PWG-21 DEVELOPMENT AWARDS GUIDELINES FOR PARTICIPANTS		
Effective date:	**2 May 2011**	**Version: #2**

FINAL REPORT (DEVELOPMENT AWARD)

AWARD TITLE and CODE

2009/315.13 "People development program: 2011 Aquatic Animal Health Training Scheme"

AWARD RECIPIENT: Dr Richmond Loh

ADDRESS: 119 Mills Street, Queens Park WA 6107, Australia.

HOST ORGANISATION: The Fish Vet

DATE: 16 July 2012.

ACTIVITY UNDERTAKEN
Attendance of Aquavet 2 workshop to receive advanced veterinary training in aquatic animal health.

OUTCOMES ACHIEVED TO DATE
Have gained a wealth of knowledge, pictures and networked with a large number of aquatic animal health experts. This is beneficial to improve teaching and diagnostics.

Acknowledgements

I would like to acknowledge with appreciation the Australian Government's contribution via the Fisheries Research and Development Corporation (FRDC) to the project through the "People development program: 2011 Aquatic Animal Health Training Scheme."

I wish to thank all those who have supported my application, the various representatives/end users that I represent through my work:

- Australian College of Veterinary Scientists – Aquatic Chapter - President – Dr Matt Landos.
- Murdoch University –A/Professor – Dr Alan Lymbery, Lecturer – Dr Teresa Collins and Student – Dr Jo Bannister.
- RSPCA National – Ms Jade Norris.
- Challenger TAFE – Hatchery Manager – Mr Bruce Ginbey.
- Fisheries Department –Fish Pathologist – Dr Fran Stephens.
- Wild Oceans (Western Rock Lobster Fishery) – Director – Mr Greg Hart.
- AQWA – Curator – Mr Oren Lifshiz.
- Ornamental Fish Association of Australia (OFAA) – Mr Chris Rout.
- Koi Society of WA – President – Mr Allan Bennett.
- Fish Wholesaler - Bundarra Tropical Fish Farm – Mr Marty Bell.

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Background

The Fish Vet
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University-based qualifications:
- Bachelor of Science, Murdoch University (2001).
- Bachelor of Veterinary Medicine & Surgery, Murdoch University (2001).
- Master of Philosophy – Veterinary Pathology, Murdoch University (2006).

Other qualifications and appointments:
- Awarded the George Alexander International Fellowship (2012).
- Communications Committee Member of World Aquatic Veterinary Medical Association (2012).
- Secretary and Treasurer of the Aquatic Animal Health Chapter of the Australian & New Zealand College of Veterinary Scientists (2011).
- Adjunct Senior Lecturer for Murdoch University, School of Veterinary Science (2009).
- Member Australian & New Zealand College of Veterinary Scientists (Veterinary Pathobiology) (2009) – by examination.
- Certificate in Companion Animal Services – Aquatics, Level 3 – Nelson Marlborough Institute of Technology (2009).
- Founding Member of the World Aquatic Veterinary Medical Association.
- Diploma in Project Management – TAFE, Tasmania (2007).
- Member Australian & New Zealand College of Veterinary Scientists (Aquatic Animal Health) (2006) – by examination.
- Chartered Member of the Australian Veterinary Association (2006).

Biography
I have always been interested in animals, nature and medicine, so naturally I studied to become a veterinarian at Murdoch University. My first job was as a veterinary fish pathologist for the Tasmanian state laboratory, providing diagnostic services for the large aquaculture farms including species such as salmon, trout, ornamental fishes, abalone and oysters.

I have been admitted as a Member of the Australian & New Zealand College of Veterinary Scientists (ANZCVS) by examination in the subjects of "Aquatic Animal Health" and in "Pathobiology". I was awarded a Master of Philosophy degree for research into Tasmanian Devil Facial Tumour Disease and published seminal papers in Veterinary Pathology. In 2011, I published a book entitled "Fish Vetting Essentials" which has gained popularity and is being sold world-wide. Following this, my next book entitled "Fish Vetting Medicines – Formulary of Fish Treatments" was published in May 2012. I am now working on another publication entitled "Fish Vetting Cases – A Colour Review of Fish Diseases".

I offer veterinary consultancy services as "The Fish Vet" in the states of Western Australia and in Victoria. I am the consultant veterinarian to AQWA (the Aquarium of WA), an adjunct senior lecturer at Murdoch University, a founding member and a communications committee member of the World Aquatic Veterinary Medical Association (WAVMA), the secretary for the Aquatic Animal Health Chapter of the ANZCVS and provide advice on fish health and welfare to several universities and the RSPCA. My clients are diverse and range from individual pet fish owners, to retailers and aquaculturists.

Need

According to the latest statistics available, almost 30 percent of fish stocks are overexploited. Sustainable fisheries and aquaculture play a crucial role in food and nutrition security and in providing for the livelihoods of millions of people.

In Australia, there is a shortage of highly-skilled individuals within both laboratory and field service provisions in the specialty area of aquatic animal health industry. The need for veterinary support is integral to the success of the aquatic sector. The demands for professional aquatic animal health services is likely to increase over the next 5-10 years, which will only exacerbate the currently recognised shortages.

It is widely recognised that many of the traditional pathways for training groups of such skilled individuals was through mentorship and self-education within State and Commonwealth Governments. These are now severely restricted due to a changing role of Government and ongoing tightening of resources.

The courses on aquatic animal health that are available in Australia are provided on an ad hoc basis and are of insufficient depth for specialised aquatic animal health professionals. The courses available overseas are dedicated to aquatic animal health, are intensive and they run for longer periods of 2-4 weeks or more. Some courses are flexible enough to be tailored to suit the skill and knowledge level of participants. In the field of adult learning it has been shown that one-off or short conferences are not usually successful in achieving meaningful knowledge transfer unless this is followed up by continual updates.

The recent biosecurity risk assessment of the ornamental fish industry suggests current practices are inadequate and that ornamental fish poses a biological threat to native fish, commercially cultured fish and recreational fisheries. There is negligible disease surveillance with ornamental fish after they depart quarantine facilities. There is a large pool of veterinarians across the country who can conduct disease surveillance, mirroring the practices of the livestock industry. I have generated interest among veterinarians through my publication entitled "Fish Vetting Essentials", an e-mail list I have collated and the Unusual and Exotic Pets special interest group of the Australian Veterinary Association and from my presence on the internet.

I service the needs of a diverse variety of clients that employ the full range of activities that is assumed of a veterinarian – from individual pet fish medicine, through to large operations involving food fish; in clinical practice through to laboratory diagnostics and education.

Objectives

Travel to the USA to attend Aquavet II in order to:

1 Expand the skill-set of the principal investigator, to increase the versatility, for the provision of aquatic animal health veterinary services to stakeholders/end users - encompassing fish and aquatic invertebrates, under their various forms of existence - home aquaria, public aquaria, laboratory, aquaculture and wild.

2 To learn alternative techniques and acquire new skills to be more effective at teaching aquatic animal health units and delivering lectures to students at university and to impart and share knowledge via participation at conferences and in publications.

3 To foster stronger relationships with the international network of fish veterinarians for future collaborations nationally and internationally.

4 Provide me an opportunity for accelerated learning and to fill the gaps in my knowledge, in particular in the area of advanced aquatic animal pathology. Upon completion of the course, I will be better equipped with the new knowledge and experience that I had acquired to assist the end users and other aquatic animal health providers in Australia.

5 To gain a better understanding of issues relating to developments in the aquaculture industry in the USA and compare it with the Australian industry.

Methods

This year, the Aquavet II course was held at
Roger Williams University
One Old Ferry Road
Bristol, RI 02809

Aquavet II was delivered as a series of lectures with powerpoint presentations, practical microscopy sessions with glass slides and laboratory practicals/dissections over a 2-week period. The subjects covered are listed in the itinerary in the “Appendix - Itinerary”. The lectures were presented by various experts in their fields as detailed in the “Appendix – Faculty Contact Information”.

Results/Discussion

Fish Haematology - Dr Dianne Brown - DVM, PhD, DACVP

Dr Dianne Brown provided an overview on fish blood. We covered the practical aspects of comparative haematology, covering teleosts, elasmobranchs and molluscs. Sampling protocol, preparation and interpretation of blood profiles that can generate information on the health of the animals including states of inflammation (e.g. bacterial infection), viral infection, their immunocompetence and more.

I believe there would be great value in aquaculture farms adopting this tool on a weekly basis as part of their normal routine. Traditional histopathology and bacteriology testing takes 4-7 days at the earliest to produce a result. Although haematology should not replace the traditional diagnostic testing, the single day turnaround time for results would allow the health advisors to check on the status of the fish health. Prompt intervention can be taken if signs of disease states are detected early.

This is of great importance because when things in aquaculture go wrong, they go very wrong, very quickly! To be able to foresee disease states would save pens of fish from mass mortalities. To be forewarned is to be fore-armed. Every fish farm should be routinely sampling and examining blood. Early intervention is the key to profitability!

Corals - Dr Ilze Berzins - PhD, DVM

Coral reefs are home to over 25% of all marine life including 1/3 of all marine species, yet comprise less than 1% of the Earth's surface. The reefs support more species per unit area than any other marine habitat. The local human population rely on the reefs for their income from commercial and recreational fishing. Millions of jobs and businesses (influx to local economy) have developed through tourism and recreation. So it is very important to conserve the reefs. But that being said, we cannot protect them with an "iron fist", banishing all human contact. As a policy management decision, "sacrificial reefs" have been designated for tourists in order for people to become acquainted with the reefs and in turn, create opportunities for education and conservation.

The biology, gross and microanatomy and diseases of corals were presented. One of the challenges in advancing the study of coral diseases is that we need to move towards agreeing on single terminology. Biologists/ecologists have been the pioneers of the study of invertebrates and have contributed a great deal to our current understanding of corals. However, the gaps in knowledge of their diseases are best studied by scientists with a background in pathobiology such as veterinarians.

Many coral diseases occur as a result of poor environment and they must live in a balanced ecosystem where they expel (bleach) and engulf different algae according to the environmental cues, sea urchins remove excess algae and parrotfish prune back the coral growth. Currently there are limited medicines that can be used to treat the diseases. Maintaining a balanced ecosystem is the only way of maintaining good coral health.

A lot of work has been invested into coral rehabilitation by means of coral culture, health certification and replanting.

Mollusc - Dr Roxana Smolowitz - DVM

The biology, culture techniques, gross and microanatomy and diseases of a variety of molluscs (oyster, mussel, whelk, scallop, octopus, squid, nautilus) were presented.

Again, there is a large gap in knowledge of their immune system. Much of the previous work was in identifying the disease agents as exemplified by the availability of large numbers of good pictures of aetiological agents, however, there is not much understanding of the pathobiology. So, our mission as veterinarians is to try to connect and fill in the gaps.

One of the important lessons that the oyster industry learnt was the effect of poor biosecurity. Farmers had moved pacific oysters (*Crassostrea gigas*) from the west coast of USA to the east coast to see if they could culture it. The pacific oysters did not do well, but they introduced MSX that killed the eastern oyster (*Crassostrea virginica*). This could have been avoided with good health certification. Now, effort has been put into selecting disease resistant oysters to restock the wild populations.

Catfish - Dr Herman Jack – DVM, MS, PhD

Did you know that in the US, the catfish industry is by far the largest aquaculture industry worth US$452M compared to any other aquacultured species? The second largest is the rainbow trout industry at US$70.5M, then baitfish at US$55M, followed by ornamentals at US$53M, oysters US$50M and atlantic salmon at US$43.5M.

There were a few pertinent learnings.

1. Choice of species.
2. Polyculture.
3. Product integrity.
4. Partitioned aquaculture system.

In terms of the choice of species, the channel catfish (*Ictalurus punctatus*) are the ideal culture species because of their ability to accept an omnivorous diet, with less reliance on the expensive and diminishing supplies of fishmeal. They can be held at relatively higher stocking density because of their ability to supplement respiration by taking in air at the water surface. And at the end of the cycle, there is an existing market for the product.

Does Australia have a species equivalent to the channel catfish? Should we be spending funds investigating another carnivorous species to culture? Protein requirements for Australian species are almost one third higher than omnivorous species such as tilapia. It is reasonable to suggest that we could be looking at culturing a known culturable species and where equipment for harvesting etc. already exists. We need to draw parallels from the terrestrial livestock industry. Much work has been invested in faster growth rate, better feed conversion, improved disease resistance, farm management and

husbandry of the staple species of cattle, sheep, poultry and pigs. We should not be fixated on "the next big thing". Already, the ostrich, emu and alpaca industries did not produce the results as was expected. Too often, valuable research funds for aquaculture are directed into investigating carnivorous species as "the next big thing" for aquaculture. Should we be investigating culture of octopus, lobsters, striped trumpeter, kingfish and mulloway (all carnivores) when we should be investigating omnivorous species such as tilapia, catfish and carp? It is uneconomical and unsustainable to continue culturing carnivorous fish.

Are there species that we can culture simultaneously? Polyculture is being used in some catfish culture industries to maintain the balance. Tilapia can be used to control algae and to keep the nets clean. Tilapia may also eat the catfish waste, converting a waste product into edible product.

The big issue in Australia with freshwater fish culture is that consumers can never be guaranteed a good product that is without a muddy taint. Once a consumer has had a bad experience, they will never purchase that species again, regardless of which farm it came from. In terms of product integrity, catfish farmers take it very seriously. The fish are flavour-checked at the following frequencies relative to harvest - 1-month prior, 2-weeks prior, 1-week prior, at 1-day prior, on the day of the harvest and the day after the harvest. Are we doing this for our freshwater cultured fishes such as barramundi, silver perch, murray cod and rainbow trout? If not, this should be encouraged.

The most recent research finding for recirculating aquaculture system (RAS) is that the "partitioned aquaculture system" (PAS) may improve yield per unit total volume or area. The PAS works by dividing the pond to allow 2/3 for the biofilter and only 1/3 for the cultured fish to occupy. The reason for the increased efficiency is not yet understood. The drawback is the higher cost of pumping to circulate the water. This could be investigated further in Australian conditions.

<u>Coldwater fish health and diseases - Dr Mark Fast - DVM</u>

Dr Fast covered the health and disease aspects of salmon farming. He sees issues arise when there is poor management and they include:

A. High concentration of farms.
B. High fish densities.
C. Poor smolt quality.
D. Lack of zone management.
E. Lack of fallowing.
F. Frequent movement of fish between farms.
G. No comprehensive Government regulations and control.

To elaborate more on point C, the Australian salmonid hatcheries currently test the readiness of their smolts to go to sea by a salinity challenge followed by blood testing to check for blood sodium levels. This has served the industry well. In the US, there is an additional step that some farms take to test for smolt quality. Studies have shown that transient stressors that elevate blood cortisol and depress frontline immunity are risks for various diseases. Prior to stocking, some farms use this as a stress test on their stock whereby fish are injected with cortisol and exposed to temperature stress to see if they

break out with disease. This can be likened to the formalin or hyposalinity stress test as promoted in the better management practices (BMPs) of prawn farming in Asia. This sort of test could be used in many different aquaculture industries where fingerling fish or seed molluscs/shrimp are used to stock grow-out ponds/sites.

Dr Fast provided some solutions to address poor health issues and they include:

1. Removing fish twice a day rather than once a day.
2. Vaccination.
3. Ban use of seawater hatcheries.
4. Ban movement between seawater sites.
5. Introduce compulsory health certificates for aquaculture farms.
6. Disinfection of waste water from slaughter houses, processing plants and smolt transport.
7. Year class separation.
8. Fallowing.
9. Integrated multitrophic aquaculture (IMTA).

These are commonsensical statements. I would like to elaborate on my thoughts on some of those points.

Point 2 is a great way of reducing the use of chemotherapeutants in farming. I believe investing in vaccines for cultured fish would greatly improve health and profitability of fish farming. Prevention is better than cure.

The issue in Australia is that autogenous vaccines are only allowed to be used on the farms where the pathogen was isolated. This means that the vaccine can only be manufactured after a disease outbreak. Often the process takes too long to be practical. We want to be able to use the vaccine to prevent disease, not as a reaction to a disease outbreak. Vaccines should be made readily available and its use should not be restricted in this way.

Point number 6 sounds very simple. But I wonder how some of the abalone plants handle their wastes. How do the tuna farm/ranches slaughter their stock? To release untreated waste water back to the culture sites or wildstock sites will amplify most disease causing organisms.

Point number 8 made me reflect on the current practices of the Australian salmonid farming industry with their biggest issue being amoebic gill disease (AGD). Could fallowing the sites and improving the benthic flora and fauna be a reasonable management plan? Breaking the cycle to manage disease is a commonly used practice in many animal production industries. Terrestrial farms cycle between animal farming and cropping. Land-based aquaculturists may clean and disinfect between batches. Can those using net pens in open water alternate between sites to allow time for fallowing? Is government policy aligned for this to occur?

Point number 9 is IMTA. This is currently in its infancy, however, there is promise that any particular site can become more productive and the water quality improved. Currently some farms are trying mussel farming in conjunction with salmon farming.

During the trials, there was some indication that ISA (infectious salmon anaemia virus) can be inactivated by mussels. But on the contrary, infectious pancreatic necrosis virus (IPNV) may be carried by mussels.

Diseases of Coldwater Fish - Dr Sal Frasca Jr – VMD, PhD, DipACVP

Dr Frasca spoke on bacterial, protozoal and fungal diseases of coldwater fishes. The most interesting topic was on *Neoparamoeba pemaquidensis*. The most recent research shows that the pathophysiology does not relate to respiratory compromise, but it interferes with osmoregulation. The amoebae that causes amoebic gill disease (AGD) is bacteriophagic and are opportunistic disease causing organisms. Factors that predispose fish to AGD include crowding, poor water quality, cage fouling, bacterial gill disease and physical stressors. Lesion severity is directly proportional to the water temperature. *N. pemaquidensis* is associated with other types of aquatic organisms and they have been detected in lobsters (in neuronal tissue and within haemocytes in antennal glands) and also seen in sea urchins. Such vectors will need to be investigated in Tasmania. In addition, consideration of integrated multitrophic aquaculture (IMTA), fallowing of sites and stocking densities need to be revisited if not already done.

Emerging Diseases of Fish in the US - Dr Rod Getchell - DVM

Using several disease examples that have had a huge impact on fish kills, Dr Getchell provided evidence to support that the biggest threat to biosecurity is from the activities of those who undertake fishing activities. Viral haemorrhagic septicaemia (VHS) in2007 was among the worst of diseases because it could infect at least 30 different fish species, some without clinical signs of disease. Those baitfish were moved from one water body to another as the fishers moved or bought/sold bait from one location to another. Some fish (blue gill) were even introduced into a residential koi pond and all the fish died.

The talk on koi herpesvirus (KHV) is of significant interest for Australia. This disease hit New York state in 2005. It was suspected that the ornamental fish trade had brought the disease into the country. Approximately 25,000 adult carp (20–30 lbs each) died on the popular holiday destination of Chautauqua Lake shore line, just 1 week prior to the 4th July US holidays. The local council drew on US$17,000 of emergency funds for the massive fish kill clean up. KHV has since been found in carp in several other water bodies and in residential ponds. The disease in the US is now considered to be endemic and wild carp populations have since rebounded. KHV is an OIE listed disease and to have it in the country would present with significant international trade implications.

There was also a presentation of goldfish herpesvirus (GHV) that causes haematopoietic necrosis. It was first discovered in Japan in 1995 and it arrived in the US in 1998 most likely through the trade in ornamental fish. High mortalities were reported around that time in goldfish in the US. Reports of the disease had since dissipated. The GHV in goldfish was likened to the KHV in koi in terms of the epidemiology.

Diseases Of Farmed Penaeid Shrimp - Dr Robert A. Bullis & Arun K. Dhar

The global total shrimp production was estimated at 2.1million tons. It is so important to some countries that their entire economy is reliant on shrimp exports. The USA has downsized its shrimp culture as coastal land prices and input costs increase and production in other countries became more competitive. Today, the USA imports 90% of the shrimp that is consumed domestically. The role the USA plays in shrimp aquaculture is primarily in education and research. What keeps the USA in the industry is its cutting edge technology, its commitment to research and education and a global service industry that exports knowledge and technology. Shrimp culture in the USA still occurs and the most interesting location is in the middle of the desert in Arizona. The water in the area is slightly saline (2g/L) and the waste water from the shrimp farm is used to irrigate durum wheat and olive trees.

The major issue faced by shrimp farmers is disease, and of these, the highly contagious viruses such as white spot syndrome virus is capable of spreading through the entire nation's crop in as little as 3 days. One of the most important risks identified at the course was the use of non-endemic shrimp bait by fishers. It is estimated that 90% of the bait is lost in the course of fishing and couple this with the use of imported shrimp that may be harbouring the disease agent, this could spell disaster for the shrimp culture industry. Hence biosecurity is of utmost importance. On some farms, the workers are even forbidden to eat or touch shrimp.

The speaker predicts that the way of the future in shrimp culture is by super-intensive systems because it can yield up to 100,000kg/ha in a biosecure environment and increased automation with recirculating systems, automated feeders, aeration and monitors.

Shrimp culture has given rise to the most sophisticated diagnostic tools that are comparable to the field of human medicine. But why is histopathology still an important tool? It is because some tests are fallible and each has its limitations. PCR tests are not specific enough and histopathology confers the ability to provide a broad overview of shrimp health; capable of diagnosing multiple concurrent issues such as the various viral diseases, nutritional condition, parasitic conditions, to confirm molecular results, the ability to detect new diseases, and more.

Thus we should not rely on a single diagnostic test method. When feasible, we should confirm initial findings by using a second technique. And histopathology remains the most specific test for shrimp diseases.

One of the major diagnostic challenges is the rapid autolysis of specimens. However, it is still possible to obtain a diagnosis from markedly autolysed shrimp when a bioassay is conducted. The dead shrimp carcases can be fed to the live shrimp and then testing can be conducted on the challenged shrimp.

On another note, listening to the series of lectures, I reflected on the work that had been put into investigating the possibility of inland saline aquaculture in Australia in the 1990's. Unfortunately, these ventures failed because the water parameters did not meet the fish's biological requirements. Is it possible that a crustacean species may be more suitable? Brine shrimp are becoming increasingly valuable as the natural dry stocks are

being depleted and at the same time, the increasing demand for the resource. Could Australia's inland saline water bodies support culture of Artemia?

Benefits and Adoption

When assessing the current state of the aquaculture industry, I believe that key areas critical to future success will be dependent on the activities of the following bodies:

- Government
- Industry
- Education and training
- Professional Associations and the
- Community.

To maximise the outcomes, I believe that it is essential that all knowledge transfer activities be aimed at these sectors.

I have been undertaking a range of activities to share the insights and new skill sets generated by this grant. I have been producing material on various social media platforms including a blog (Wordpress), Facebook fan page, Twitter, Linked In and YouTube. I also encourage active learning by providing support via phone or email for veterinarians dealing with aquatic animal health cases and by making available, traditional resources such as text books and my web page. I intend to use the newly gained knowledge in future educational opportunities. I have been invited to teach the aquatic component of the Masters in Wildlife Health at Murdoch University during September 2012.

Further Development

Listening to the experiences and having gained a broader view of aquaculture, I have found evidence to support some of my previous thoughts and have also formulated new ideas in the Australian context. I see Australia as a country where solutions are implemented.

Government -*Recommendations:*

1. Revisit the species selection for culture. Do we persist with investigating new native species versus import of domesticated aquaculture species? For an analogy, should we embark in trying to culture native Australian animals like the kangaroo and emu, versus importing domesticated agriculture species such as cattle, sheep, pigs and poultry?

2. Divert research into feasibility studies, biosecurity and environmental risks of culturing domesticated aquatic species. There are populations of known non-

native species already in Australia such as carp and tilapia. Could we turn this into an industry such as we have with trout and salmon?

3. At the moment, the government plays a role as both the "police" and the "promoter" of the aquaculture and fisheries industries. These roles may become conflicted in some circumstances. Some work could be subcontracted to aid aquaculture farms with the aim of improving productivity rather than playing a disease surveillance role.

4. Revitalise the "one stop shop" to help people wanting to start aquaculture rather than just existing as a regulatory role – since there is nothing to regulate if aquaculture is non-existent.

5. Wild Stock enhancement

    a. Reintroduce supportive breeding as a management tool to enhance fish populations. This is an important long-term conservation tool for sustaining harvestable populations and genetic diversity in wild fish populations. This will also need to be combined with predator and shelter conditioning to enhance survival in the wild.

    b. Creation of artificial reefs and FADs – more habitats for fish to live.

    c. Consider wild stock enhancement for the abalone as well.

6. Australia currently imports a great deal of products from South-East Asia and not all nations will have the necessary expertise and laboratory tests. For improved biosecurity, it may be possible to facilitate the development of good laboratory facilities and expertise in developing countries where Australia imports high volumes of aquacultured foods that may carry potentially exotic diseases.

7. Bad idea to use KHV as a biological control agent. Epidemiologically, KHV will behave like GHV and become endemic, wild populations will naturally rebound. There will be huge clean up expense. It will severely affect the ornamental sector. KHV is OIE listed disease and it will have important international trade implications. We should be viewing wild carp as a resource, for exporting for coarse fishing in Europe and for domestic consumption (will need to allow for licence to hold and purge fish for human consumption).

8. With increasing intensification of farming, comes the increasing cost of disease. Sometimes good management alone cannot alleviate disease and chemotherapeutants may become necessary. Minor use permits (MUPs) are few and far between and they are difficult to obtain. Grants and workshops to support the development of new animal drugs intended for minor species would be highly beneficial.

9. Modify the current conditions of autogenous vaccine production and use to allow it to be used as a prophylaxis rather than as a response to a disease outbreak. This will improve fish health and enhance the performance of many aquaculture systems and reduce the reliance on chemotherapeutants.

Industry - *Recommendations:*

1. Use more genetically improved stocks and species suitable for farming rather than relying on wild caught broodstock.

2. Limits imposed by the availability of feed resources would be lessened by growing more herbivorous species.

3. There is an issue with freshwater fish culture in that the product may have a muddy taint. Promote marketing strategy and product uniformity by branding and good quality control in terms of taste testing the fish at regular intervals in relation to time of harvest. This is a way of ensuring that the product tastes right, the first time and every time.

4. Investigate possibility of *Artemia* ranching in the many salt lakes and salt-affected lands.

5. In the US, bivalve aquaculture is now considered a form of agriculture. It was considered to be a massive move forward because now farmers can get access to more help, rather than just the department of fisheries. Perhaps this can be looked into for all areas of aquaculture.

6. Secure more culture sites to allow for fallowing for healthier aquaculture systems and reduced use of chemicals.

7. Investigate the merits of integrated multitrophic aquaculture.

Education and Training - *Recommendations:*

1. Rather than create new courses/units, it may be possible to incorporate learnings into pre-existing curriculae. At Murdoch University, we have been successful in designing and delivering lectures and practicals, pertaining to aquatic animal health, into the veterinary curriculum.

2. Touch tanks are extremely good educational tools, helping people to gain an understanding of the animals and the environment. Even if we lose a few animals in the process.

Professional Associations - *Recommendation:*

1. Australian and New Zealand College of Veterinary Scientists (ANZCVS) currently exists merely as an examining body. Apart from Science Week that is usually conducted during the exam years (alternate years for Aquatic Animal Health), it does not provide teaching or learning opportunities. It would be beneficial if the members of Aquatic Animal Health chapter could be provided continuing professional development. It is recommended that the ANZCVS AAH Chapter to join WAVMA as an Allied Member. In order to do this, the topic will be raised at the AGM. Consider increasing the subscription fees to recover costs.

2. Foster passive learning by encouraging veterinarians and veterinary students to:

   - Join the WAVMA mailing list and AVN.
   - Enrol for examinations in the AAH Chapter of the ANZCVS.
   - Subscribe to my blog.
   - Attend webinars enabled through ABIN.

3. Encourage active learning by providing support via phone or email for veterinarians dealing with aquatic animal health cases and by making available traditional resources such as text books.

Community - *Recommendations:*

1. Biosecurity issues have been demonstrated to be a concern. The major groups identified as risks are recreational fishers and the ornamental fish sectors. More educational programs are needed. Possibly work with a fishing show, radio stations, produce brochures, magnets, etc.

Appendices

Faculty Contact Information

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Aquavet II Schedule

Sunday, 27. May 2012

14:00 Orientation - Directors

15:00 RWU Required Safety Lecture - Caitlin Conley

16:00 Fish Haematology- Dr. Diane Brown – Harvard Medical School

18:30 Fish Histology (continued) - Dr. Diane Brown

Monday, 28. May 2012

8:00 Corals - Dr. Ilze Berzins – IAAAM President

13:00 Corals – continued – Dr. Ilze Berzins

15:00 Comparative Anatomy of Shellfish - Introduction to Pathology of Molluscan Diseases - Dr. Roxanna

18:30 Invertebrate Pathology - Diseases of Bivalves - Dr. Roxanna Smolowitz

Tuesday, 29. May 2012

8:00 Using Animals in Research - Dr. Amy Hancock-Ronemus

9:30 Introduction to Diseases of Aquaculture Species – Warmwater – Catfish - Dr. Sherman Jack

13:00 Pathology of Catfish Diseases - Dr. Sherman Jack

18:30 Diagnostic Case Studies and Practicum - Aquacultured Species - Drs. Sherman Jack and Rod Getchell

Wednesday, 30. May 2012

8:00 Toxicologic Pathology of Fishes - Dr. Jeff Wolf.

13:00 Toxicologic Pathology of Fishes (continued) - Dr. Jeff Wolf

13:00 Toxicologic Pathology of Fishes (continued) – Drs. Jeff Wolf and Rod Getchell

Thursday, 31. May 2012

8:00 Toxicologic Pathology of Fishes (continued) - Dr. Jeff Wolf

13:00 Toxicologic Pathology of Fishes (continued) - Dr. Jeff Wolf

18:30 Toxicologic Pathology of Fishes (continued) – Drs. Jeff Wolf and Rod Getchell

Friday, 1. June 2012

8:00 Invertebrate Pathology – Diseases of Bivalves - Dr. Roxanna Smolowitz

13:00 Normal Anatomy and Diseases of Cephalopods and Opistobranchs - Dr. Roxanna Smolowitz

18:00 Normal Anatomy of Echinoderms and Limulus - Dr. Roxanna Smolowitz

Saturday, 2. June 2012

8:00 Parasites in Aquatic Animals - Dr. Sarah Poynton

Sunday, 3. June 2012 – OFF

8:30 leave campus for Whale Watch – Barnstable, MA

Monday, 4. June 2012

8:00 Invertebrate Pathology – WET LAB - Dr. Roxanna Smolowitz

13:00 Invertebrate Pathology – WET LAB - Dr. Roxanna Smolowitz

18:30 open

Tuesday, 5. June 2012

8:00 Diagnostic Case Studies and Practicum - Aquacultured Species - Dr. Mark Fast, Dr. Sal Frasca and Dr. Rod Getchell

11:00 Diseases of Coldwater Aquaculture Species - Infectious and Non-Infectious - Drs. Mark Fast, Sal Frasca, and Rod Getchell

13:00 Diseases of Coldwater Aquaculture Species - Infectious and Non-Infectious (continued) - Drs. Mark Fast, Sal Frasca, and Rod Getchell

18:30 Diseases of Coldwater Aquaculture Species - Infectious and Non-Infectious (continued) - Drs. Mark Fast and Rod Getchell

Wednesday, 6. June 2012

8:00 Conundrums - Drs. Mark Fast, Rod Getchell and/or Paul Bowser

10:00 Fish as Lab Animals - Dr. Paul Bowser

13:00 Normal Anatomy of Crustaceans - Dr. Roxanna Smolowitz

18:30 Diseases of Crustaceans - Dr. Roxanna Smolowitz

Thursday, 7. June 2012

8:00 Neoplasia of Fish - Dr. Renate Reimschuessel

13:00 Fish Diagnostics and Techniques WET LAB - Dr. Rod Getchell

18:30 Emerging Viral Fish Diseases in the US – SVCV, SHSV, KHV, LMBV - Dr. Rod Getchell

Friday, 8. June 2012

8:00 Overview of the Principal Infectious Diseases Found in Farmed Penaeid Shrimp - Dr. Arun Dhar and Dr. Robert Bullis

13:00 Overview of the Principal Infectious Diseases Found in Farmed Penaeid Shrimp - Drs. Arun Dhar and Robert Bullis

Saturday, 9. June 2012

By 12:00 check out