planning towards immediate provision of funds for emergency disease situations be seriously considered both at national and regional levels. It is essential that appropriate health management and biosecurity measures



Members of the Emergency Disease Control Task Force (Drs. Somkiat Kanchanakhon, MB Reantaso and Angus Cameron, second, fourth and fifth from left) during a courtesy call to Indonesian officials, Director Dr. Fatuchri Sukadi, Director General of Aquaculture, Ministry of Marine Affairs and Fisheries (third from left) and Dr. Ahmed Rukyani (sixth from left).

are continuously put in place and effectively implemented. Otherwise, the risks of major disease incursions and newly emerging diseases will continue to threaten the sector. Sometimes I wonder whether doing something or doing nothing at all can make a difference. Glenn Hurry, of AFFA (Australia) when I reported to him about these seemingly incessant disease incursions, commented ‘not bad, especially when governments are told what to and what not to do!’. There are many lessons from the past and hopefully our memories will not be too short to forget the events caused by various trans-boundary aquatic animal disease epizootics (e.g. epizootic ulcerative syndrome of fresh and brackishwater fishes, viral nervous necrosis of marine fish, viral diseases of shrimps, haplosporidiosis in oysters, akoya pearl oyster mortalities, etc.). These lessons can assist us towards preparing better and improving responses to similar events when they occur in the future.

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Continued from page 23

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