NETWORK OF AQUACULTURE CENTRES IN ASIA-PACIFIC

Sixteenth Meeting of the Asia Regional Advisory Group on Aquatic Animal Health

REPORT OF THE MEETING

Anvaya Beach Resort, Bali, Indonesia

26-27 August 2017

Prepared by the NACA Secretariat

Preparation of this document:

This report was prepared by the 16th Asia Regional Advisory Group on Aquatic Animal Health (AG) that met at Anvaya Beach Resort, Bali, Indonesia on 26-27 August 2017.

The Advisory Group was established by the Governing Council of the Network of Aquaculture Centres in Asia-Pacific (NACA)in 2001 to provide advice to NACA members in the Asia-Pacific region on aquatic animal health management, through the following activities: (a) evaluate disease trends and emerging threats in the region; (b) identify developments with global aquatic animal disease issues and standards of importance to the region; (c) review and evaluate the Quarterly Aquatic Animal Disease reporting programme and assess the list of diseases of regional concern; (d) provide guidance and leadership on regional strategies to improving management of aquatic animal health including those under the framework of the Asia Regional Technical Guidelines; (e) monitor and evaluate progress on Technical Guidelines implementation; (f) facilitate coordination and communication of progress on regional aquatic animal health programmes; (g) advise in identification and designation of regional aquatic animal health resources, as Regional Resource Experts (RRE), Regional Resource Centres (RRC) and Regional Reference Laboratories (RRL); and (h) identify issues of relevance to the region that require depth review and propose appropriate actions needed. Members of the Advisory Group include invited aquatic animal disease experts, representatives of the World Animal Health Organisation (OIE) and the Food and Agricultural Organization of the United Nations (FAO), collaborating regional organisations such as SEAFDEC Aquaculture Department (SEAFDEC AQD) and OIE-Regional Representation in Asia and the Pacific (OIE-RRAP), and the private sector.

Reference: NACA 2017. Sixteenth Meeting of the Asia Regional Advisory Group on Aquatic Animal Health: Report of the Meeting. Published by the Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand.

ABBREVIATIONS AND ACRONYMS

AAH	Aquatic Animal Health
AAHRDD	Aquatic Animal Health Research and Development Division of DoF Thailand
AAHSC	Aquatic Animal Health Standards Commission of the OIE
AG	Advisory Group
AGM	Advisory Group Meeting
AHPND	Acute Hepatopancreatic Necrosis Disease
AMC/AMS	ASEAN Member Countries/ASEAN Member States
AMR	Antimicrobial resistance
AMU	Antimicrobial use/usage
ANAAHC	ASEAN Network of Aquatic Animal Health Centres
AQSIQ	General Administration of Quality Supervision, Inspection and Quarantine of the P. R. China
ASEAN	Association of South East Asian Nations
AVA	Agri-Food and Veterinary Authority of Singapore
AVG	Abalone viral ganglioneuritis
AVM	Abalone viral mortality
BMP	Best management practices
CA	Competent authority
CMNV	Covert mortality nodavirus
DAWR	Australian Government Department of Agriculture and Water Resources
DoF	Department of Fisheries (Thailand)
EU	European Union
EUS	Epizootic ulcerative syndrome
FAO	Food and Agricultural Organization of the United Nations
FAO-RAP	FAO Regional Office for Asia and the Pacific
HPM-EHP	Hepatopancreatic microsporidiosis caused by *Enterocytozoon hepatopenaei* (EHP)
IHHN	Infectious hypodermal and haematopoietic necrosis
IHNV	Infectious haematopoietic necrosis virus
IMN	Infectious myonecrosis
IMNV	Infectious myonecrosis virus
ISKNV	Infectious spleen and kidney necrosis virus
KHV	Koi herpesvirus
LPT	Laboratory proficiency testing
MOA	Ministry of Agriculture, PR China
MrNV	*Macrobrachium rosenbergii* nodavirus
MBV	Monodon baculovirus
NACA	Network of Aquaculture Centres in Asia-Pacific
NC	National Coordinator
NHP	Necrotising hepatopancreatitis
OIE	World Organisation for Animal Health
OIE-RRAP	OIE Regional Representation in Asia and the Pacific, Tokyo, Japan
PCR	Polymerase chain reaction
POMS	Pearl oyster mortality syndrome
RT-PCR	Reverse transcriptase PCR
SEAFDEC	Southeast Asian Fisheries Development Center
SEAFDEC-AQD	Southeast Asian Fisheries Development Center Aquaculture Department
SPF	Specific pathogen free
SPR	Specific pathogen resistant
SPT	Specific pathogen tolerant
SVC	Spring viraemia of carp

SVCV	Spring viraemia of carp virus
TCP	Technical cooperation project
TG	Technical Guidelines (Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals)
TiLV	Tilapia lake virus
TSV	Taura syndrome virus
VCMD	Viral covert mortality disease
VHS	Viral Haemorrhagic Septicaemia
VP	*Vibrio parahaemolyticus*
WAHIS	World Animal Health Information System
WAHID	World Animal Health Information Database
WFS	White faeces syndrome
WHO	World Health Organization
WSD	White spot disease
WSSV	White spot syndrome virus
WTD	White tail disease
WTO	World Trade Organization
YHV	Yellowhead virus

The 16th Asia Regional Advisory Group on Aquatic Animal Health.

Back Row (From Left to Right)

Dr. Eduardo Leaño (NACA), **Dr. Ingo Ernst** (AAHSC, OIE; Australia), **Dr. Chien Tu** (Observer, AHRI, Chinese Taipei), **Dr. Hirofumi Kugita** (OIE-RRAP, Japan), **Dr. Andy Shinn** (FishVet Group, Thailand), **Prof. Timothy Flegel** (Centex Shrimp, Thailand), **Dr. Siow-Foong Chang** (AVA, Singapore), **Dr. Yu Lun** (PHARMAQ-Zoetis, China).

Front Row (From Left to Right)

Dr. Rolando Pakingking, Jr. (SEAFDEC AQD, Philippines), **Dr. Melba Reantaso** (FAO, Rome, Italy), **Dr. Supranee Chinabut** (Thailand), **Dr. Diana Chee** (AVA, Singapore), **Dr. Janejit Kongkumnerd** (AAHRDD, Bangkok, Thailand), **Mrs. Sri Hastuti** (DGA, Indonesia), **Dr. Jing Wang** (OIE-RRAP, Tokyo, Japan)

TABLE OF CONTENTS

OPENING SESSION

The 16th meeting of the Asia Regional Advisory Group on Aquatic Animal Health was convened in Bali, Indonesia on 26-27 August 2017. The meeting was held back to back with the 10th Symposium on Diseases in Asian Aquaculture (**Annex 1: List of participants**; **Annex 2: Provisional Agenda**). The meeting was officially opened (on behalf of NACA) by Dr. Eduardo Leaño, Aquatic Animal Health Programme Coordinator of NACA and Secretary to the AG. Welcome remarks was given by Dr. Melba Reantaso (FAO), Chairperson of the AG.

Dr. Melba Reantaso facilitated the meeting through the adoption of the provisional agenda by the AG members, co-opted members and observer.

SESSION 1: PROGRESS SINCE AGM-15

1.1. PROGRESS REPORT FROM NACA'S REGIONAL AQUATIC ANIMAL HEALTH PROGRAMME

Dr. Eduardo Leaño presented the progress report of NACA's Regional Aquatic Animal Health Programme. The Final Report of the 15th Meeting of the Asia Regional Advisory Group on Aquatic Animal Health (AGM-15) was published online at NACA website, and was widely disseminated to the network and partner organizations in the region and the world. For the Quarterly Aquatic Animal Disease Reporting, three quarterly reports were published since the AGM-15 (3rd and 4th quarters of 2016, and 1st quarter of 2017). An average of only 13 reports were received by NACA and OIE-Regional Representation in Asia and the Pacific (RRAP) for each quarter, a quite low percentage of the 33+1 countries in the Asia-Pacific region. The e-copy of the reports are available at both NACA and FAO-RRAP websites. NACA was invited in the International Symposium on Health of Aquatic Animals and Nutrition Immunology held in Guangzhou, China in March 2017, where Dr. Leaño delivered a plenary lecture on "Important Diseases of Aquatic Animals in the Asia-Pacific Region", and on "Biosecurity in Aquaculture" during a side meeting held at the Sun Yat Sen University.

NACA's expertise on AAH was also tapped during the International Symposium on Aquatic Animal Health and Epidemiology for Sustainable Aquaculture (ISAAHE) held in Lucknow, India in April 2017. Back-to-back with the symposium was the "Strategy Planning Workshop on National Surveillance Programme for Aquatic Animal Diseases" of India, where Dr. Leaño was invited as one of the experts. For the first time (through the initiative of OIE-RRAP), NACA was invited at the OIE-GS (General Session of World Assembly of Delegates) held in Paris, France in May 2017. Dr. Leaño attended the 85th Session on behalf of NACA and presented "QAAD Reporting in the Asia-Pacific", as NACA's important activity in the region in collaboration with OIE, during the break-out session of the different Regional Commissions.

NACA was approached by FAO-RAP to work on antimicrobial use in Asian aquaculture, as part of their on-going project on "Addressing Antimicrobial Usage in Asia's Livestock, Aquaculture and Crop Production Systems". The project is being funded by USAID. Thus, in April 2017, a Letter of Agreement was signed between FAO-RAP and NACA on the "Documentation and Characterization of Antimicrobial Use in the Aquaculture Sector Including Current and Proposed Practices in Aquaculture and Aquatic Disease Status in Asia". Activities included in this project include:

- Conduct a review of current aquaculture practices for major aquaculture species in selected countries in Asia;
- Conduct a comprehensive review of diseases affecting the identified major aquaculture species in selected countries in Asia;
- Develop a framework and methodology document on antimicrobial use in the aquaculture industry in Asia to include the value chain, datasets to obtain, specific industry profiles to describe and what assessments will result (e.g. farm level, sector and national level assessments) ;
- Pilot the methodology for AMU documentation on selected farms in Indonesia, Myanmar, Thailand and Vietnam to include analysis of the results of the pilot study;
- Provide recommendations on prudent and responsible use of antimicrobials that will contribute to existing good aquaculture practices (GAP) and good biosecurity practices;

- Conduct and document aquaculture stakeholder consultations (government, industry and academe) to raise awareness on the purpose and objectives of antimicrobial usage (AMU) and antimicrobial resistance (AMR) surveillance in aquaculture in selected developing countries; and,
- Using the results of the above activities, identify specific capacity requirements to implement effective AMU and AMR surveillance/diagnosis in the aquaculture sector.

Tilapia Lake Virus (TiLV), which was reported in Middle East and South America, became a current concern in the region when its presence was confirmed in cultured tilapias in Thailand. NACA, in collaboration with key researchers in Thailand who worked on this disease for the past few years, has published several news articles online including: A waring and an improved PCR method for TiLV disease in Thai tilapia farms; OIE technical disease card: Tilapia lake virus – a novel Orthomyxo-like virus; and, Urgent update on possible worldwide spread of TiLV. In May 2107, NACA also released a Disease Advisory which was disseminated widely to all NACA member countries and partner institutions, and published online at NACA website. NACA also collaborated with WorldFish in the preparation of TiLV Fact Sheet and Literature Review. To address this current disease problem in the region, NACA also approached several donor agencies for holding of an emergency regional consultation, and the Ministry of Agriculture of the People's Republic of China responded positively and agreed to fund the consultation, which was scheduled to be held in Guangzhou, China in September 2017.

NACA's involvement in AAH management activities in the ASEAN continues through its involvement in relevant activities of the ANAAHC. In June 2017, DoF Thailand, ANNAHC and NACA co-organized the 1st ANAAHC Meeting on Implementation of ASEAN SOP for Responsible Movement of Live Aquatic Animals. The meeting was generously hosted by the DoF Thailand and was attended by representatives from eight AMS and AAH experts in the region.

Discussion

- On AMU and AMR, there is a need to involve farmers as they need to be informed of what is good for the industry. The current AMU survey also involves an awareness drive for farmers. Collaborators from the government and other institutes facilitated contacts to local stakeholders in the participating countries, but the main clients are farmers. Awareness seminars on AMU and AMR were undertaken in Myanmar and Thailand.
- The way to drive farmers on AMU is the market; if the market demands food safety and no antibiotic use, then the industry will follow. So, the market needs to make the demand for regulating AMU. Then farmers would be unable to sell their products if they used antibiotics.
- As most farmers see an immediate cost-benefit from AMU (i.e. if they use antibiotics, they can have higher production), the long-term effects need to be explained. Consumer awareness, market demand, and helping farmers in disease management are needed. It is also important to advise farmers on the prudent/responsible/rational use of antibiotics.
- For the ASEAN SOP on responsible movement of live aquatic animals, the long-term goal is to harmonize relevant procedures involved in the implementation (e.g. quarantine, diagnostics, health certificates). At present, implementation depends on the capacity of each AMS. Most, with the exception of Lao, Cambodia and Myanmar, have implemented the SOP or are in the process of implementing the SOP and making stepwise advances in the rigor of this.
- On TiLV, tilapia-producing countries are now advised to test their stocks for the presence or absence of the virus, and to officially report to OIE and NACA. Movements of live tilapia are practiced worldwide, thus there is high risk of spreading the disease;
- TiLV mostly affects nursery production and not much the grow-out, thus the losses are usually not reflected in the overall tilapia production of the country (e.g. Thailand); farmers just tend to produce more fingerlings (to compensate for the mortality due to the disease) for stocking in grow-out ponds.

Recommendations

- AG recommended that NACA should continue to participate in programs for education and implementation of AMU and AMR issues in aquaculture and give them high priority

- AG recommended that with the recent spread of IMNV to India and possibly to Malaysia and the growing number of reports on TiLV, NACA's participation in harmonization of relevant procedures involved in the implementation of an ASEAN SOP on responsible movement of live aquatic animals for aquaculture should remain a high priority.

SESSION 2: OIE STANDARDS AND GLOBAL ISSUES

2.1. OUTCOMES OF RECOMMENDATIONS FROM OIE GENERAL SESSION AND THE AQUATIC ANIMAL HEALTH STANDARDS COMMISSION

Dr. Ingo Ernst gave a presentation on the process of the general session and commission in considering submissions and updating OIE documents. These include work programmes of the Commission (the aquatic code, the aquatic manual and the OIE Reference Centres (Ref labs and collaborating centres). For the Aquatic code, there is a thorough revision of Section 4 (Disease prevention and control) which was re-structured to include new chapters on disinfection and biosecurity. Other revisions include: requirements for self-declaration of freedom (all diseases); new disease specific chapter on Infection with *Batrachochytrium salamandrivorans*, and Acute hepatopancreatic necrosis disease (AHPND).

For the aquatic manual, there is a new template for disease-specific chapters: Improved case definitions; Improved information on the validation of tests. Disease specific chapters were reviewed and revised in terms of susceptible hosts. Three revised chapters were circulated for Member comments. A new chapter on AHPND was also added in the manual.

Other issues presented include: changes to OIE Reference Laboratory status; and gaps in the Reference Laboratory network.

DISCUSSION

- On delisting of OIE aquatic animal diseases, occasionally a few were proposed but no sound evidence for delisting. Criteria for delisting should be met. One of the criteria considered for listing is that, a disease is not found everywhere, i.e. there are some disease-free zones. Thus, if the disease is found everywhere then it could be delisted.
- Disease being listed in OIE is oftentimes costly especially for countries which are major aquaculture producers (i.e. with regard to issuance of health certificates, surveillance programme). If OIE can find ways to delist some of the diseases, then it can give some economic benefits to the countries. Delisting of diseases does not necessarily mean that the surveillance for these should stop. In the last 15 years, 15 diseases have been delisted in OIE – they failed to meet the criteria; but at the same time, 19 diseases have been listed.
- IHHNV and a few other diseases have been pushed for delisting as there have been no reports of outbreaks in shrimp producing countries; but this was not realized to date, because the main evidence for not delisting these diseases is the "lack of evidence". MBV and HPV were delisted but it took around 10 years.
- Decisions on delisting diseases should be based on the implementation of standards.
- Consider looking again on delisting criteria, as when the criteria were set up, there were no appropriate examples.

RECOMMENDATIONS

- AG recommended renaming of crustacean diseases in QAAD list in line with OIE (Infection with "pathogen");
- AG recommended that member governments request OIE to reconsider looking at the delisting criteria, and to submit proposals to delist some diseases that already have no significant impact on production;

2.2. UPDATES ON FAO INITIATIVES IN ASIA PACIFIC IN SUPPORT OF AQUATIC ANIMAL HEALTH

Dr Melba Reantaso presented an update of the progress of the implementation of the FAO projects presented during AGM 15 (2016).

Three facility projects under FAO's Technical Cooperation Programme (TCP) include the following: (i) TCP/MAL/3501 developed Malaysia's National Strategy on Fish Health; trained government officials on risk analysis, farm-level biosecurity and aquatic epidemiology; (ii) TCP/PLW/3601/C1 developed the following: aquaculture (import and export) policies and regulations; hull fouling regulations; green/red lists and a database of imports; biosecurity database – through a workshop that was held in January-February 2017; and (iii) TCP/MIC/3602 C2 – this project facility to be implemented in 2018 will develop a National Aquatic Animal Health and Biosecurity Strategy, review the current biosecurity legislation, provide training on risk analysis and basic aquatic animal health management.

Two inter-regional TCPs that are being completed (until December 2017) include: (i) TCP/INT/3501 (IMNV). This project participated by 6 countries (Brasil, China, Ecuador, Indonesia, Mexico, Thailand) achieved the following achievements: (a) Emergency Preparedness and Response System audit for the 6 countries; (b) IMNV Strategy Manual as part of Contingency Plan; (c) IMNV surveillance; and (d) capacity building on IMNV. These were achieved through three interregional workshops (Beijing, 2016; Natal, 2017; Qingdao, 2017); (ii) TCP/INT/3502 (AHPND) participated by 11 countries in Asia (India, Iran, Philippines, Sri Lanka) and the Latin America and the Carribean (LAC) organized two international technical seminars on AHPND (Panama, 2015; Bangkok, 2016), several national level consultations which developed and finalised the National Action Plans on AHPND; and an AHPND Special Publication (2018).

A book Responsible Management of Bacterial Diseases in Aquaculture is also work in progress. This publication is seen as a pre-requisite to FAO's future work on AMR in aquaculture. The book, being prepared through a series of write-shops, will serve as an important reference to antimicrobial usage in aquaculture. It contains general (i.e. aquaculture, health and aquatic animals, general techniques of bacterial diseases, antimicrobial usage, alternatives to antibiotics, antimicrobial resistance) and pathogen-specific chapters (some 10 bacterial species groups affecting finfish, crustaceans and molluscs).

An Expert Workshop held in March 2016 discussed the current understanding on the use of specific pathogen-free (SPF), specific pathogen-resistant (SPR) and specific pathogen-tolerant (SPT) stocks in shrimp populations. While general concepts are known, definitions remain ambiguous; procedures and methodologies for testing and monitoring health status has not been subjected to international scrutiny; misuse of terminology by stakeholders in shrimp sector – all these have affected biosecurity maintenance and access to market and trade. A paper entitled Facts, truths and myths about specific pathogen-free (SPF) shrimp in aquaculture is being finalised. The purpose of this position paper is to clarify these concepts and to reconfirm the importance of developing, maintaining and using domesticated, SPF shrimp stocks (which may also be SPR and/or SPT) to reduce the risk of disease expression in aquaculture ponds . The paper also discusses the new approaches to health management that combine SPF with SPT/SPR strategies, and the difficulties that may arise in confirming SPF status due to the existence of endogenous viral elements.

An expert workshop held in March 2017 in Manila Philippines agreed on the contents of the compliance manual series, the first being Volume 1: Compliance Manual for Small-scale Aquaculture Certification: Health and Welfare. They will provide knowledge and information on what small-scale aquaculture farmers should do to be able to comply with the FAO Aquaculture Certification Guidelines

FAO supported the initiative of the University of South Pacific and the Biosecurity Authority of Fiji and JICA in developing a National Strategy on Aquatic Animal Health through a workshop held in Fiji in January 2017.

DISCUSSION

- Conventional methods of biosecurity do not appear to be effective and it is suggested that they be reviewed. For example, tilapia and salmon require very different handling. Some diseases are so specific and there is a need to review the approach in biosecurity for each species and pathogen.

- Biosecurity in aquaculture usually lacks focus when compared with livestock, and this can be due to the complexity of the industry, the diversity of culture environment, species being cultured, etc. There can be a moral hazard with Governments in regard to biosecurity practices.
- Actions (on the issues) or implementation is the problem from the CAs; guidelines are there but no actions are usually taken especially at the national level;
- One of the problems is the lack of expertise on AAH compared with the livestock sector; countries having problems with aquatic animal diseases generally lack experts and expertise – the new generation moving into this area is becoming less. In most cases, if livestock veterinarians try to help whenever there is a problem on aquatic animal diseases, usually it is in the wrong direction because aquaculture is totally different from livestock. There is also not enough information available, so it becomes difficult for the Government to make decisions on the information available;
- The concept of a national reference laboratory for animal diseases (including aquatic animals), that can also function as OIE reference laboratory is now being planned for Thailand and should be pursued. Although there is already an animal health laboratory under the direction of the CVO, it does not have any links to the Government aquatic animal health laboratory. Through this national reference laboratory, the plan is to bring these two sectors together. Livestock and aquaculture production are separate divisions but there is a need to remove bureaucratic barriers and allow these two separate divisions to meet and to share information and expertise. The national reference laboratory will also become a big selling point for the country to share their expertise.
- Although the concept of national reference laboratory could lead to efficient use of expertise, the problem, however, is on how to motivate Governments to take such actions. AHPND failed and TiLV has not yet motivated Governments to take action.
- Most losses in aquaculture are not underwritten/covered by insurance. For many, insurance cover is not available, cannot be covered or cannot be afforded. So with regard to the point as to who is applying pressure to Governments, it has to come from producer organisations as one voice. For industries where there is insurance cover, there appears to be greater pressure applied because several levels of organisation highlight the problems and the losses involved.
- Another problem is "do producers want to be regulated?". In most cases, they do not, and so they are open to disease events. Big producers will want to trade but they are challenged by many smaller producers who do not want to be regulated. There are also disagreements between those who want to comply and those who do not. Streamlining of biosecurity measures comes with resource.

Recommendations

- AG recommended that aquatic animal health laboratories should be strongly linked with the country's national animal laboratory, which is usually under the CVO who is the official country Delegate to OIE. Actions should be taken by member governments to remove bureaucratic barriers and promote sharing of information and expertise between the aquatic animal sector and the livestock sector;
- AG recommended that due to lack of expertise in aquatic animal health in most member governments, training of terrestrial veterinarians should be promoted to make them become more familiar with aquatic animal diseases and health management, which is totally different from livestock health management.

Session 3: Special Discussion on Listing of Diseases in QAAD-AP

Background/Discussion

During the previous AGM, additional diseases were endorsed by AG 15 for inclusion in the QAAD list for 2017. These diseases, which did not undergo any assessment prior to inclusion, include Carp edema virus disease, Viral covert mortality disease, *Spiroplasma eriocheris* infection, and Iridovirus in crayfish. As such, an issue was raised on the AG protocols on inclusion of a disease in the QAAD list. The AG 16 made the following points:

- Reporting of these new diseases should follow OIE criteria on a regional context - describing the consequences of the infection, how to diagnose, describe the distribution (we do not follow strictly), etc. – to show that a process has been followed prior to listing. There is a need to provide a robust justification for reporting which will then support the need for investment in testing in surveillance and reporting of these new diseases;

- The main purpose of QAAD is to gather as much information as possible on the presence or absence of diseases from the participating countries, and does not have any impact of trade as those listed by OIE. QAAD is to alert countries on current and emerging disease problems so that necessary actions can be taken;
- For example, in the past, assessments (following OIE criteria) were provided for listing of AHPND and delisting of Milky haemolymph disease of crayfish and Akoya oyster disease;
- AHPND was also a good example as there was no case definition initially and it was listed as a syndrome (AHPNS) in QAAD (after assessment using OIE criteria) and then later changed to a disease (AHPND) after the pathogen was identified;

RECOMMENDATION

- AG recommended that a simple assessment following (but not strictly) OIE criteria should be carried out for all new aquatic animal diseases that will be included in (or delisted from) the QAAD list.

SESSION 4: REVIEW OF REGIONAL DISEASE STATUS

4.1. CURRENT STATUS OF SHRIMP DISEASES IN ASIA

Prof. Timothy Flegel gave a presentation on recent developments in crustacean health. As with the review for AGM15, levels of disease threat depend on the species of shrimp cultivated and on the geographical location of farms. For viral pathogens in Asia, white spot syndrome virus (WSSV) and yellow head virus type-1 (YHV-1) are still the most lethal for both species, although the latter has still been confined to Thailand. There has not been any news of spread of a new, lethal variant (YHV-8) that was reported from China and covered in the AGM14 report, and it is still recommended that a disease card for this, together with a specific detection method be posted at the NACA website. It would also be good if a comparative virulence study could be carried out with YHV-1 and YHV-8. A disease card for covert mortality nodavirus (CMNV), also from China [Zhang et al. 2014. J Gen Virol. 95, 2700-2709.] has been submitted to NACA but should be improved before publication. So far, negative impacts from CMNV have not been reported from other countries, although it has been detected by PCR in Thailand (Thitamadee et al. 2016. Aquaculture. 452, 69-87).

For *P. vannamei* only, the next most important viral threat is still infectious myonecrosis virus (IMNV). Unfortunately, outbreaks of IMNV have very recently been reported from India and were reported to have originated from contaminated *P. vannamei* broodstock brought into India for PL production to supply shrimp farms (Sahul Hameed et al. 2017. J Fish Dis. DOI: 10.1111/jfd.12655: available online). This is the same mode that led to transmission of IMNV to Indonesia. The event should serve as a serious warning to other Asian countries of the dangers from such activities.

As with AGM 15, Taura syndrome virus (TSV) and infectious hypodermal and hematopoietic necrosis virus (IHHNV) are not serious threats to the tolerant shrimp stocks being cultivated. However, *P. vannamei* sometimes exhibits abdominal segment deformity disease (ASDD), associated with a retrovirus-like agent but prevalence has dropped sharply since publication of an article describing its nature (Sakaew et al. 2013. BMC Veterinary Research. 9, 189). For P. monodon only, the next most important viral pathogen is Laem Singh virus (LSNV) and an integrase-containing element (ICE) that are together associated with monodon slow growth syndrome (MSGS), but so far, this has been reported only from Thailand (Panphut et al. 2011. BMC Vet Res. 7, 18). Less important are hepatopancreatic parvovirus (HPV) and monodon baculovirus (MBV), but only when captured *P. monodon* are used for postlarval production without implementation of proper preventative measures. At Centex shrimp, laboratory bioassays have shown that MBV infectious for *P. monodon* was not infectious for *P. vannamei* (manuscript submitted).

The current top bacterial disease threat for shrimp in Asia is still acute hepatopancreatic necrosis disease (AHPND) that is caused by isolates of *Vibrio parahaemolyticus* (VP) that carry an AHPND plasmid (pAP) that encodes two Pir-like toxins (PirvpA and PirvpB) (VPAHPND) that can cause massive sloughing of shrimp hepatopancreatic tubule epithelial cells (the pathognomonic lesion of AHPND). AHPND is now a listed crustacean disease of OIE. There is still some confusion caused by the persistent use of the term early mortality syndrome (EMS) as if equivalent to AHPND. This should be discouraged since early mortality in shrimp arises from several different causes, some of which are still unknown. In addition, the description of AHPND should be modified to include description of isolates of other *Vibrio* species such as *V. harveyi*, *V. owensii* and *V. campbellii* that carry pAP and produce PirvpA and PirvpB toxins and cause AHPND (Kondo et al. 2015. Genome Announc. 3, e00978-00915; Xiao et al. 2017. Sci Rep 7:42177; Han et al., 2017. Aquaculture 470:84 –90). The pAP plasmid has also been shown to be present in many serotypes of VP in Thailand (Chonsin et al. 2015. FEMS Microbiol Lett, fnv222; Kongrueng et al. 2015. J Fish Dis. 38, 957-966), indicating its ability to spread in the VP population and suggesting that spread to other species of *Vibrio* or other genera of gram negative bacteria should be investigated. More recently, there are results (yet unpublished) for isolates of *V. harveyi* (collected in 1999 and stored at -80^{o}C and collected more recently in 2010) that produce Pir^{vp}A and Pir^{vp}B toxins that cause AHPND in reverse gavage tests. The genome of one of these isolates has been sequenced to reveal that the toxin genes are located on the bacterial chromosome in a genetic environment that is dissimilar to that of the toxin genes in the pAP plasmid. The significance and ramifications of these results are still being analyzed. The ability of these isolates to cause massive sloughing of hepatopancreatic cells was not recognized at the time of their isolation because bioassays were carried out using injection challenge. The relationship between these isolates, more recent similar isolates from Thailand and AHPND isolates that carry toxin genes on a plasmid is under study.

Also included in the AHPND definition should be the description of isolates of VP that carry mutated pAP that do not produce Pir^{vp}A and Pir^{vp}B toxins but still cause approximately 50% shrimp mortality (Phiwsaiya et al., 2017. Appl Environ Microbiol, doi: 10.1128/AEM.00680-17 AEM.00680-17; Theethakaew et al. 2017. Infec Genet Evol. 51, 211-218). These do not cause pathognomonic AHPND lesions, but instead collapsed HP tubule epithelia, a non-specific pathology that makes diagnosis by histopathology uncertain. The mechanism of shrimp death resulting from such mutant isolates should be further investigated, particularly with respect to additional toxins that may cause shrimp mortality in their own right or potentiate the virulence of the Pir^{vp}A and Pir^{vp}B toxins (Sirikharin et al. 2015. PLoS ONE. 10, e0126987).

Production of farmed shrimp in Thailand rebounded from a low of 180,000 metric tons in 2014 to approximately 350,000 metric tons in 2016. This has been aided by knowledge about AHPND, by use of PCR methods for VPAHPND detection to eliminate contaminated broodstock and post larvae (PL) and by changes in pond management to reduce the overall quantity of organic matter in shrimp rearing pond water and sediments. The observational case–control epidemiological study of risk factors associated with EMS in Thailand (Boonyawiwat et al. 2016. J Fish Dis. 44, 649–659) has contributed to the improvements. Since AGM 15, work on the 2 isolates of non-AHPND bacteria that potentiate AHPND virulence has not yet been published [*Roseateles* sp. (Berkholderiales, Comamonadaceae) and Shewanella sp. (Alteromonadales, Shewanellaceae), and the reason why they increase virulence is still unknown.

With respect to spread of AHPND, it has more recently been reported from Australia caused by *V. harveyi* (with toxin genes apparently on the chromosome, similar to the *V. harveyi* described from Thailand above). There are reports in the literature for AHPND in Mexico but still denied by the national competent authority. I also met a group of shrimp farmers from South American countries who described work on AHPND caused by several *Vibrio* species there. However, there are no published or official reports of AHPND being present in South America or nearby Central America outside Mexico.

The other major emerging disease in Asia is hepatopancreatic microsporidiosis (HPM) caused by *Enterocytozoon hepatopenaei* (EHP). Please refer to the AGM15 report for a summary of developments up to November 2016 and to the recent review on shrimp diseases in Asia (Thitamadee et al. 2016. Aquaculture. 452, 69-87). Since that time, progress has still been slower than desired and many questions still remain open. Significant progress has been made using inhibition of polar tube extrusion by Phloxine B as an indication of spore inactivation. Inactivated spores (i.e., no polar tube extrusion with Phloxine B) do not cause shrimp infection in reverse gavage assays while active spores (i.e., give polar tube extrusion with Phloxine B) do cause infection (unpublished). This revealed that spores isolated and purified from infected hepatopancreatic tissue can be infectious and spread the infection within the hepatopancreas. The effect of Phloxine B appears to be pH based, so pH 9-11 solutions of KOH also cause extrusion but it is not easily visible without subsequent staining, so it is convenient to achieve both in a single treatment with Pholoxine B. This supported our earlier recommendation that earthen ponds that had experienced HPM be treated with calcium oxide (burnt lime) to inactivate spores before restocking. The extrusion assays also revealed that potassium permanganate at 15 ppm for 15 min was the most effective chemical for deactivation of EHP spores when compared to other chemicals such as chlorine and formalin often used in hatcheries for disinfection.

Despite this limited progress, many problems remain. For example, a study of 196 shrimp ponds selected before stocking from 4 provinces in Thailand (submitted) showed a prevalence of 61% for EHP as determined by PCR early in the study and this shocking result was widely communicated in Thailand together with proposed control measures (see the review by Thitamadee et al. above). However, I talked to an executive member of the Thai Marine Shrimp Farmers Association and was told that their recent survey of PL batches they obtained from hatcheries in Thailand revealed that the prevalence was still 60%. This is despite the fact that knowledge and tools are available to ensure that PL sold to farmers are free of EHP. The reason for the failure to deliver EHP-free PL needs to be urgently addressed and rectified.

Finally for EHP, a recent report has suggested that pre-infection with EHP predisposes shrimp to AHPND and hepatopancreatic necrosis caused by other bacteria (Aranguren et al. 2017. Aquaculture. 471, 37–42). On the other hand, results from the Thai cohort study above revealed no association between EHP and AHPHD or bacterial lesions in the hepatopancreas. The possibility of secondary bacterial infections caused by severe EHP infections has been previously proposed (Thitamadee et al. 2016 above) and the severity of infection in most of the shrimp in the cohort study was low, so the discrepancy between the result of the laboratory study (Aranguren et al. 2017, above) and the cohort study may have resulted in difference of EHP severity. In the case of very severe infections of EHP, shrimp sometimes exhibit white feces syndrome (WFS) (Tang et al. 2016. J Invertebr Pathol. 140, 1-7) but not always (Tangprasittipap et al. 2013. BMC Vet Res. 9, 139), suggesting that some unknown factor(s) may be involved. This is yet another issue that warrants further study.

Many other questions from 2016 still remain unanswered about HPM and EHP despite the fact that tools are available to find the answers. Are there life stages in other host species (i.e. environmental carriers)? Do other cell or spore types exist for internal reinfection and external transmission (Vávra, J., Lukeš, J., 2013. Adv Parasitol. 82, 253-319)? Is therapeutic treatment possible? Among the most urgent needs is to identify infected carriers, since this should help in developing more effective biosecurity methods for shrimp hatcheries and ponds. There are reports of batches of *Artemia* positive for EHP but there is still no answer as to whether *Artemia* is susceptible to EHP infection. It should be possible to determine this in laboratory tests using purified EHP spores. It would be good if an international group of interested researchers could be assembled and funded to answer these questions in a coordinated manner so that answers could be obtained quickly without excessive parallel work.

A variant of EHP has been recently reported from Venezuela (Tang et al. 2017. Aquaculture. 480, 17-21). It appears to be the same species based on ssu rRNA gene sequence but a geographical variety based on its spore wall protein gene sequence. On the other hand, we have received samples from another South American country that has given a positive result for EHP by PCR and *in situ* hybridization but has a spore wall protein gene sequence nearly identical to that of Asian EHP. Again, further work is needed.

Another emerging, crustacean pathogen mentioned at AGM 15 was *Spiroplasma eriocheiris* origninally described from the Chinese mitten crab *Eriocheir sinensis* (Wang & Gu. 2002. Dis Aquat Org. 48:149-153; Wang et al. 2002. J Invertebr Pathol. 81: 202-204) and reported to also be infectious for *Procambarus clarkii*, *Machrobrachium rosenbergii*, *Machrobrachium nipponensis* and *Penaeus vannamei* (Wang et al. 2011. Int J Syst Evol Microbiol. 61:703-708). Our challenge tests with this pathogen in *P. vannamei* using inoculum obtained from infections in *M. rosenbergii* did not cause any mortality and showed no lesions by histology or *in situ* hybridization. Similar results were obtained in bioassays using pure cultures of *S. eriocheiris* suggesting that the tested *P. vannamei* were not adversely affected.

There have, as yet, been no reports of the 3 other new crustacean pathogens that were mentioned at AGM 15 and reported from China. These were 1) Macrobrachium rosenbergii Taihu virus (MrTV) (Pan et al. 2016. Int J Mol Sci. 17, 204) in the Family Dicistroviridae together with Taura syndrome virus; 2) a new Macrobrachium nipponense reovirus (MnRV) (Zhang et al. 2016. J Fish Dis. 39, 371-375); and 3) a new iridovirus of exotic redclaw crayfish (*Cherax quadricarinatus*) (CQIV) (Xu et al. 2016. Dis Aquat Org. 120, 17-26). As reported at AGM 15, CQIV has been tested in laboratory challenges with the American *Procambarus clarkii* and with the whiteleg shrimp *Penaeus vannamei* and found to cause high mortality in both. Thus, it should be of particular concern for shrimp farmers in the region. It would be useful if NACA could arrange for a disease card including illustration of distinctive histological lesions caused by CQIV, if they exist. In addition, a new picornavirus in red claw called *Chequa iflavirus* (Sakuna et al. 2017. Virus Res. 238:148-155) has been reported in redclaw crayfish from Australia. The infectivity of this virus for penaeid shrimp has not been reported.

4.2. Updates on Finfish Diseases in Asia

Dr. Siow Foong Chang gave a presentation on recent developments in finfish health. The presentation covered the reports of the spread of Tilapia Lake Virus (TiLV) in the region, scale drop and muscle necrosis (SDMND)(1) and Infectious spleen and kidney necrosis virus (ISKNV)(2) in outbreaks in farmed barramundi (*Lates calcarifer*).

For SDMND, it was noted that only *V. harveyi* could induce disease in *in vivo* experiments while four other bacteria species cultured from diseased fish (*V. tubiashii, T. litopenaei, Tenacibaculum sp.* and *Cytophaga* sp.) did not reproduce the disease. It was postulated that *V. harveyi* in this case may have a unique plasmid or contains virulent genes that produce deadly toxins causing these histopathological lesions. Bacteria may also work in tandem to cause disease. However, these lesions could also be caused by *V. harveyi* secondary infection following a primary viral disease outbreak.

With the ISKNV outbreak, it was noted that the use of RSIV vaccine reduced mortality to 11-15%, from the original mortality figures of about 40-46% from 2012-2014 in unvaccinated fish. In a real world situation, a 30% improvement in survival would be considered significant, and vaccination would be a practical disease control measure.

The ability of the fungus, *Batrachochytrium dendrobatidis* (Bd) to infect and multiply on zebrafish larvae **treated with antibiotics** highlights potential reservoirs and transmission of this pathogen via the ornamental fish trade (3).

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4.3. Updates on Amphibian and Molluscan Diseases in the Asia-Pacific Region

Dr. Andy Shinn reported current updates on amphibian and molluscan diseases in the region and provides a summary of significant molluscan and amphibian diseases throughout Asia (Table 1). In the past year, there have been a series of notable mortality events and, marked technological advances in the diagnosis and management of pathogens impacting on wild and managed populations of molluscs and amphibians.

Notable mortality events include that of blood cockles, *Tegillarca* [*Anadara*] *granosa,* in Samut Prakhan, Thailand, which extends over the past 5 years and has varied in its severity from year to year (Anonymous, 2014; Yurimoto *et al*., 2014; Pahri *et al*., 2016). The cause of mortality appears to be multifactorial that includes environmental, husbandry and disease components. Local climatic conditions resulting in low salinity, low water levels, consequential high water temperatures and low dissolved oxygen concentrations across culture zones and high levels of *Vibrio* spp. have had a marked impact on production (*pers. comm.* J. Pratoomyot, Institute of Marine Sciences, Burapha University, Thailand). The magnitude of the mortality is not dissimilar from that which occurred in Ban Don Bay, Surat Thani Province where heavy rainfall events in 1996 and 2008 across a 30 sq mile area of culture resulted in losses amounting to US$ 10 M and US$ 170 M respectively. Losses in Surat Thani, Thailand in 2014, for example, were estimated at between US$ 11.2 and 14.0 M. Heavy rainfall in 2011 during the spat sowing season (March), also resulted in the significant loss of stock (Ratchatapattanakul *et al.,* 2017).

The mass mortality of lyrate hard clams, *Meretrix lyrata,* reported from Binh Dai (Ben Tre) district in Vietnam in July 2017 resulting in a 60% mortality of 20-30 g sized clams across a 12-hectare equivalent to 50 (?) tons of clam meat also appears to be due to sudden decreases in salinity. The cause of mortality is linked to the influx of flood water from upstream combined with high levels of sediment washing into the clam grounds where the tide does not drain (Anonymous, 2017a). A low level *Perkinsus* sp. infection (20.9 spores g^{-1}) was suggested to be a contributory factor (Anonymous, 2017b). The agriculture sector advised removing all dead clams, the relocation of culture beds, where this is possible, and, the thinning of stock to <150 clams m^2 (<300 juvenile clams m^2) (Anonymous, 2017b).

Pacific Oyster Mortality Syndrome or POMS is an infection with ostreid herpesvirus-1 microvariant (OsHV-1 µvar) a contagious viral disease affecting Pacific oysters, *Crassostrea gigas*. OsHV-1 µvar has caused repeated seasonal outbreaks of mass mortality in *C. gigas* populations in Europe, New Zealand and in New South Wales, Australia. A study conducted by de Kantzow *et al.* (2017) investigated the risk factors associated with infection through a study of six Tasmanian farm sites throughout March-April 2016 where there was an av. 78% mortality (range 37-92% across sites). The study found higher rates of mortality in the smaller age class (i.e. 96% mortality in 0–20 mm length class versus 33% in the 61–115 mm size group) with a 3.2-3.8 increased odds of mortality if the average size of the oyster shell length ≤40mm compared to those with an average of >61mm. The study also found that, generally, the longer the time spent on the farm, the lower the mortality, consistent with the increasing age and size of the oysters. Standard density resulted in lower mortality than high or low stocking density (notably spat). Mortality, however, was nearly twice as likely when oysters were handled for routine husbandry in the 7 days prior to the outbreak compared to stock that was not handled. Environmental and husbandry factors including water temperature and basket clip height on inter-tidal long-lines are associated with the occurrence and severity of POMS outbreaks. Decreasing the immersion time by raising the height of the growing infrastructure by 300 mm above the industry standard, reduced the POMS-induced mortality of adult oysters by half.

In a second study by Pauletto *et al.* (2017), induction of an immune response to OsHv-1 by long dsRNA in *C. gigas* was possible. dsRNA-mediated genetic interference (RNAi) is a widely used reverse genetic tool for determining the loss-of-function phenotype of a gene. During massive mortality events, Cg-IKB2 mRNA levels exhibit significant variation depending on the amount of OsHV-1 DNA detected. In the study, dsRNAs targeting Cg-IKB2 and green fluorescence protein genes were injected *in vivo* into oysters before being challenged by OsHv-1. Survival appeared close to 100% in both dsRNA injected conditions associated with a low detection of viral DNA and a low expression of a panel of 39 OsHV-1 genes when compared to an infected control group of oysters. The study concluded that the long dsRNA molecules Cg-IKB2- and GFP-dsRNA, may have induced an anti-viral state controlling the replication of the OsHv-1 virus.

The haplosporidian parasite *Bonamia ostreae* though largely restricted to the northern hemisphere including Europe, eastern and western North America was reported in *Ostrea chilensis* from New Zealand for the first time in 2015. In an investigation conducted by Lane *et al.* (2016), histology on 149 adult oysters collected from the Marlborough Sounds,

Table 1. The table summarises the last known report of each significant molluscan and amphibian disease in Asia. No data is recorded for the following Asian territories: Bhutan K.; Cook Islands; Fiji R.; Guam T., Indonesia R.; Kiribati R.; Korea PDR; Laos PDR; Marshall Islands R.; Micronesia FS; Nepal FDR; Northern Mariana Islands C.; Pakistan IR; Palau R.; Papua New Guinea IS; Philippines R.; Samoa IS; Samoa American T.; Solomon Islands; Sri Lanka DSR; Tuvalu; Vanuatu R.; Wallis and Futuna Islands T. Data is drawn from a variety of resources including NACA-OIE-FAO (2016-2017), the International Database on Aquatic Animal Diseases (Cefas, 2017), and white and grey literature.

Abbreviations: [a]Import of *Crassostrea gigas* tested positive for OsHV-1 (Tan *et al.*, 2015); Abalone herpesvirus (**AH**); Acute viral necrosis – scallops (**AVNS**); *Batrachochytrium dendrobatidis* (**BD**); *Bonamia exitiosa* (**BE**); *Bonamia ostreae* (**BO**); Bonamiosis (**BON**); *Haplosporidium nelsoni* (**HN**); *Marteilia* (**MAR**); *Marteilioides* (**MART**); *Marteilioides chungmuensis* (**MC**); *Marteilia*-like organisms (**MLO**); *Mikrocytos mackini* (**MM**); Ostreid herpes virus-1 (**OHV1**); *Perkinsus marinus* (**PM**); *Perkinsus olseni* (**PO**); *Rickettsia*-like organisms (**RLO**); Ranavirus (**RV**); *Xenohaliotis californiensis* (**XC**).

	Mollusc and amphibian disease								
	AH/AHLV	**AVNS**	**BD**	**BE**	**BO**	**BON**	**HN**	**MAR**	**MART**
Australia C	2012		2013	2016		2005			2005
Bangladesh PR			2013						
Cambodia K.			2012						
China PR	2012		2016		2013		2012		
French Polynesia OCFR									
Hong Kong SAR-PRC			2014						
India R			2013						
Japan			2016				2006		
Korea RO			2013?				2006	2002	2014
Malaysia			2011						
Myanmar RU	2009								
New Zealand			2013	2016	2016	2005			
Singapore R			2016						
Taipei ROC	2012								
Taiwan ROC	2005								
Thailand K			2012						
Vietnam SR									

	MC	**MLO**	**MM**	**OHV1**	**PM**	**PO**	**RLO**	**RV**	**XC**
Australia C			2006	2016		2016		2012	
Bangladesh PR								2008	
China PR		2012		2013		2006	2012	2016	
French Polynesia OCFR				2015[a]	2013?	2013			
Hong Kong SAR-PRC								2014	
India R						2016		2016	
Japan	2014					2012		2013	2015
Korea RO	2012			2015	2013	2010			
Malaysia								2013?	
Myanmar RU									
New Zealand				2014		2015			
Singapore R									
Taipei ROC								2014	
Taiwan ROC									
Thailand K								2017	
Vietnam SR						2013?			

New Zealand found *Bonamia* micro-cells in 119 (79.9%) specimens. *Bonamia* generic PCR and DNA sequencing produced 100% matches with *B. ostreae* but specific primers found 2.7% of the samples infected with *B. exitiosa*, 40.3% with *B. ostreae* and 53.7% with concurrent infections. The overall prevalence of *Bonamia* spp. was 96.6%.

In May this year, *Bonamia ostreae* was also discovered in two oyster farms in Big Glory Bay in Southland, New Zealand, which led to the Ministry for Primary Industries pulling millions of potentially infected oysters from the sea as a means of minimising the potential spread of infection (Fletcher, 2017; Ministry for Primary Industries New Zealand, 2017).

One other notable mass mortality event is that of the vermetid gastropod *Ceraesignum* [*Dendropoma*] *maximum* in waters surrounding the Society Islands, French Polynesia. Up to 100% mortality (density of up to 165 gastropods per m^2) due to unknown causes was documented around four Polynesian islands (Brown *et al*., 2016). The mortality event apeared to be extremely rapid (2nd July – 24th July 2015) and specific with other vermetid species seemingly unaffected. While the involvement of a pathogen is hypothesised, this has yet to be proven. The area is a popular tourist destination and the involvement of human activity and vessels is under investigation. As seen with the ongoing blood cockle mortality in Thailand, environmental anomalies can lead to widespread effects. The event occurred in the austral winter (i.e. 26°C *vs* summer temps of ca. 28°C) and while there have been repeated coral bleaching events in French Polynesia, some lasting to late July, there was no concurrent bleaching seen. The event appears to mirror a similar situation in the Caribbean in the 1980s (see Lessios *et al*., 1984), where the action of a pathogen implicated.

Infection with chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*), responsible for chytridiomycosis, remains a pathogen of global significance that has been implicated in the decline of >200 amphibian species, with declines beginning from the 1970s (Skerratt *et al*., 2007; Crawford *et al*., 2010). To date, *Bd* infection has been reported in >500 amphibian species (Olson *et al.*, 2013). The introduction of *Bd* into susceptible, naïve amphibian populations is characterised by a rapid, simultaneous increase in prevalence and infection intensity, followed by mass mortality and population decline.

The documentation of new infections suggests dispersal via natural methods such as frog-frog contact and water flow (Scheele *et al.,* 2017). *Bd* has, however, also been reported on feet of waterfowl (Garmyn *et al.,* 2012), in rainwater (Kolby *et al*., 2015), in reptiles (Kilburn *et al*., 2011), on crayfish (McMahon *et al.,* 2013), on and from *Caenorhabditis elegans* (Shapard *et al.,* 2012). *Bd* is viable for 6 weeks in the absence of amphibian hosts as shown from a study inoculating autoclaved pond water (Johnson & Speare, 2003). Dispersal across across desert areas and to islands, however, suggests human interaction assisting the unintentional movement of infected amphibians (Scheele *et al*., 2017). This is supported by a *Bd* outbreak in a captive amphibian population on Tasmania which came in contact with a frog accidently transported from the mainland in vegetable produce in 1993 (Obdendorf, 2005 cited in Scheele *et al.,* 2017). The study of Scheele *et al.* (2017) raises a critical point that although frogs are regularly traded, few countries, if any, have formally adopted recommended measures to control the spread of *Bd* if and when introduced. A study by Converse *et al.* (2017), however, have built models to better understand what management actions are required to address chytridiomycosis-associated declines.

In the molecular detection of *Bd*, there are concerns that sensitive PCR methods for the detection of *Bd* cannot distinguish between viable from non-viable cells and so there must be some rate of false positives due to contamination and non-specific PCR. The utility of swabbing specimens to accurately determine the true burden of *Bd* infection was investigated by Clare *et al.* (2016). While the method detected a significantly higher number of *Bd* positive cases from visually healthy cases, swabbing does not allow for an accurate indication of true fungal burden.

The report of *Bd* from crayfish, however, remains valid. The infection of crayfish was reported on by Nuwer (2012) commenting that crayfish can maintain infections for up to 12 weeks with consequential mortalities from infection. A challenge study by McMahon *et al.* (2013) found that *Bd* can induce greater levels of mortality in crayfish compared with sham inoculations. A survey of wild and farmed of crayfish populations in Louisiana, USA by Brannelly *et al.* (2015), found a low prevalence and intensity of infection but raised the point that crayfish may serve as important vectors in spreading *Bd*. A later challenge trial conducted by Betancourt-Roman *et al.* (2016), however, resulted in a general absence of infection and mortality thereby questioning the role of crayfish in the *Bd* life-cycle. *Bd* has also been reported as an infection of the Malaysian giant freshwater prawn, *Macrobrachium rosenbergii* (Paulraj *et al.*, 2016), however, this finding has been rejected after the results were found to be incomplete and inconsistent with previous descriptions of *Bd* (Pessier & Forzan, 2017).

A dose-dependent mortality study investigating *Bd* infection in zebrafish by Liew *et al.* (2017) demonstrated that *Bd* can infect and proliferate on zebrafish tissue. Infection phenotypes (fin erosion, cell apoptosis and muscle degeneration) are direct symptoms of infection. Interestingly, the study also found an important role of commensal bacteria in mitigating against *Bd*'s ability to infect fish larvae, where the intensities of infection were greater when conducted in the presence of antibiotics.

Finally, ballast water released from ocean vessels has been linked to the translocation and introduction of many marine pathogens to new aquatic environments. In the interests of pathogen surveillance and biosecurity monitoring, it was interesting to learn of the development of a new and unique bioluminescence-based method for extracting the ATP from the cell walls of all marine organisms, including those with hard shells, in <5 mins. The method allows for the analysis of organisms that are >50 µm (most often zooplankton), 10-50 µm (which frequently includes phytoplankton), and bacteria, which other current ballast water monitoring systems reputedly struggle to achieve (Aqua-tools, 2017; Anonymous, 2017c). The method ensures that the ballast water treatment system satisfies regulation D-2 of the Ballast Water Convention by the quantification of biological signal from viable and living organisms in ballast water [which states ….. "*Ships conducting ballast water management shall discharge less than 10 viable organisms per cubic metre greater than or equal to 50 micrometres in minimum dimension and less than 10 viable organisms per milliliter less than 50 micrometres in minimum dimension and greater than or equal to 10 micrometres in minimum dimension; and discharge of the indicator microbes shall not exceed the specified concentrations*"] (International Maritime Organization (2017).

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4.4. Listing of Tilapia Lake Virus (TiLV) in QAAD-AP

Dr. Eduardo Leaño presented the assessment of TiLV for listing in QAAD in 2018. The assessment was based on the listing criteria of OIE which include Consequences, Spread and Diagnosis. TiLV satisfied one of the criteria for Consequences by causing significant losses among cultured tilapias in Israel, Egypt and Thailand which were affected by the disease, thus it can be considered for listing. For Spread, TiLV satisfied the criteria for Infectious etiology, as the main causative agent has already been identified as Orthomyxo-like virus. It also satisfied two other criteria: international spread is likely; and, several countries may be declared free of the disease. As such, TiLV fully met the criteria for Spread. For Diagnosis, TiLV satisfied the criterion for repeatable and robust means of detection through RT-PCR, Nested and semi-nested RT-PCR, cell culture, and histopathology.

Discussion (for whole Session 4)

- On IMNV in India, introduction of *P. vannamei* broodstock from Indonesia seemed to be legal, as it was the CA/Government which allowed for such. This was facilitated at the height of AHPND prevention strategy, when importation of broodstock from Thailand (an AHPND affected country) was stopped. Although control on the import of broodstock should have been in place (on both sides), there is still a probability of IMNV-infected animals being included in the imported broodstock.
- The imported broodstock were used directly to produce PLs for stocking in grow-out ponds. IMNV detection and confirmation was through the on-going national surveillance programme, and has been officially reported in QAAD;

- IMNV in Malaysia (?), unconfirmed report.
- The white muscle observed in *Macrobrachium rosenbergii* was in juveniles. This might be similar to the previous cases in PL's (observed and described several years ago by G. Nash) where no pathogen was involved, the cause was identified to be more on environmental factors. In Prof. Flegel's laboratory, some specimens of both *M. rosenbergii* and *P. vannamei* that show white muscles and also have necrotic muscle lesions did not give positive PCR results for any of the known white muscle viruses or with their antibody probes. However, they did find in some of these specimens immunopositive results with Mab against MrNV in grossly normal hepatopancreatic tissue and ventral nerve cord tissue and not in the muscle lesions, suggesting the possible existence of a new nodavirus that cross reacts with the MrNV antibody. This means that the cause of the muscle lesions is still unknown. There is a need to do TEM work on the muscle lesions and the immunopositive tissues of these unusual shrimp specimens.;
- Two isolates of *V. harveyi* in 1999 found positive for PIR toxin did come from diseased shrimp and were proven pathogenic by injection. The laboratory prepared cultures from which toxins were extracted and shown to cause AHPND by reverse gavage tests (unpublished). The geonome of one of the isolates was sequenced and the PIR toxin genes were found to be chromosomal (unpublished). The other isolate was not sequenced, nor was this done for a similar *V. harveyi* isolate acquired in 2010;
- There was one study by CF Lo wherein a *V. parahaemolyticus* isolate positive for the pAP plasmid with PIR toxin genes did not cause any mortality when they did bioassays.
- On TiLV, the effect is more on hybrid tilapia (red tilapia) and at the nursery stage, that is why grow-out is not directly affected in terms of production data. Farmers just tend to breed more (to compensate for the mortalities), to produce more fingerlings that can be stocked in the grow-out ponds. Thus, there is no reason to panic at this stage;
- There is a need to get more information on the environmental factors contributing to TiLV infection. So far, no data to suggest the importance of certain temperature ranges that will trigger infection/outbreak, but it was called "summer mortality syndrome" in Egypt, suggesting that infection occurs at higher temperature.
- At present, in countries which confirmed the presence of TiLV, spread are most linked to the movement of live fish rather than to the probability of infection arising from commercial products (as the likelihood of products being discarded in water bodies is very low by comparison; unless if it is being used as bait).
- Data on actual losses due to TiLV should be collected. The 98,000 MT loss in Egypt suggested by Fathi et al. (2017) was based on "summer mortality" losses of young fish, and did not clearly indicate whether it was directly caused by the virus;
- A recent publication from Thailand (Tattiyapong et al., Vet Microbiol. 207, 170-177) published on line 17 June 2017, stated in the abstract that TiLV isolated in Thailand was propagated in E-11 cell line and used to challenge Tilapia. They reported that "In vivo challenge studies showed that high mortality in Nile (86%) and red tilapia (66%) occurred within 4–12 days post-infection." and that "Our results fulfilled Koch's postulates and confirmed that TiLV is an etiologic agent of mass mortality of tilapia in Thailand. The emergence of this virus in many countries has helped increase awareness that it is a potential threat to tilapia aquacultured in Thailand, Asia, and worldwide."
- On WSD (outbreak in Australia), fishermen usually buy quality prawns as bait wherein some of which are imported. A 70% prevalence of WSSV in shrimp being sold at supermarkets was found. The probability of such as a source of infection has not been determined. However, there has been situation where WSSV was detected in the wild and the cause of this is being investigated. Many fisherman on the river using imported shrimp as bait also raises the question of this as a possible source;
- The first WSD report was in the pond furthest from the river and was the first to be stocked. This was stocked with PL obtained from wild, captured *P. monodon*. The question is, whether the stock used was tested before or after stocking. Ballast water could also be an important source, and this should be tested;
- If it is proposed that the source of the outbreak was shopping-market shrimp used as bait, there is a need to consider the host range of WSSV as there are many crustacean populations in the wild which could act as a host and carrier of the virus. In Iran as example, they only have one crop per year and the ponds were dried for the rest of the year, yet they still get WSSV infection in the next cropping season. This can be explained by the presence of other crustaceans in the wild (water source) that could act as hosts for the virus;

- On IHHNV, since the virus does not have any impact of shrimp culture and production in general, can this be ignored during health assessment of shrimps? In most shrimp culture operations, IHHNV has very low impact on production and there is no need to eradicate the stock even if the virus is present. Usually, SPF *P. vannamei* are highly tolerant to the virus.
- On Scale drop and muscle necrosis diseases (SDMND) in seabass observed in Vietnam, this is totally different from Scale Drop Syndrome (SDS) previously observed/described in Singapore;
- On ISKNV, the virus has a wide host range and geographical distribution in both freshwater and marine fish. The severity of the disease is usually greater in smaller fish from <1g up to 100g. Clinically, fish above 200g are less affected. The difficulty is in differentiating the various disease manifestations caused by ISKNV, RSIV and other viruses in the *Megalocytivirus* genus over a wide range of fish species. The lack of a consistently applied surveillance for *Megalocytivirus* makes it difficult for us to understand the entire range of diseases caused by these closely related viruses. ISKNV is widespread but there is a] need to look closely at its precise classification.
- On EHP, it is still a usual practice in shrimp hatcheries in Thailand to feed the broodstock with live polychaetes for better production of larvae/PLs. Hatchery operators do not screen their live feeds for EHP and nor do shrimp farmers screen the batches of PLs they buy for stocking in grow-out ponds. If hatcheries are really cleaned up and not fed live feeds, then EHP-free PL can be produced;
- Biosecurity-produced polychaetes are now available in Thailand, and registered shrimp hatcheries are required to use such polychaetes. However, they cost more and farmers do not always consider the disease free guarantee when buying. Many farmers still use non-biosecure-produced polychaetes;
- The problem with EHP is the persistence of spores. Farmers can use EHP-free broodstock or EHP-free polychaetes, but if the ponds are not prepared and managed properly, then the hard work can be undone;
- On Infection with *Batrachochytrium dendrobatidis* (Bd), laboratory study shows that they can cause mortality in crayfish, but no record or report of mortality in natural or cultured populations;
- On Streptococcus infection, the pathogen affects several aquatic animals when there are sudden changes in water temperature.

RECOMMENDATIONS

- Since the report of IMNV in India and possibly Malaysia, AG recommended that vigilance for possible translocation of IMNV to other countries in Asia where it is currently not reported be increased. It is also recommended that wild, *P. monodon* captured near Indonesia and used as broodstock in Asian countries be monitored as possible grossly normal carriers of IMNV that might be able to transmit it to their cultivated *P. vannamei*.
- AG recommended that research on mutants and variants or AHPND bacteria be continued so that the basis of virulence, nature of genetic exchange and epidemiology can be better understood.
- AG recommended that research on identification of natural reservoir carriers infected with EHP be given high priority, especially with respect to those commonly used a live broodstock shrimp feeds and larval/PL feeds.
- AG recommended that research on TiLV be continued to understand its variation in virulence (genetic and environmental factors including interaction with other microbes), its global distribution, its global economic impact and the feasibility of developing vaccines.
- AG recommended that TiLV be included in the QAAD list of diseases for 2018.

SESSION 5: REPORTS ON AQUATIC ANIMAL HEALTH PROGRAMMES FROM PARTNER AGENCIES

5.1. AQUATIC ANIMAL HEALTH ACTIVITIES OF THE FISH HEALTH SECTION, SEAFDEC/ AQD

Dr. Rolando Pakingking, Jr. presented highlights of the Fish Health Section (FHS) activities. In 2017, Fish Health Section (FHS) of the Aquaculture Department, Southeast Asian Fisheries Development Center (SEAFDEC AQD) carried out 1 inhouse and 9 externally funded studies under its thematic program "Healthy and Wholesome Aquaculture." These studies aim to (1) investigate the efficacy of probiotics and rationalize the need and application of diagnostics that will ensure biosecurity within culture systems and keep out exotic pathogens, especially trans-boundary pathogens; (2) promote the wider use of conventional diagnostic as well as new methods especially for newly reported, emerging diseases; (3) find effective alternative safe drugs/chemicals (including natural products) to manage aquaculture diseases in lieu of harmful chemicals and drugs whose use has been discouraged or banned due to quality and safety issues; and (4) re-educate stakeholders and develop the capability of fish health specialists on fish disease diagnosis using gross clinical examination, and bacteriology, mycology, parasitology and histopathology techniques.

To realize objective 1, an investigation on the protective effects of *Bacillus sp.* JL47 containing different levels of amorphous Poly-β-hydroxybutyrate (PHB) in a model culture system using gnotobiotic Artemia was conducted. The *Bacillus* isolate was grown to accumulate different levels of amorphous PHB (29% and 55% PHB on cell dry weight) and was fed to gnotobiotic Artemia nauplii during a *Vibrio campbellii* LMG 21363 challenge test. The results showed that Artemia nauplii fed the *Bacillus* sp. JL47 containing 55% PHB attained a significantly higher survival than those Artemia fed the *Bacillus* sp. JL47 containing 29% PHB. Moreover, a complete protection against pathogenic *V. campbellii* was observed in *Artemia* fed the Bacillus sp. JL47 containing 55% PHB since no significant difference was observed between this treatment and the non-challenged control. The data suggest that, the protective effects of *Bacillus* sp. JL47 is superior when it contains higher amount of amorphous PHB and that the amorphous PHB is suggested to be a main determinant in the protective effect of the *Bacillus* sp. JL47. In another study, *P. monodon* PL (1.75 cm ± 0.75 S.D.) were acclimatized for a week and cultured for 30 days in 50 L nursery tanks at 5 shrimps L^{-1}. Shrimps were fed shrimp diet supplemented with PHB-accumulating *Bacillus* sp. JL47 at 5 g kg^{-1} feed (0.5%). Shrimps fed diet without *Bacillus* sp. JL47 supplementation was used as control. At 7,14, 21 and 30 days of culture (DOC), 30 shrimps from each tank were transferred in glass aquaria containing 7 L seawater and subsequently bath challenged with *V. parahaemolyticus* 1213 strain at a dose of 1×10^5 cell mL^{-1} for 24 h. Shrimps were eventually monitored for 7 days. Results showed that survival in all treatments was very low in shrimps challenged after 7 (0% survival in all treatments), 14 (control: 0% survival; JL47: 0.83% survival) and 30 days (control: 16.7% survival; JL47: 14.8% survival) of feeding (treatment). However, at 21 DOC, challenged shrimps fed with *Bacillus* sp. JL47 showed higher survival (52.5% survival) compared with the control (16.7% survival).

The practical applications of commercial probiotics (PRO W, PRO 2) and disinfectant (PUR) to control acute hepatopancreatic necrosis disease (AHPND) and luminescent vibriosis in *P. vannamei* in penaeid shrimps have been also undertaken. Ongoing activities focus on the effect of PRO 2 on the bacterial level/ load and composition in the gut of *P. vannamei* and rearing water and effect of PRO W on water quality and as well as growth and survival of *P. vannamei* when added in the rearing water. In addition, the effects of INVE probiotics (PRO W, PRO 2) and disinfectant (PUR) on the survival of *P. vannamei* against *V. parahaemolyticus* and *V. harveyi* challenge are being examined.

In an attempt to determine the microbial quality of oysters grown in Capiz province, major oyster production sites located along the coastal villages of Roxas City (Culajao [n=3 sampling stations] & Cagay River [n=5]) and municipalities of Ivisan (Cabugao Bay [n=7]) and Panay (Culajao River [n=5]), Capiz province, Panay, Western Visayas, Philippines, were examined monthly for their microbiological quality, i.e. quantity of *Escherichia coli*, *Vibrio cholerae, V. parahaemolyticus*, and *Salmonella* in oysters' meat and intervalvular fluid and fecal coliforms of the rearing water, over a period of 2 years. The monthly coliform count in the water samples collected from all sampling stations were generally high (≤ 540 MPN/100 ml) regardless of the sampling period (wet or dry season). Similarly, the monthly *E. coli* count in oysters' meat and intervalvular fluid were typically high (330~24,000 MPN/100 g) particularly during the warm dry months of the year, i.e. April to June. *V. cholerae* was not detected in any of the oyster samples examined while *V. parahaemolyticus* count was within acceptable range. *Salmonella* was erratically detected in oysters collected from all sampling stations examined. Relaying oysters in an approved area in Cabugao Bay was likewise attempted. As a result, *E. coli* count in contaminated oysters significantly dropped from 24,000 MPN/ 100g to ≤ 20 MPN/ 100g after 2 weeks of relaying, suggesting the practicality of this technique in rendering raw oysters safe for human consumption. Taken together, current data indicate the urgent need to improve the quality of raw oysters cultured in these sites through the adoption of environment friendly culture methods such as raft or long line together with the establishment of a National Shellfish Sanitation Program whose primary task shall include continual monitoring of the microbiological quality of oysters and their culture environments.

To address objective 2, i.e. promote the wider use of conventional diagnostic as well as new methods especially for newly reported, emerging diseases, studies focusing on the prevention and mitigation of diseases in cultured mud crab and development and acceleration of rapid and effective fish and shrimp health management have been conducted. Ongoing experiments include the determination of the threshold levels for WSSV in the water, soil, and system of mud crab that may result in infection and mortality or outbreak are currently being examined in vitro and in vivo. Future activities including the formulation of practical management scheme that will prevent disease outbreak related to environmental conditions or WSSV through the application of different lime concentrations, crack drying of soil, use of greenwater system and fermented *Moringa* sp. (malunggay) will be also undertaken.

In addition, studies involving the application of adjuvants, carriers and RNAi technology to enhance the antiviral immune response of shrimp to WSSV, enhancement of vaccine efficacy for the prevention of viral nervous necrosis in high value marine fish, and establishment of protective measures against persistent and emerging parasitic diseases of tropical fish have been likewise undertaken to address objective 3.

Finally, to achieve objective 4 which is to re-educate stakeholders and develop the capability of fish health specialists on fish disease diagnosis using gross clinical examination and bacteriology, mycology, parasitology and histopathology techniques, an on-site training course on *Health management of parasitic diseases of freshwater fish species* was conducted at the Fish Health Laboratory (FHL) of the Marine Research and Development Center (MARDeC) in Sihanoukville, Cambodia from 6 to 10 December 2016. Staff of the Department of Aquaculture Development (5 participants), National Aquaculture Research and Development Institute (2), Freshwater Aquaculture and Development Center (2), and MARDeC (2) participated in the training. Lectures and hands-on exercises focused on parasitic diseases of freshwater fish species such as snakehead, catfish, and tilapia collected from different earthen ponds in Sihanoukville. Updates on acute hepatopancreatic disease of penaeid shrimps were likewise presented.

From the 1st to 3rd quarter (January to August) of 2017, AQD'S Fish Health Section's diagnostic cases include the detection of shrimp viruses (WSSV: 15 positive/ 235 total number of specimens/cases examined (6.4%); IHHNV: 36/119 (30.2%) and bacteria (VP_{AHPND}): 21/104 (20.2%), and fish virus (NNV: 0/6 (0%).

Discussion

- On *Salmonella* in cultured oysters, detection was based on standard methods and no serological studies were done;
- Oysters were cultured at salinity range of 25 ppt (rainy season) to 35 ppt (dry season), and Salmonella can survive these conditions especially if they are already in the flesh of the oysters;
- There has been a lot of reports on Salmonella in the marine environment, which clearly indicate potential zoonotic effect. This should be monitored and observed more closely.
- It is a common practice that before oysters reach the market, they have to undergo depuration. This will at least reduce the bacterial load (including *Salmonella*) of oysters prior to consumption. Also, Government usually announce "no eating of raw oysters" during some season when *Salmonella* count is high. In the Philippines, people are usually discouraged to eat raw oysters;
- Other concerns in eating raw oysters are the heavy metal contents and presence of hepatitis virus, which cannot be removed by depuration. Heptatitis is the most dangerous infection as a consequence of eating raw oysters;
- there was a case of raw scallops exported from the Philippines to the USA and then eaten as sashimi in Hawaii, and there were reported cases of human infection;
- On diagnostic capacity of Myanmar, Cambodia and Laos, it is good to know their progress from level I to level II, through the SEAFDEC support programme.
- Myanmar is one of the top 10 aquaculture producers in the world, and it is high time that AAH management is being developed as well. One of the problem was the movement of staff (trained in AAH management and

diagnostics) to other government sectors (e.g. livestocks). Forming the linkages between the Government DoF, industry and academe is, therefore, critical in the development of AAH capacity of Myanmar and other developing countries;

- One way to assess the AAH capacity of the country is through OIE-PVS assessment. Only a few countries in the region have made a PVS for aquatics. Often the PVS assessment is so laborious which may explain why only few have proceeded with this;
- One of the problems in some of the developing countries is, training is given but there is no industry (aquaculture) drive to force improvement in disease diagnostics and other AAH management activities. This is the current scenario in Cambodia and Lao, but Myanmar has all the potential to fully develop its aquaculture industry soon.

Recommendations

- AG recommended that a mapping exercise should be done, as there are many activities that are being implemented by different organizations/institutions. Otherwise, it is very difficult to trace what is going on. Countries will always welcome development assistance and input from anybody, and such mapping exercise will be able:
    - To see all the activities implemented across the ASEAN region;
    - To identify areas where there is a lack of focus and where there is a need to strengthen collaboration/inputs;
    - To put coherence on the several supports that the country are receiving that will make better use of the project grants.

5.2. AAH Activities of OIE Regional Representation in Asia and the Pacific

Drs. Hirofumi Kugita and Jing Wang presented updates on aquatic animal health activities by OIE Regional Representation in Asia and the Pacific. OIE RRAP conducted several activities related to aquatic animals, including OIE Reference Centres Meeting for the Asia-Pacific, teleconferences about the AAHSC report as well as the letter from the President of the Regional Commission on “Enhancing the performance of Aquatic Animal Health activities in the region”. Further actions will be taken to improve the engagement of aquatic animal sectors in the OIE activities during coming events, such as the 30th OIE Regional Conference for Asia, the Far East and Oceania and the Regional Workshop for National Focal Point for Aquatic Animals.

The situation of aquatic animal disease reporting (WAHIS six-month report & QAAD report) in the AP region was informed. OIE RRAP also called for the suggestion from the AG to further encouraging Member Countries to engage in aquatic animal disease reporting. The World Animal Health Information System (WAHIS) renovation concept (WAHIS+) as well as the technical support to harmonization of QAAD report and WAHIS was introduced. Once developed, NACA/OIE RRAP staff will be able to access new WAHIS+ system and review local reports to extract necessary information monthly or quarterly. However, additional NACA specific information such as non-OIE listed diseases, which is not within the mandate, may not be accessible via the WAHIS+ system.

Discussion

- WAHIS+ will include previous OIE database into the new system (but not the none-OIE data). The move of OIE-RRAP to request the inclusion of non-OIE listed diseases into the system which will cater the need of the QAAD AP reporting system;
- In the new WAHIS+, NACA will also be given an account to access the system and extract data that will be useful for QAAD Reporting system;
- During the 1990s to 2000s, there was no WAHIS and reporting was dependent upon the competent authority of the country. Some of the OIE Delegates then usually did not report frequently on aquatic animal diseases as they were tucked away at the bottom of a long list of terrestrial diseases.
- On encouraging Member Countries to report, it is important that strong links between the OIE Delegate and the competent authorities (National Focal Points for Aquatic Animals; NFP-AA) are made for comprehensive

reporting – a platform needs to be made where these two can sit together. Thailand has been very successful in doing this, and there is a need to look at this at regional level from the context of aquaculture;

- AP is the major aquaculture producer in the world. Although Member Countries are becoming more active in the OIE Aquatic Standards Setting Process, aquatic animal disease reporting is way far behind compared to terrestrial animals. For OIE, the focus has to be on the OIE Delegates and FPs, and the motivation that should be put onto them is for them to engage more with their fisheries counterparts.
- One of the previous suggestions in resolving this gap between the NFPs and Delegates is through the OIE Seminar for NFP-AA (planned every 2 years), i.e. to bring the Delegates in the meeting to update and communicate with them key information on AAH. In many cases, the veterinary service is responsible for reporting on the aquaculture sector but unfortunately their focus is on terrestrial and do not take the aquatic sector seriously;
- With the continuous increase in aquaculture production in the region, the NFP-AA are indeed pushing hard to effect changes in OIE and its reporting to OIE;
- On motivating Governments to take aquatic animal health management seriously and to take action when they do listen, this might probably happen when zoonotic aquatic animal diseases emerge, only then they will take things seriously. Another problem is the way that aquatic species are taught in University veterinary courses – perhaps just a couple of hours dedicated to fish/aquatic animals. There is a need to effect a shift in focus and to show that aquatic species need more attention;
- The reporting system already generated a lot of data, and there might be some way to analyse these retrospectively (e.g looking at the trends of reporting, emerging diseases, etc.). Analysis depends for what purpose the data will be used. The main purpose of data collection is gathering of information on the presence or absence of diseases in each participating country. There are things to pull out but the nature of the data needs to be considered very carefully. This goes back to what sort of data should be requested and be able to justify why this sort of data is being asked for. The WAHIS+ should allow for users to conduct their own analysis to some extent.

RECOMMENDATIONS

- AG recommended that actions should be taken (by OIE and NACA) on establishing stronger links between Aquatic Focal Points and the OIE Delegate of each member country, and to motivate Delegates to be engaged more on aquatic animal counterpart rather than focusing solely on terrestrial animals;
- AG recommended that the need to effect a shift in focus and give a bit more attention to aquatic species should be pursued and promoted to existing veterinary courses and trainings at a national level.

5.3. ACTIVITIES OF AAHRDD ON AQUATIC ANIMAL HEALTH (2016-2017)

Dr. Janejit Kongkumnerd presented the on-going aquatic animal health programmes of Thailand. Aquatic Animal Health Research and Development Division (AAHRDD) has been set up in 2016 which combined the Inland Aquatic Animal Health Research Institute (IAAHRI) and Coastal Aquatic Animal Health Research Institute (CAAHRI). AAHRDD takes responsibilities on undertaking research (e.g. aquatic animal immune mechanisms, spread, prevention, and treatment of diseases in aquatic animals), planning and conducting aquatic animal disease surveillance, notifying disease and epidemiological information to OIE, monitoring hygiene of farms and declare disease-free farms for aquatic animal exportation, and establishing and maintaining ISO/IEC 17025 accredited laboratory for aquatic animal health and providing disease diagnosis services.

AAHRDD consists of four groups at the main office in Bangkok and one regional center in Songkhla province:

1. Aquatic Animal Health Research and Development Group;
2. Aquatic Animal Diseases Surveillance and Control Research and Development Group;
3. Drugs and Chemicals Control Research and Development Group;
4. Aquatic Animal Health Certification Research and Development Group;
5. Songkhla Aquatic Animal Health Research Center

Below are the activities of AAHRDD in 2016-2017:

Aquatic animal disease surveillance and monitoring programme. Surveillance and control the aquatic animal diseases following the OIE list and other diseases which make economic or environmental losses to the country. This is regularly done among registered farm establishments intended for export of aquatic animal from Thailand

GAP for hatchery of SPF Pacific white shrimp (*Litopenaeus vannamei*). DOF implements a new mandatory agricultural standard, Thai Agricultural Standard (TAS 7432-2015)-Good Aquaculture Practices for Hatchery of SPF Pacific white shrimp (*Litopenaeus vannamei*). This standard was enforced in June 2017 which covers *L. vannamei* hatcheries, in order to obtain nauplii free from target diseases: WSSV, YHV, TSV, IHHNV, IMNV and AHPND.

ANAAHC Activities. The 1st ANAAHC Meeting on Implementation of Standard Operating Procedures (SOP) for Responsible Movement of Live Aquatic Animals was held on 20-21 June 2017 at Miracle Grand Hotel, Bangkok, Thailand through collaboration with DOF Thailand and NACA. There were 32 participants from 7 countries: Brunei, Indonesia, Lao PDR, Malaysia, Philippines, Thailand and Vietnam. All the participants realized the importance and agreed on the implementation of SOP, and will establish national protocols for movement of live aquatic animals.

ANAAHC and SEAFDEC/AQD also worked on a project proposal on "ASEAN Regional Technical Consultation on Aquatic Emergency Preparedness and Response Systems for Effective Management of Transboundary Disease Outbreaks in Southeast Asia" which is now submit through ASEC for fun support of the Japan-ASEAN Integration Fun (JAIF). The project is expected to be hold in early 2018 in Bangkok.

Emerging Disease: TiLV. In Thailand Tilapia Lake Virus Disease (TiLVD) was initially reported in 2017. The affected fish samples tested by RT-PCR were positive for TiLV, however most of them were also infected by bacteria and/or external parasites. Although TiLV has been found in Thailand, the production of tilapia has not been significantly reduced. Tilapia production statistics in Thailand from 2012 to 2016 shows a slight decrease which was correlated with the reduction of culture areas. Though Tilapia lake virus disease (TiLVD) is an emerging disease and not listed in OIE, the DOF, competent authority for aquatic animals, pays attention to this disease. Therefore DOF has put in place the action plans for prevention and control of TiLV as follows:

- Disease diagnosis preparedness: DOF has the diagnostic capacity for both virus isolation in cell culture and PCR techniques.
- Surveillance and monitoring program: DOF has taken action on TiLV surveillance (active and passive) and monitoring program in both exporting and non-exporting farms.
- Exporting farms must be registered and fulfill “aquaculture establishment for export standard”. This standard requires
    - Biosecurity measures in place;
    - Farm must be inspected at least 2 times a year;
    - Fish samples must be taken at least 2 times a year for disease surveillance according to OIE Aquatic Code.
- Communication: DOF organized meetings for fish farmers for sharing information on TiLV as well as finding solution.
- Research on TiLV especially in field of epidemiology such as identifying the potential factors associated with TiLVD.

Discussion

- On TiLV surveillance and testing, cell culture and PCR are used;
- On TiLV management, active surveillance is being undertaken among exporting farms (mainly fry producers) to ensure that the produced tilapia are free from TiLV. Surveillance for other farms are also currently undertaken. The problem, however, there are too many small-scale farms (total number of tilapia farms in the country is more than 100,000);

- The total number of farms has to be highlighted because it emphasises how many farms need looking for disease surveillance. This is important when reporting the aquatic animal health activities to the Government compared to terrestrial farms which is much lower in numbers;
- Thus, status of TiLV in tilapia is still not available especially for small scale farms. These farms, however, were already advised to stock disease free fingerlings. Most tilapia produced from the Thailand is for domestic consumption only, and only fry and fingerlings are exported;
- Farm registration system in Thailand is very good, and all registered farm is covered under the surveillance system (it is costly but is being done), and government has to make sure that all tilapia exported from the country are free from TiLV;
- This current problem might lead to setting-up of a national board for research (production or market research). Thailand used to have the WSSV board, but this was temporary while WSSV was a big problem in the shrimp industry. It would be good to have a permanent aquatic animal health board, and TiLV situation can be used for future development.

Recommendations

- AG recommended that Thailand should consider establishment of a permanent National Board for Research for important and emerging aquatic animal diseases, highly considering TiLV as a current example.

5.4. AAH Activities of Australia

Dr. Ingo Ernst presented updates on aquatic animal health activities of Australia. These include their national Aquatic Animal Health Program where national coordination covers aquatic animal health management, surveillance, diagnostic capability, disease reporting, training, emergency disease preparedness and response. The status of the government's international engagement was also presented including marine pest management (development programme for looking at molecular methods for the detection of pathogens in marine plankton samples); ballast water measures in place and testing (e.g. biofouling with oysters positive for OsHv moving between Australian states found); exports (trade standards branch); and quarantine policy (biosecurity).

Australia's national strategic aquatic plan (AQUAPLAN) covers both tropical and temperate aquaculture (biosecurity, disease preparedness, diagnostics, etc). Current projects are looking at abalone herpesvirus, pilchard orthomyxo-like virus, yellow head virus (new genotypes turning up), *Perkinsus olseni* (molecular detection is problematic; linked to the sensitivity of what tissues are sampled).

The next round of Regional Laboratory Proficiency testing Program was also presented which will be implemented in 2018. Status on WSD of shrimps was also discussed.

Discussion

- On WSD outbreak, first infection began quite a few days between when the farmer noticed a problem and then when it was confirmed. The farm noticed some mortalities (over the weekend) and so it was a few days by the time official samples were taken and confirmed;
- The affected farms will remain dry for the next season. Difficult policy questions now are: what would happen if the farm were infected again? What the compensation costs might be? There is a marine park nearby, for example, but the nearest neighbouring shrimp farm is around 100 km away;
- On eradication, too much chlorine was used and it definitely has a negative effect on the environment. What was done, however, was to hold the treated water inside the pond for a period of time until the residual level is low, before they were discharged;
- Australia is a model for Asia, especially on the way this situation (WSD) was handled and how the entry of exotic disease is prevented. There have been other introductions in the past (e.g. EUS), but then the nearest incursion was with OsHv which has spread to Tasmania (which produces most of the spat). NSW is now trying

to set-up hatcheries as spat are needed, and they do not want to accept the risks of taking spat from Tasmania;

- Australia also had emergency exercises in the past and have looked at what worked out and what did not. An emergency laboratory network did work well – quality control , proficiencies and consistent performance. During disease emergencies, there is a need to accommodate a surge of samples with other laboratories for testing.
- For WSSV, a contingency plan is already in place which was very useful. However, there was no response agreement between Industry and Government – so there was lots of stress for farms and whether they would get compensation, otherwise they would be bankrupt;
- All the farms in the area are now dry and surveillance in place at 40 sites throughout the bay. If WSSV is in the wild, then there is a need to reengineer how the farms are operated;
- Before the outbreak, there was no surveillance in place for WSD. In 2001, there was an incidence in Darwin at an aquaculture facility where it was noticed that the prawns being used to feed animals had WSSV or were subsequently found to be WSSV positive. All the animals were destroyed and the entire facility was decontaminated;
- An epidemiological study looked at reverse tracing to look at routes. Outbreak is not linked to broodstock (but still under investigation), but a likely pathway is bait;
- This could serve as a lesson learned for Thailand in case of IMNV threat, as it will surely be a big disaster if IMNV comes to the country. There is a need to set-up a similar scheme in the event that IMNV comes in, so that the concerned authorities can respond quickly;
- Decision makers/officers should be brave and strong as there is a need to implement drastic measures to eradicate infected stocks, especially when talking compensation for the farmers (none of the losses were insured, thus no compensation was granted). Additionally, they have to answer questions from Government officials and the media.

RECOMMENDATIONS

- AG recommended that Australia's response to WSD should serve as a lesson or guide to other countries when new disease threat comes in. Example is on the imminent threat of IMNV in the shrimp industry in the region.

5.5. AAH ACTIVITIES OF CHINA

Dr. Jie Huang presented updates on aquatic animal health activities of China. China produced 69 million tons of aquatic products in 2016, of which 74.5% were produced by aquaculture industries in 8.35 million ha production area. The major aquaculture species included grass carp, silver carp, common carp, bighead carp, crucian carp, tilapia, large yellow croaker, sea bass, flounders, white leg shrimp, fresh water crayfish, Chinese mitten crab, oysters, clams, and scallops. China has well developed aquatic animal health services under the competent authority of Bureau of Fisheries and Fisheries Law Enforcement (BOF), Ministry of Agriculture (MOA), with 1886 licensed veterinarians, 1206 licensed veterinary assistants, and 16183 registered village veterinarians for aquatic animal health. The aquatic animal disease surveillance programs include passive aquatic animal disease monitoring and reporting based on clinical signs at 4122 reporting sites in 31 provinces, and active targeted surveillance program for 8 aquatic animal diseases based on molecular diagnostics.

The national level communication on AAH was through working meetings, such as summary workshop on national surveillance, workshop of the Commission of Experts for AAD Control, national conference on AAD. Training courses for aquatic animal monitoring, reporting and information communication for surveillance, laboratory diagnostic technology of AADC System, and Official Veterinarians for aquatic animals were organized officially at national level. Other training courses were also frequently organized by provincial and municipal AAHS, institutions, or private sectors. Nationwide laboratory proficiency testing was organized by AAHS with 93 laboratories for 7 diseases, which reached 90% satisfaction in total. China established a web based platform for national remote diagnosis network of aquatic animal diseases and 36 provincial remote diagnosis platforms in 27 provinces with 2013 users. The platforms received 5.3 million visits and provided 1113 expert diagnosis in 2016. Surveillance on AMR of aquatic animal pathogenic bacteria covered 12 provinces, 10 aquatic animals, 908 bacterial isolates, and 15 antibiotics. There were also many other activities on standardization for aquatic animal disease control, international cooperation, and research programs.

Progresses on shrimp disease research were also introduced for the surveillance on EHP, WSSV, VP_{AHPND}, IHHNV, CMNV, SHIV, YHV, and TSV. A new genotype of YHV-8, a new virus SHIV (shrimp hemocyte iridescent virus) under the proposed *Xiairidovirus* nov. gen., and a strain of *Vibrio campbellii* carrying pirAB genes and causing AHPND were reported. Biosecurity concept was introduced as the resolution for aquaculture health management. The risk based ideology concept brought new features different from traditional disease control and health management. Globe, country, zone, and farm levels of biosecurity plan were characterized with rules of standards, regulations, agreements, or protocols. A five-level biosecurity grade based on implementation of biosecurity plan at farm level were suggested, which include BSG1 for contingent control, BSG2 for preventative control, BSG3 for risk control, BSG4 for systemic disease-free, and BSG5 for official certification.

DISCUSSION

- The national surveillance programme started before 2007 (maybe 2005) but initially involving few provinces. More provinces joined the programme in the later years, especially the major aquaculture-producing provinces. For monitoring and reporting, all aquaculture-producing provinces are involved. Currently, TiLV is still not covered under the programme.
- On Jade perch (*Scortum barcoo*) which is quite popular in China, there is no information on its culture. Usually, newly introduced species are still not included in the national statistics.
- On *Xiairidovirus* nov. gen., it might be the same as Iridovirus in Crayfish which was included in the QAAD list for 2017.
- On CMNV, epidemiology research is on-going and found many positive cases from farmed and wild shrimp, even samples obtained from the Antarctic. How this disease causes mortality is still not very clear.
- The Disease Card for CMNV was prepared last year but got a lot of comments from the AG and some of these are related to infection and to the localisation of the virus. If this can be demonstrated, then the Disease Card can be finalised.

RECOMMENDATIONS

- AG recommended that the Disease Card on CMNV should be finalized by providing more information on the pathogen and its effects on host (e.g. pathogencity studies, localisation of the virus, etc.), especially now that the disease is already included in the QAAD list.

5.6. AAH ACTIVITIES OF INDONESIA (INVITED PRESENTATION)

Ms. Mukti Sri Hastuti presented updates on aquatic animal health activities of Indonesia. Indonesian Competent Authority dealing with aquatic animal health is Directorate General of Aquaculture (DGA) under The Ministry of Marine Affairs and Fisheries and has close collaboration with Fish Quarantine Agency and Marine and Fisheries Research Agency. There are 5 main programs implemented: 1) Diseases control; 2) Fish medicine control; 3) Residue monitoring; 4) Water quality monitoring; and, 5) Laboratory and Indonesia National Standard Development.

Diseases control is being implemented by the DGA and Fish Health Development which undertake the following activities: a) Surveillance, monitoring and reporting; b) National diseases concern; c) Import Risk Analysis; d) Vaccination; e) Farm level biosecurity; and, f) Emergency response and contingency planning.

Based on DGA Decree in 2017, surveillance and monitoring for 14 fish/shrimp diseases (national concern) in 115 districts were targeted. The National reference and testing laboratories are designated by DGA. The fish/shrimp diseases surveillance and monitoring results are inputted in an online system in District Fisheries Office and DGA-

Technical Implementing Unit, and can be accessed through www.impikan.kkp.go.id. The national fish/shrimp diseases list is reviewed every 2 years.

Import Risk Analysis is implemented by collaboration among DGA, Quarantine Agency and Research Agency based on Ministry of Marine Affairs and Fisheries Decree. The National Fish Vaccination Program started in 2009 and in 2017, local vaccines were developed from major aquatic animal pathogens including *Aeromonas hydrophila*, *Streptococcus agalactiae, Edwardsiela ictaluri*, Polyvalent *Vibrio*, Viral Nervous Necrosis (VNN), Mycobacterium, Koi herpes virus (KHV), and also their combination. Some vaccines were imported from other countries such as those for Iridovirus, *Streptococcus iniae* and KHV.

Farm level biosecurity implemented in traditional shrimp farms and emergency response and contingency planning is continuing under the FAO TCP/INS/3402 program. For the Fish medicine control implemented by the Directorate of Fish Feed and Fish Medicine Development, some activities include: a) Development of fish medicines monitoring system; b) Assessment of fish medicine usage in aquaculture; c) Determination of withdrawal time of authorized antimicrobials for B1 group; and, d) Antimicrobial resistance evaluation. The fish medicines monitoring system obliged manufacturers and suppliers to register all fish medicines which will be traded in Indonesia. Assessment of fish medicine usage in aquaculture is conducted in 19 provinces, which are targeted for drug residue monitoring. Residue monitoring is conducted by Directorate of Aquaculture Area and Fish Health Development, including: a) National Residue Monitoring Plan; b) Residue testing; c) Development of information system on residue control management; and, d) Capacity improvement of national and local staff.

Water quality monitoring is implemented by the Directorate of Aquaculture Area and Fish Health Development. Activities include: a) Water quality monitoring and reporting; b) Mapping of appropriate area for aquaculture; c) Mapping on the eutrophication status of the reservoir; and d) Controlling waste disposal from the fish/shrimp ponds. Water quality monitoring and reporting is undertaken in 115 districts which are targeted for fish/shrimp diseases surveillance and monitoring. The mapping of appropriate area for aquaculture focussed on mollusk culture, since exported mollusk from Indonesia is banned by the European Union countries.

Laboratory development and national standard is under the Directorate of Aquaculture Area and Fish Health Development, activities include: a) Maintain and expand the laboratory capacity; b) Maintain and expand the scope of ISO accreditation; c) Strengthening the role of POSIKANDU and provide better laboratory services; and d) Developing National Standard correlating with fish health issues. Indonesia has 15 fish disease laboratories under the DGA, 47 laboratories under Quarantine Agency and 3 laboratories under Research Agency and more than 75 under the Provincial/District Fisheries Office. Two laboratories under the DGA have twinning program with OIE Reference Laboratory since 2015. The Sukabumi Laboratory with National Research Institute of Aquaculture Japan for KHV, and the Situbondo Laboratory with University of Arizona Laboratory, USA for shrimp diseases. DGA also encourages the laboratories to be ISO 17025-accredited laboratory, and at present, there are 13 laboratories that have accreditation while 2 more laboratories are under process.

Discussion

- On becoming OIE Reference Laboratory after a twinning programme is finished, OIE recognition is through application from the concerned laboratory. OIE will evaluate the application through the Aquatic Animal Health Standards Commission. Then this will be recommended to the Council and then to the Assembly for endorsement and approval;
- OIE Reference laboratory also depends on the available expertise (e.g. Don Lightner's lab for several shrimp diseases, which is now non-existent after Lightner retired). Other criteria to be considered are the capacity, facility and available expertise in the laboratory and the support of the CA;
- On VNN, vaccine is applied to 10-cm fingerlings by injection to prevent infection;
- The online reporting system involves reporting from the local district level to the provincial level, and from provincial level to the Centre;

- Importation of probiotics are banned, and local probiotics are produced within the county for use by the farmers;
- For herbal treatment, the concoction is composed of a mixture of 5 species of herbs, and used to treat bacterial infection (e.g. *Aeromonas*);
- There is a need to pay particular attention to the detection of IMNV from Indonesia and a good bilateral cooperation and responsibility for testing and communication. This is with regard to the reports of IMNV in India and unconfirmed report from Malaysia. IMNV, as mentioned in several previous AGMs, could be the next big problem for the shrimp industry in the region
- There were cases in China wherein similar disease signs in shrimps were observed, but was PCR-negative for IMNV.

Recommendations

- AG recommended that necessary actions should be taken by Indonesia, as well as other by neighbouring countries, to prevent the further spread of IMNV.

Session 6: Disease Reporting

6.1. QAAD Reporting and Revision to the QAAD List

Dr. Eduardo Leaño presented the status of QAAD Reporting in the Asia-Pacific region. Now on its 19th year, a total of 75 QAAD Reports were published. Hard printed copy of the report has been stopped since the 3rd quarter of 2015 while the first purely web-based report (e-copy) commenced in the 4th quarter of 2015. Records show that downloads of each published e-copy (from NACA website; no record can be obtained from OIE-RRAP website) were still low, ranging from 90-160 download per report. Thus the questions “Is dissemination of information wide enough?” and “Are readers losing interest? And why?” have been raised. It is hoped that download records will improve as NACA and OIE-RRAP continue to promote the report through their respective websites.

The number of countries submitting quarterly reports continues to decrease, with only around 14 countries (41% of the 33+1 participating governments) regularly submitting reports. The question therefore remains on what can be done or what actions are needed to revive the interest of most, if not all, participating governments to submit disease report regularly. Four new diseases (as endorsed by AG15) has been included in the 2017 list of diseases (under non-OIE listed diseses) including carp edema virus, Viral covert mortality diseases of shrimps, *Spiroplasma eriocheiris* infection, and Iridovirus in crayfish. Of these newly added diseases, Carp edema virus among Koi carps has been reported by India during the first quarter of 2017.

For OIE, Dr. Ingo Ernst reported that the only changes in the list is the change in the name of crustacean diseases to “Infection with (pathogen)” except for AHPND, and a new chytrid disease of salamander (refer to Session 2.2).

Discussion

- Looking at reporting, there is more diligence in reporting terrestrial diseases than aquatic diseases. There is great work being done but more action is still needed for compliance in disease reporting.
- Some governments cannot cope with the rapid growth of aquaculture, and most still think aquaculture is not as important as the other industries. For example, pangasius culture in Vietnam quickly grew from a small industry to nearly one million tons production.
- Disease reporting is critical, if the CAs don’t report and someone else reports, then control of the flow of information as well as the right to control reporting are lost. Familiarity with aquatic animal diseases is also lacking – those responsible for national reporting are perhaps not familiar with aquatic species and their diseases.
- Yearly statistics on the number of countries reporting might be similar to the quarterly statistics, i.e. ca. 40% of 33+1 countries. Report from China, as the top aquaculture producer in the world, is really needed in the QAAD Report;

- For other countries which are not submitting reports, it maybe that aquaculture is not so important industry in the state, thus this can be somehow ignored;
- Currently, the QAAD Form is in Excel and Word format, and in some countries, the OIE NFP-AA regularly prepares the report, but there are bottlenecks in getting these signed off and submitted by the OIE Delegate;
- The frequency and quality of reporting is really dropping off and it is a shame that reporting obligations by OIE Member Countries are not being fulfilled, more so that important diseases are not being reported on;
- Another recommendation to the OIE NFP-AA is for them to have a more active role in the country. In the OIE focal point meetings, this (the importance of reporting) needs to be emphasised. There is a need to find out what the problems /challenges are in reporting.

RECOMMENDATIONS

- AG recommended that the QAAD results need to be reported back to raise awareness and to support national biosecurity planning. This should be brought up at the next NACA Council Meeting. Before the 20th year of reporting, it would be good to look back and prepare a document (as support paper) of what has been achieved so far;
- AG recommended to adopt the OIE changes in the names of crustacean diseases (Infection with “pathogen”) in the QAAD Form for 2018 reporting;

SESSION 7. ANTIMICROBIAL RESISTANCE (AMR)

Dr. Melba Reantaso made an introduction about AMR which refers to a condition whereby microorganisms (e.g. bacteria, fungi, viruses and parasites affecting humans, terrestrial & aquatic animals and plants) become resistant to antimicrobial agents, thus making infections or diseases caused by such microorganisms more difficult or impossible to treat. An antimicrobial is any substance of natural, semisynthetic or synthetic origin that kills or inhibits the growth of microorganisms but causes little or no damage to the host; all antibiotics are antimicrobials, but not all antimicrobials are antibiotics. Antimicrobials play a critical role for ensuring health and productivity; however, their misuse and the associated emergence and spread of antimicrobial resistant microorganisms place everyone at great risk.

Antimicrobial resistance happens when microorganisms (such as bacteria, fungi, viruses, and parasites) change when they are exposed to antimicrobial drugs (such as antibiotics, antifungals, antivirals, antimalarials, and anthelmintics). Microorganisms that develop antimicrobial resistance are sometimes referred to as “superbugs”. Antimicrobial resistance occurs naturally over time, usually through genetic changes. However, the misuse and overuse of antimicrobials is accelerating this process.

Antimicrobial resistance is a complex problem that affects all of society and is driven by many interconnected factors. Single, isolated interventions have limited impact. Coordinated action is required to minimize the emergence and spread of antimicrobial resistance.

To support the implementation of FAO’s Conference Resolution 4/2015, an AMR inter-departmental working group was formed. This inter-departmental FAO Working Group meets on a regular basis, chaired by Chief Veterinary Officer Dr Juan Lubroth and brings together FAO officers from Animal Health, Animal Production, Codex Alimentarius, Fisheries, Food Safety and Plant (regional and country offices), FAO brings multidisciplinary expertise (from animal health, livestock and production, food and feed safety, plant health and production, fisheries and aquaculture, legislative contexts, etc.) that is needed to address a cross-sectoral issue such as AMR. FAO contributes to many aspects of ONE HEALTH through its multi-disciplinarity. Each of these aspects were considered in developing the FAO Action Plan (in support of WHO’s Global Action Plan on AMR) and implementing at national and regional levels. FAO’s Plan of Action on AMR (2016-2021) has four pillars: (1) awareness: improve awareness on AMR and related threats; (2) evidence: develop capacity for surveillance and monitoring of AMU and AMR in food and agriculture; (3) governance: strengthen governance related to AMU and AMR in food and agriculture; and (4) practices: promote good practices in food and agricultural systems and the prudent use of antimicrobials

AMR in aquaculture is now a new area of emphasis and high work priority of FAO's Department of Fisheries and Aquaculture. An ongoing project "Strengthening capacities, policies and national action plans on prudent and responsible use of antimicrobials in fisheries (aquatic animal health and aquaculture component)" provides assistance to four countries (China, Malaysia, the Philippines and Viet Nam) in developing the aquatic component of National Action Plan (NAP) on AMR and guidance in the conduct of a survey on antimicrobial use. As part of the project, guidelines on the design of antimicrobial susceptibility testing programmes relevant to aquaculture and aquaculture products are also being prepared. The fish food safety and quality component focuses on antimicrobial residues monitoring for aquaculture products, fish waste management, and updating of the FAO Guidelines on risk-based fish inspection including AMR aspects for fishery and aquaculture products. Both components are preparing information, education and communication (IEC) materials.

Discussion

- Every country is now required to develop a National Action Plan on AMU/AMR. Aquaculture is a small component within this Plan, but it is necessary. Aquaculture is a reservoir and contributor to the development of AMR microorganisms and we need to regulate our uses of antimicrobials;
- Action are needed to be taken, there is no doubt about this. There is a need to be cautious of a feverish approach without realising the outcome of specific actions. These need to be monitored carefully so that what actions result in the best returns could be determined. Millions of dollars can be invested on this, but if it is not measured and monitored carefully, the benefits may not be realised;
- Too much money is being spent without proper thinking on what the outcomes are. It is easy to do surveillance but perhaps it is better to do other things first like legislation, raising awareness, enforcement, regulatory framework and controlling of use. There is a need to start on a common platform because there are so many countries doing surveillance but if the results for each country cannot be compared because of the different approaches, then it may difficult to pull out clear results;
- Other sectors are well advanced on this subject, but aquaculture is being left behind. One reason why aquaculture is lagging behind is because we have a very complex industry (freshwater to marine, extensive to intensive systems, integrated to multitrophic systems, etc.) and it is difficult to focus on a particular species or system;
- On the EU project in 2000 (Asia-Resist), the outcome of the project was scary which suggests mounting resistance (of bacterial pathogens) to antibiotics, and still we cannot get the answer on the causes. Some antibiotic resistance did not come from those used for aquaculture, for example chicken-fish integrated systems where antibiotics are given to fish freely through the droppings of chickens. The consequences of antibiotic use and how this should be discouraged has been discussed, and yet we see antibiotics moving through the food chain especially in integrated systems;
- AMR prevention is a shared responsibility, as sources of antibiotics concern all the sectors. In some cases, project results cannot be published or made available publicly due to the economic consequences on the AMU in aquaculture.
- Microbes in terrestrial animals, human, and aquatic animals are different, and they follow different pathways. Caution is needed in the interpretation of any results, because certain resistance is being reported for antibiotics against some bacterial species that would not ordinarily be applied (e.g. antibiotics for Gram-bacteria prescribed for Gram+ pathogen);

Recommendations

- AG recommended that programs on AMR in aquaculture in the region should be properly coordinated and shared, for better management and to minimize the development of AMR among important pathogens of aquatic animals;
- AG recommended that AMU/AMR surveillance should be consistent and based on standards. Standard protocols should be developed especially for assessment of AMR.

- As antimicrobial use cannot be prevented in major aquaculture operations in some countries, AG recommended that awareness programs on AMU and AMR and promotion of responsible and prudent use of antimicrobials should be pursued.

SESSION 7. CLOSING

7.1. ADOPTION OF REPORT AND DATE OF NEXT MEETING

Report of the meeting (Discussions and Recommendations) was circulated by e-mail to all AG members, co-opted members and observer for comments and adoption.

The next meeting (AGM 17) will be held in Bangkok, Thailand in November 2018 (dates to be decided)

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ANNEX A

16TH MEETING OF ASIA REGIONAL ADVISORY GROUP ON AQUATIC ANIMAL HEALTH (AGM 16)
26-27 AUGUST 2017
ANVAYA BEACH RESORT, BALI, INDONESIA

AGENDA:

Day 1 (26 August, Saturday)

09:00 – 12:00

Opening Session

- Welcome address: **Dr. Eduardo Leaño**, Coordinator, Aquatic Animal Health Programme, NACA
- Opening Remarks: **Dr. Melba Reantaso**, AG Chairperson
- Self introduction

(AG Chairperson, will take over)

Session 1. Progress Reports

- Progress since AGM 15 **(Dr. Eduardo Leaño**, NACA)

DISCUSSIONS AND RECOMMENDATIONS

Session 2. OIE Standards and Global Issues

- Outcomes of recommendations from OIE General Session and the Aquatic Animal Health Standards Commission (**Dr. Ingo Ernst**, AAHSC, OIE)
- Updates on FAO initiatives in Asia-Pacific in support of aquatic animal health (**Dr. Melba Reantaso**, FAO)

DISCUSSIONS AND RECOMMENDATIONS

Group Photo

Lunch

13:30 – 17:00

Special Discussion: Listing of Diseases in QAAD-AP

- Do we need to use/satisfy OIE Criteria for listing? (**Chairperson** will facilitate)

Session 3. Review of Regional Disease Status

- Updates and emerging threats on finfishes (**Dr. Siow Foong Chang or Dr. Diana Chee**, AVA, Singapore)
- Updates and emerging threats on crustaceans (**Prof. Tim Flegel**, Centex Shrimp, Thailand)
- Updates on other diseases (molluscs and amphibians) (**Dr. Andy Shinn**, Fish Vet Group, Thailand)

- Tilapia Lake Virus (TiLV): Assessment for Listing (in QAAD Asia-Pacific) (**Dr. Eduardo Leaño**, NACA)

DISCUSSIONS AND RECOMMENDATIONS

Day 2 (27 August, Sunday)

09:00 – 12:00

Session 4. Reports on Aquatic Animal Health Programmes from Partner Agencies

- Fish Health Section, SEAFDEC Aquaculture Department, Philippines (**Dr. Rolando Pakingking, Jr.**, SEAFDEC AQD)
- OIE-Regional Representation in Asia and the Pacific (**Dr. Hirofumi Kugita**, OIE-Tokyo)
- Aquatic Animal Health Research and Development Division, Thailand (**Dr. Janejit Kongkumnerd,** AAHRDD)
- Australian Department of Agriculture (**Dr. Ingo Ernst**, DA)
- Aquatic animal health activities of China (**Dr. Liu Hong**, APIQTC; TBC)
- Aquatic animal health activities of Indonesia (**Mrs. Mukti Sri Hastuti**, Directorate General of Aquaculture, MMAF)

DISCUSSIONS AND RECOMMENDATIONS

Lunch

14:00 – 17:00

Session 5. Disease Reporting

- QAAD Reporting: status and updates (**Dr. Eduardo Leaño**, NACA)
- New OIE Disease List and revisions to the QAAD List for 2018 (**Dr. Ingo Ernst**, AAHSC, OIE)

Session 6. Antimicrobial Resistance

- Progress of AMU/AMR Project (**Dr. Melba Reantaso**, FAO)

DISCUSSIONS AND RECOMMENDATIONS

Session 7. Closing

- Other important matters
- Presentation and Adoption of Report Discussion and Recommendations

19:00 -

NACA hosted dinner

ANNEX B

List of Participants (AGM 16)

I. Advisory Group Members
World Organisation for Animal Health (OIE) / Australia
Dr. Ingo Ernst (AAHSC; DA-Australia) Director, Aquatic Pest and Health Policy Animal Division Australian Government Department of Agriculture and Water Resources GPO Box 858, Canberra ACT 2601, Australia Ingo.Ernst@agriculture.gov.au
Food and Agriculture Organization of the United Nations (FAO)
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Annex C:
List of Diseases in the Asia-Pacific

Quarterly Aquatic Animal Disease Report
(Beginning January 2018)

1. DISEASES PREVALENT IN THE REGION	
1.1 FINFISH DISEASES	
OIE-listed diseases	**Non OIE-listed diseases**
1. Epizootic haematopoietic necrosis	1.Grouper iridoviral disease
2. Infectious haematopoietic necrosis	2.Viral encephalopathy and retinopathy
3. Spring viraemia of carp	3.Enteric septicaemia of catfish
4. Viral haemorrhagic septicaemia	4.Carp edema virus disease (CEVD)
5. Infection with *Aphanomyces invadans* (EUS))	5. Tilapia lake virus (TiLV) disease
6. Red seabream iridoviral disease	
7. Infection with koi herpesvirus	
1.2 MOLLUSC DISEASES	
OIE-listed diseases	**Non OIE-listed diseases**
1. Infection with *Bonamia exitiosa*	1. Infection with *Marteilioides chungmuensis*
2. Infection with *Perkinsus olseni*	2. Acute viral necrosis (in scallops)
3. Infection with abalone herpes-like virus	
4. Infection with *Xenohaliotis californiensis*	
5. Infection with *Bonamia ostreae*	
1.3 CRUSTACEAN DISEASES	
OIE-listed diseases	**Non OIE-listed diseases**
1. Infection with Taura syndrome virus (TSV)	1. Hepatopancreatic microsporidiosis (HPM) caused by *Enterocytozoon hepatopenaei* (EHP)
2. Infection with White spot syndrome virus (WSSV)	
3. Infection with yellow head virus genotype 1	2. Viral covert mortality diseases (VCMD)
4. Infection with Infectious hypodermal and haematopoietic necrosis virus (IHHNV)	3. *Spiroplasma eriocheiris* infection
5. Infection with Infectious myonecrosis virus (IMNV)	4. Iridovirus in crayfish
6. Infection with *Macrobrachium rosenbergii* nodavirus (MrNV; White tail disease)	
7. Infection with *Hepatobacter penaei* (Necrotising hepatopancreatitis)	
8. Acute hepatopancreatic necrosis disease (AHPND)	
9. Infection with *Aphanomyces astaci* (Crayfsh plague)	
1.4 AMPHIBIAN DISEASES	
OIE-listed diseases	**Non OIE-listed diseases**
1. Infection with Ranavirus	
2. Infection with *Bachtracochytrium dendrobatidis*	
2. DISEASES PRESUMED EXOTIC TO THE REGION	
2.1 Finfish	
OIE-listed diseases	**Non OIE-listed diseases**
1. Infection with HPR-deleted or HPR0 salmon anaemia virus	1. Channel catfish virus disease
2. Infection with salmon pancreas disease virus	
2. Infection with *Gyrodactylus salaris*	
2.2 Molluscs	
OIE-listed diseases	**Non OIE-listed diseases**
1. Infection with *Marteilia refringens*	
2. Infection with *Perkinsus marinus*	

Annex D:
AG Action Plan (for 2018)

(Based on the list of recommendations from all sessions)

Issue(s)	Actions needed
1) Disease Reporting	• Renaming of all OIE-listed crustaceans diseases in line with OIE: Infection with "pathogen"; • Listing of diseases in QAAD to follow a simple assessment following OIE Criteria; • Inclusion of TiLV in 2018 QAAD list; • Reporting back of QAAD results to raise awarenbess and to support national biosecurity planing (to be brought up to the next NACA Council Meeing); • Prepare a document (before the 20th year of the programme) on what has been achieved so far by the reporting system;
2) Delisting of Diseases	• Delisting of diseases in QAAD should also follow the OIE Assessment Criteria; • Member governments to send request to OIE to reconsider delisting criteria and to submit proposals to delist some of the diseases that already have no significant impact on production
3) Emerging Diseases	• Harmonization of relevant procedures involved in the implementation of ASEAN SOP on Responsible Movement of Live Aquatic Animals; • More vigilance in the translocation of IMNV to other countries in Asia where it is not yet reported; • Continuous research on TiLV to understand its variation in virulence, global distribution and economic impact, and the feasibility of developing vaccines; • Australia's response to WSD Outbreak: serve as a lesson or guide to other countries when new disease threat comes in; • Establishment of a National Board for Research (in Thailand and possible other countries) dedicated for important and emerging aquatic animal diseases.
4) Other Important Diseases	• AHPND: Continued research on mutants and variants of AHPND bacteria, so that the basis of virulence, nature of genetic exchange, and epidemiology can be better understood;

	• EHP: Identification of natural reservoir carriers, especially those that are commonly used as live feeds. • Finalize Disease Card for CMNV: coordinate with Chinese experts;
5) AMU/AMR	• NACA to continue to participate in programs for education and implementation of AMU and AMR issues in aquaculture; • Proper coordination and sharing of AMU/AMR programmes in the region; • AMR surveillance should be consistent and based on standards; • Continue awareness programmes on AMU/AMR especially at grass-root level (local farmers and other stakeholders).
6) One Health	• Strong linkage of aquatic animal health laboratories with the national animal laboratory: removal of bureaucratic barriers; promote sharing of information and expertise; • Training of terrestrial veterinarians on aquatic animal diseases and health management; • Establish stronger linkage between Aquatic Focal Points and the OIE Delegates of each member country; motivate Delegates to be engaged more on aquatic counterpart.
7) Other issues	• Mapping of aquatic animal health activities in the region being implemented by different organizations and institutions; • Identify areas where there is lack of focus and where there is a need to strengthen collaboration/inputs; • Put coherence on several supports that the country are receiving for implementation of aquatic animal health programmes; • Shift in focus to aquatic animal species to be pursued and promoted to existing veterinary courses and trainings at national level.

ANNEX E:

ASIA REGIONAL TECHNICAL GUIDELINES – STATUS OVERVIEW (ADOPTED FROM AGM 9 REPORT)

Element of technical guidelines	Progress / status	Gaps / opportunities
1. Disease reporting *An understanding of the basic aquatic animal health situation is a pre-requisite for prioritising activities, developing national policy and identifying pathogens of national importance.*	• Regional QAAD reporting system established – participation has increased • The QAAD list has incorporated emerging diseases that were later listed by the OIE • Many countries have established national lists for reporting purposes with appropriate supporting legislation	• Participation could improve further – some countries report irregularly • The proposed regional core utilising the OIE's WAHID will streamline reporting and may improve participation • The exact status of individual countries with regard to adoption of national lists and supporting legislation is not know
2. Disease diagnosis *Diagnosis requires various levels of data, starting with farm- or site-level observations and progressing in technical complexity to electron microscopy, immunological and nucleic acid assays and other biomolecular methods. This means all levels of expertise, including that of the farmer and extension officer working at the pond side, make essential contributions to rapid and accurate disease diagnosis.* *Effective diagnostic capability underpins a range of programs including early detection for emergency response and substantiating disease status through surveillance and reporting.*	• Diagnostic capabilities have improved in many countries • NACA disease cards have been developed and maintained for emerging diseases • The Asia regional diagnostic manual has been developed • An Asia regional diagnostic field guide has been developed • OIE reference laboratories • Regional reference laboratories – where no OIE reference laboratory exists • Regional Resource Experts are available to provide specialist advice • Ad hoc laboratory proficiency testing programs have been run	• OIE twinning programs are a means to assist laboratories to develop capabilities • The exact status of diagnostic capability in individual countries is not certain • There is limited or no access to ongoing laboratory proficiency testing programs • Some areas of specialist diagnostic expertise are lacking • Network approaches are a means draw on available diagnostic expertise
3. Health certification and Quarantine measures *The purpose of applying quarantine measures and health certification is to facilitate transboundary trade in aquatic*	• Strong progress has been made, particularly for high risk importations (e.g. importation of broodstock and seed stock) • Training has been provided through regional initiatives (e.g. AADCP project)	• The importance of supporting aquatic animal health attestations through sound aquatic animal health programs continues to be underestimated, with possible ramifications for trade

animals and their products, while minimising the risk of spreading infectious diseases	• Commercial implications for trade have driven improved certification practices • Harmonisation with OIE model certificates has occurred	• Some inappropriate or illegal activities continue and threaten to spread trans-boundary diseases
4. Disease zoning and compartmentalisation *Zoning (and compartmentalization) allows for part of a nation's territory to be identified as free of a particular disease, rather than having to demonstrate that the entire country is free. This is particularly helpful to facilitate trade in circumstances where eradication of a disease is not feasible.Zoning is also an effective tool to restrict the spread of important pathogens and aid in their eradication.*	• Is an emerging need to meet requirements of importing countries • To facilitate trade, some countries are working toward having compartments and zones recognised	• Where common health status can be identified restrictions on trade can be reduced • Training opportunities would be beneficial • Learn from the experience of terrestrial animal industries (e.g. poultry)
5. Disease surveillance and reporting *Necessary to produce meaningful reports on a country's disease status by providing evidence to substantiate claims of absence of a particular disease and thereby support import risk analysis, justify import health certification requirements, and enable export health certification*	• Regional Resource Experts are available to provide specialist advice • Training has been provided through a number of initiatives (e.g. AADCP project) • Many published resources are available, including those of the OIE (publications and the OIE centre for aquatic animal epidemiology) • Collation of surveillance information has improved through participation in international reporting	• Remains a reliance on passive surveillance. Active surveillance may be beneficial but cost is often a barrier. • Methodologies to undertake effective but low-cost active surveillance would be of assistance • Epidemiological expertise is often limited • There is a need to increase surveillance of wildlife to support health status
6. Contingency planning *Important to provide a rapid and planned response for containment of a disease outbreak—thereby limiting the impact, scale and costs of the outbreak*	• Important provides a rapid and planned response for containment of a disease outbreak Some countries have advanced contingency planning with appropriate supporting legislation • Some countries have tested contingency plans through simulation exercises • Resources are available (e.g. Australia's AQUAVETPLAN, FAO guidelines, OIE links to resources)	• The exact status of contingency planning in individual countries is not certain • Training in emergency management frameworks may be useful • Support for developing contingency plans might usefully be directed at particular disease threats e.g. IMN

7. Import risk analysis *The movement of live aquatic animals involves a degree of disease risk to the importing country. Import risk analysis (IRA) is the process by which hazards associated with the movement of a particular commodity are identified and mitigative options are assessed. The results of these analyses are communicated to the authorities responsible for approving or rejecting the import.*	• Numerous resources and case studies published • The approach has been applied, particularly for some circumstances e.g. import of live *P. vannamei* • However risk analysis is not always applied, or is not applied appropriately • Regional training has been provided (e.g. AADCP project) •	• There is a need to build awareness of the concepts • Training can be abstract and disengaging - should aim at trainees learning on scenarios relevant to their circumstances • This is a high priority generic need that is suited to development of a central training program
8. National strategies *The implementation of these Technical Guidelines in an effective manner requires an appropriate national administrative and legal framework, as well as sufficient expertise, manpower and infrastructure.*	• Many countries have developed national strategies • Detailed assistance has been provided to some countries (e.g. AADCP project)	• The exact status of national strategies in individual countries is not certain • The OIE's PVS tool provides a means of assessing the progress of individual countries
9. Regional capacity building *Regional-level capacity building in support of the implementation of the Technical Guidelines*	• Regional level programs are a cost-effective means to support capacity building in the region • Organisational structures are in place to coordinate activities and communicate progress (e.g. NACA, AG) • Numerous projects have been implemented to support capacity building across a range of disciplines (e.g. those supported by/through FAO, OIE, SEAFDEC, AADCP etc.) • Many organisations have an ongoing interest in investing in aquatic animal health capacity building in the region	• While many projects have been implemented, they are sometimes ad hoc in nature and ongoing impact may not be measured • Better coordination might be achieved by better documentation of progress and remaining gaps • There may be strategic benefit in implementing major projects that address multiple capabilities