Travel Bursary

Attendance at the AQUAVET program at Cornell University, in Massachusetts, USA

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Disclaimer

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Background

AQUAVET is a demanding intensive 4 week aquatic veterinary medicine course aimed to equip members of the veterinary profession with the skills and knowledge required to work in the aquatic field. AQUAVET has been running since its conception in 1976 and has been an integral part of training for many of the prominent aquatic veterinarians around the world. The biomedical skills used so successfully by veterinarians to deal with disease and increase productivity in the terrestrial world can be applied to aquaculture too, but this is only possible by fostering knowledge and skills through programs such as AQUAVET. I attended this course in May/June this year to further my own knowledge and skills in aquatic medicine for the benefit of Panaquatic and Australian aquaculture.

Objectives:

Objectives of the project – as agreed in the contract

- Attendance at in the AQUAVET program, an intensive 4-week aquatic veterinary medicine course conducted by Cornell University, in Massachusetts, USA

Activity Undertaken

Day 1

The first day comprised of mainly orientation and being brought up to date with Roger Williams University safety procedures in preparation for our future work in the labs. It's an interesting group of people that are attending the course with a wide range in experience and interest in aquatics. I am 1 of 2 qualified vets attending the course with the rest being in various stages of their post-graduate veterinary courses here in the USA. As far as I can tell, many of them hold aspirations to participate in aquatic conservation and have a background in marine biology as an undergraduate. So far in terms of speaking with others, I think it's the minority of attendees that hold interests in aquaculture.

In the afternoon we had lectures on the phyla of invertebrates and their characteristics. Interesting but not strictly applicable to our work. Though understanding some of the characteristics common to mono- and digeneans gave me a greater understanding of why they can be such a problem in aquaculture systems.

Day 2

Today based around invertebrates and ecology. It started with intertidal invertebrate collection on the beach outside of the university. Lectures on ecology, natural histology, and physiology of marine invertebrates was continued from the day before. In the afternoon, there was a wet lab to examine the specimens that were collected from the intertidal in the morning. The highlight for most was the discovery of a juvenile nudibranch amongst the specimens.

Myself and a couple of other students also helped to free dive to collect hard clams from the shallow part of the bay for invertebrate dissection lab scheduled for Day 3. The day was finished up with a lecture on commercially important invertebrates in the USA, which was very interesting as majority of species were very different to those in Australia as well as the diseases that impact those industries.

Day 3

A day dedicated to everything about fish. Dr Roy Yanong, an aquatic veterinarian from University of Florida, presented on everything regarding anatomy and physiology of teleost fish and some on elasmobranchs.

The information presented was extremely detailed and also extremely relevant. I felt this was fantastic for taking my basic knowledge to the next level. These lectures were followed by a fish structure, function and diagnostics wet lab. We had access to a number of different teleost species as well as a number of rays and dogfish. It was encouraged to interact with all the specimens in the lab not just your own, this was fantastic. The chance to compare anatomy between vastly different teleost fish such as flounder, sea robin and Atlantic cod as well as elasmobranchs was extremely interesting and educational.

It’s always good to revise diagnostic techniques such as skin scraps, gill and fin clips but I found having the opportunity to practice blood collection and have guidance on how to perform this task reliably was extremely valuable.

Day 4

Today started off with the final lectures delivered by Dr Roy Yanong. These were centred around reproduction of teleosts and elasmobranchs. These lectures were fascinating and based off Dr

Yanong's personal experiences with the experimental breeding of marine ornamentals with University of Florida in order to decrease the wild harvesting of reef ornamentals, specifically his experience with breeding of Blue Tang in captivity for the first time.

These lectures covered reproductive physiology of fishes, behavioural reproductive strategies and a couple of case studies presenting common reproduction issues such as a case of egg binding in a frogfish and inter-fish aggression in a couple of other species.

The rest of the day was dedicated to wet lab anatomical dissection of a number of invertebrates, the species used were:

- Hard clam
- Eastern Oyster
- Jonah Crab
- Squid
- Horseshoe crab

This was a fantastic experience, I had the opportunity to learn techniques to sample haemolyph from all of the above species (excluding squid) and long detailed dissection of all species. You can learn all you like from lectures and pictures but it is practical and interactive dissection workshops that are truly valuable experience and allow for true understanding of structures and function.

DAY 5

A complete day of physiology!

The physiology lectures were centred around respiratory and osmoregulation. It was very in-depth and was a great opportunity for me to deepen and add to my understanding of aquatic physiology.

The final lecture of the day was concerning whether fish feel pain. This was a fantastic lecture and whilst Dr Posner, explained she did not want to blatantly tell the lecture her opinion but present the studies and facts. Her lecture was logical and the studies presented elegantly. All students in the lecture came out with the same opinion; that fish feel pain. She also presented methods of euthanasia, and through her studies the only method of euthanasia that should be utilised is cerebral disruption i.e. spiking, percussion. It was extremely encouraging to see this information delivered to future aquatic veterinarians and bodes well for the future of welfare in fish.

DAY 6

This morning's lectures presented a range of very different topics including the use of aquatic animals in research, teleost immunity and breeding of marine ornamentals in captivity. The aforementioned latter topics were of greatest interest. Breeding programs run by the Roger Williams Marine Lab here have had great success with breeding a number of marine ornamental species with the goal of creating more adaptive domestic populations of marine species for the aquarium trade, and also mitigating some of the risks associated with importation of marine ornamentals from overseas.

I'm finding so far that I am particularly enjoying the topics of reproduction and breeding of fish species for both ornamental and aquaculture trade. This is beginning to become a standout topic of interest.

Teleost immunity was fantastic, I believed I had a basic understanding of immunity in fish before this lecture, but this lecture opened my eyes to the intricacies of fish immunity and challenged some of my preconceived ideas, particularly in response to vaccines.

The afternoon's lectures were centred around regulations around aquaculture in the US. There were some similarities to Australia in the way that there are different regulations and reportable diseases between the federal levels and state levels. However, the big difference is the requirements for the importation of species. The only requirement that is needed to be met federally is that the species is the same as what the import certificate describes. It is only the destination state requirements for disease testing that is enforced. Some states have no requirements at all!

Potential for import of disease is extremely high and the current diseases present in the USA are examples of this i.e. the most recent outbreak of Tilapia Lake Virus. There is no current support or indication of stopping the importation of foreign aquaculture species into the US, like Australia. Though there is a current movement to enforce biosecurity regulations on aquaculture farms, similar to current moves in Australia, though there is a great deal of resistance from multiple angles including farmers for labour and financial reasons as well as other regulatory agencies of aquaculture, as the United States Department of Agriculture (USDA) would have a great deal of power of it.

Other organisations involved in regulation of aquaculture in the US are the USDA, United States Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), United States Food and Drug Administration (FDA), United States Army Corp of Engineers (ACoE) and US Environmental Protection Agency (EPA).

Day 7

Whilst having classes on a Saturday was a bit of a shock to the system after a long and busy week, they were quite interesting and very relevant to my line of work. The lectures were delivered by Dr Lester Khoo who is the director of the Aquatic Diagnostic Laboratory at Mississippi State University and works closely with catfish farmers in the area.

The workshop in the morning was simple microbiology and teaching students make up agar plates for culture and sensitivity. Dr Khoo also brought along a number of necroscopy specimens from his lab with commonly seen bacterial diseases found in catfish.

The pathogens/disorders examined were *Flavobacterium columnare*, *Edwardsiella piscidia* (hole in head disease), *Methaemoglobinaemia*, anaemia, *Bolbophorus damnificus* and Proliferative Gill disease.

Antibiotics registered for use in catfish are Oxytetracycline, florfenicol and Romet (Ormetoprim Sulfadimethoxine).

Lectures presented in the afternoon were factsheet type lectures on cold water diseases of salmonids. The diseases addressed were Furunculosis, Cold Water Disease, Bacterial Kidney Disease, Bacterial Gill disease, *Yersinia rukeri* (both strains) and Infectious Salmon Anaemia.

Day 8

Day off.

Day 9

The day started off with a water quality workshop. The facility had set up 3 separate tanks with 3 different filtration systems containing 1 American lobster each. The purpose of the exercise was to become familiar with manual chemical water quality tests before being introduced to electronic water quality indicators such as a dissolved oxygen (DO) meter. Utilising LeMatte water testing kits for ammonia, nitrite, nitrate and DO. This exercise was a useful revision of water quality parameters and a good introduction to some of the manual chemical water tests such as the DO test as I have only been acquainted with electronic DO meters.

After the water quality workshop, we had a tour of the shellfish grow out farm here at Roger Williams University. They most commonly grow out Eastern oyster but also produce bay scallops,

razor clams and soft-shell clams. The university have found that the cylindrical rafts that are becoming more commonly utilised in AUS produce better oysters with significantly less biofoul and with deeper cups which tend to be more valuable in the US market, but the majority of local farms utilise rack and bag, and cage culture.

The afternoon was concentrated on fish histology and anatomy and presented by Dr Sal Frasca Jnr. Lectures were centred around normal histological features of organs and structure in teleost fishes with some added information on elasmobranches. The night classes were histology labs examining histology slides displaying normal histological structures of all organs and some fun mystery slides! I was quite proud of myself for being the first person to work out that the mystery slide was a transverse section of a gravid livebearer fish. The workshops are an essential part of the course; being presented with unlabelled slides and having to identify tissue utilising the knowledge from the lectures given prior is extremely important to be able to retain the information as well as practising the skills of recognising cell types and structure.

Day 10

Today was a day that I had been looking forward to in the program. The day's lectures were scheduled to centre on histology of common ornamental and salmonid diseases, harmful algal blooms and finishing off with fish haematology.

Dr Frasca continued on from normal fish histology from yesterday to histology of disease. A wide range of diseases were addressed in the lectures from viral, bacteria, protozoan, fungal, metazoan parasite, mesomycetozoeal, algal disease and non-infectious diseases.

The lectures were finished off with a short histology workshop with slides displaying some of the histological structures from diseases previously mentioned in the lectures. Some of the histology slides displayed diseases such as goiter, whirling disease, BKD, lymphocystis, epitheliocystis, *Ichthyophthirius multifiliis* infection and scuticociliatosis.

This was an extremely interesting set of lectures and workshop, it was great to be able to examine diseases that I am familiar with and are common to Australia, as well as diseases that are exotic to Australia.

The afternoon lectures were split between the topics of harmful algal blooms and fish haematology.

Dr Chris Gobler, a prominent expert in marine and freshwater algal ecology in the USA, delivered the lectures on harmful algal blooms. The lectures were mainly directed towards marine algal blooms and the effects on wild populations of fish; though there was a small section of freshwater algae

mostly concerning cyanobacteria blooms. The lectures were directed more toward marine algal blooms as the USA has increasing issues with red tides and the consequential effects on marine ecology, such as cetacean deaths, and effects on the shellfish industry.

Dr Gobler also briefly mentioned brown blooms in freshwater commonly caused by diatoms, these organisms are mostly harmless, though there is a species in the USA that does produce a toxin. Dr Gobler also mentioned a case in Canada where a salmon aquaculture facility was affected by a diatom bloom where the silica cases of the organisms caused irritation to the fish.

The last lecture of the day was presented by Jill Arnold, the director of laboratory services at Baltimore Aquarium, and was centred on fish and elasmobranch haematology. This was a basic identification of different cell types present in teleost and elasmobranch blood and some of the differences between the two. It was also noted that there can be large differences in cell types between different teleost species. Whilst haematology is not a diagnostic branch that is commonly utilised in an aquaculture setting, this might be useful when dealing with valuable broodstock.

Day 11

I was looking forward to today, it was programmed to have a heavy itinerary of diseases of cold-water fish.

The lectures were presented by both Dr Jan Lovy and Dr Tom Loch covering viral, environmental/nutritional, parasitic and fungal diseases of coldwater fishes. The brook trout and rainbow trout were focused on mainly, however with a small smattering of US native fishes.

Most of it was revision and the viral diseases addressed were only the OIE listed ones, but there was a case on sunburn in trout that I hadn't hear of. Another case which I found very interesting was a mortality case at a native fish hatchery raising Musky for wild restocking. Tilapia feed is commonly utilised in these hatcheries and they seems to end up with mortality events every so often – most likely due to some form of nutritional deficiency.

Day 12

Today was split between aquatic birds and diseases of warmwater fishes.

Dr Cindy Discroll presented the lectures on aquatic birds and disease investigation of mortality events. It was quite fascinating (but not fish…). This was followed by a workshop completing

necroscopy of wild birds. It is always a unique experience, being able to necroscopy species that I had never encountered before.

The afternoon was completely dedicated to diseases of catfish. Many of the parasites I was familiar with such as ambyphyra, trichodina and *Ichthyophthirius multifiliis*, but the lectures expanded on some of bacterial diseases of catfish that Dr Khoo had previously addressed. I did come out having a much greater understanding of catfish aquaculture in the USA and having a good awareness of some of the husbandry practices that contribute to disease.

Day 13

Much of today was taken up by student seminars. The current trend for seminars so far has been distinctly conservation based. Some quite interesting such as Lionfish invasion into the Atlantic and Caribbean and the effects of climate change on Olive Ridley Turtle nesting in Costa Rica. It's been a bit of a mixture of seminars in terms of knowledge basis. Some students are doing seminars on topics they previously had no knowledge on as a learning opportunity and others are presenting information that they were directly involved in during their undergraduate studies.

The remaining lectures of the day concerned corals and diseases of corals in the Atlantic, penguin health assessments and a lecture on recirculating aquaculture systems, delivered by the hatchery manager from the university's tropical ornamental hatchery. It was a nice revision of RAS systems and components. The last lecture of the day was on natural resource management in fisheries, delivered by Dr Russell Brown, an ecologist from NOAA. It had the potential to be a very interesting lecture and one that I was looking forward to. I was somewhat disappointed, the lecture itself very much concentrated on the American-specific politics of fisheries management, not the strategies of fisheries management as I was expecting.

Day 14

Today was extremely interesting! Half the day was dedicated to shrimp farming and diseases and was followed by oyster aquaculture in the afternoon.

The lecturer who presented on shrimp aquaculture in America was Dr Robert Bullis, who is a professor at Florida Keys College. The shrimp industry in America is very much moving towards intensive culture and are completely reliant on SPF/SPR *P. vannamei* to be able to farm.

The second prawn lecture was delivered by Dr Arun Dhar, a virologist and director of the Aquaculture Pathology Laboratory Arizona (World Organisation for Animal Health (OIE) reference lab

for crustacean disease). He gave a talk on prawn disease focusing on White Spot Syndrome Virus (WSSV) and Necrotising hepatopancreatitis. His talk on WSSV was very doom and gloom. The more recent outbreaks overseas like in Madagascar have resulted in huge issues. An example he gave was a semi-intensive farm that he is directly involved in helping that had an outbreak. The farm consequentially upgraded biosecurity and set up an incoming water treatment plant; drum filters and ozonation, and are continuing to have huge issues with recent outbreaks in ponds.

I was very impressed with his attitudes to PCR, which he shares our opinion in interpreting the tests as the presence of DNA of the virus, and his overarching message concerning continuing research about prawn diseases was that it's useless unless it's applicable on farms.

The other half of the day was dedicated to oyster aquaculture in America and was delivered by Dr Robert Maze, who is one of the aquatic vets who runs the AQUAVET course and owns an oyster hatchery and grow out farm. It was a nice review of oyster culture from hatchery through to grow-out. The primary oyster raised on the Atlantic coast is the Eastern Oyster, Pacific oysters have huge disease issues here so it's not viable commercially.

Their primary concerns in this region is *Vibrio* spp. issues in hatcheries and *Vibrio parahaemolyticus* infections in humans as a consequence of eating raw oysters.

Day 15

Day off

Day 16

The day started off with student seminars, and the high quality and interesting topics chosen by fellow students have continued to impress. Topics ranged from sea anemone reproduction to pinniped anaesthesia and the future and economics of aquaponics.

Mid-morning lectures transitioned back into aquaculture topics. The topics presented were drugs used in Aquaculture, public health safety and fisheries/aquaculture, and the economic considerations of aquaculture operations.

The drugs in aquaculture lecture was presented by Dr Emily Cornwell, a veterinarian working small animal practice who also does some fish work. The lecture was aimed for both treatment of aquarium fish and aquaculture operations. There are only 3 anti-biotics registered for treatment of food producing fish here in the USA (Florfenicol, oxytetracycline and sulfadimethoxine/ormetoprim)

and a number of chemical water treatments as well including formalin, chloramine-T. Interestingly potassium permanganate is not registered for use here. Also, it's only a relatively new rule, as of January 2017, that all aquatic medicated feeds need a Veterinary Feed Directive.

The afternoon lectures on aquatic toxicology and seafood safety were delivered jointly by Dr Maze and Dr Lisa Murphy, a veterinarian working exclusively in toxicology at the School of Veterinary Science at University of Pennsylvania. This was a very interesting lecture and emphasised the importance of correct storage of seafood as well as correct labelling of fish with some issues with substitution of pufferfish for other species of fish resulting in critical hospitalisation of people.

The final lecture of the day was the economics lecture delivered by Dr Laurie Landeau. This was a fantastic lecture! I thought this is an incredibly important lecture to be delivered to budding aquatic veterinarians in understanding how important health is in respect to the business bottom line and profitability of an aquaculture system. Dr Landeau also gave great advice on how to sell veterinary services to aquaculture operations in respect to economics.

Day 17

The day started off with student seminars including my own! My seminar on WSSV with special reference to the 2016/17 Australia outbreak went really well and was well received by other fellow students and the directors of AQUAVET. I was highly commended by Dr Stremme, the AQUAVET course director, for being natural speaker and presenting a highly interesting talk in a passionate manner.

The rest of the day was spent at New England Aquarium with a behind the scenes tour of the aquarium and clinic. Dr Kathy Tuxbury presented a very interesting lecture on amphibians and their treatment to finish off the day.

Day 18

Most of today was dedicated turtles. The lectures covered topics including common turtle diseases in captivity, surgery and anaesthesia, clinical exam and diagnostic procedures, rehabilitation of wild sea turtles and cold stun in sea turtles. These lectures were delivered by Dr Charles Innis, one of the veterinarians at New England Aquarium.

The lectures were followed by a necroscopy workshop on sea turtles. The turtles that were provided were juvenile Kemp's Ridley sea turtles that had died in rehabilitation. This was a fascinating morning and the necroscopy workshop was interesting and a truly new experience for me.

The evening lectures were thankfully dedicated to fish! Dr Dale Leavitt, a professor of marine biology and applied shellfish farming, delivered a lecture series on fish nutrition. The lectures were very good, and he clearly knew this stuff. The information delivered went down to the basis of fish nutrition and covered the formulation of complete diets. At the end of the lectures we went through some commonly presented cases where nutritional issues were the primary cause i.e. screamer disease. He also gave some time on covering the need for extra supplementation of taurine in certain fish species

Day 19

Excursion day! We spent the day at Atlantis Marine World Aquarium and Riverhead Foundation for Marine Research and Aquatic Animals. Now it wasn't all just relaxing and fun at the aquarium, we learnt how to do clinical exams on penguins and wild rehabilitation seals. This included techniques for taking blood samples from seals.

A super exciting experience that I never thought I'd have the chance to do.

Day 20

Second excursion day! Spent the day at Mystic Aquarium. This day was mainly based around behind the scene tours and learning about the role of training and veterinary procedures. This concept mainly applies to marine mammals. When dealing with large animals in a captive setting like Beluga Whales, it is essential that training and the bond between trainer and animal is utilised to be able to complete both regular veterinary procedures as well as procedures under emergency circumstances. In the seals, sea lions and fur seals, trainers complete a basic physical exam at every training session and the animals were present flippers, teeth and other portions of their bodies under voluntary will. This enables health staff to keep track of an animal's physical health on a very regular basis. Taking this to the next level, these animals can and have been trained to present flippers for voluntary blood draw, assuming positions for ultrasound, beaching behaviour and even voluntarily swallow endoscopes for foreign body removal.

This is extremely important in animals such as beluga whales which are large powerful animals and you cannot force these animals to do something that they do not want to do. All training is positive reinforcement based.

Different aquariums have different health protocols in terms of regular veterinary procedures. Some of the ones that I have seen so far have been CBC/biochemistry bloods every 6 months to 2 years

depending on species and health status, endoscopy every 6 months to 12 months for examination for foreign bodies (particularly important with penguins and marine mammals) and the sky seems to be limit in terms of veterinary care if an animal becomes clinically sick.

There are some instances of even fish being trained for the purpose of husbandry procedures. The electric eel in an aquarium was trained to voluntarily get into a net for husbandry procedures so to avoid any stressful procedures and the potential WHS issues for staff.

Day 21

The first lecture of the day was presented by Dr Carmen Colitz, a veterinary ophthalmologist working with marine mammals in captivity. Whilst not fish, I found this lecture to be very interesting. I had no idea that both cetaceans and pinnipeds in captivity have huge issues with eyes. Many of these issues are due to drastically increased exposure to UV in comparison to their wild comrades.

The rest of the day was spent with student seminars, all the seminars today were very much marine mammal conservation focused.

Day 22

Day off

Day 23

So the next 3 days are all focused on marine mammals and aquariums. Today was an intensive lecture day on marine mammals in captivity, the common diseases they get, laws and regulations involved in keeping them in captivity and the life support systems required. These lectures were presented by Dr Alison Tuttle, one of the directors at Mystic Aquarium and previous head veterinarian, and Dr Cara Field, staff veterinarian at the Marine Mammal Centre, California.

Preventative medicine for is an important aspect of an aquarium vet. In the USA cetaceans are vaccinated against Erysipelas. Captive pinnipeds are vaccinated for West Nile virus, distemper, rabies and given ivermectin to prevent heartworm. Captive penguins are vaccinated against West Nile virus and also given preventative medicine for avian malaria. All vaccines used in aquaria for marine mammals have been extrapolated across from production and small companion animals. Zoonotic diseases are also fairly common in marine mammals so extreme care must be taken particularly in a rehabilitation situations.

The day finished off with a lecture of the fish case studies found in large scale aquaria followed by an open ethical discussion about keeping marine mammals in captivity. This discussion and lecture were facilitated by Dr Brent Whitaker, a veterinarian at the Zooquatic lab. As I'm sure you can understand, this discussion went for some time in consideration of the complex emotive and scientific arguments along the spectrum between the adamantly against marine mammal captivity and the marine mammal advocate.

Day 24

Today's lectures all focused on marine mammals in captivity. The lectures covered husbandry and zoo management, common diseases and a large number of clinical case studies from both aquariums and marine mammal rehabilitation centres. The case studies were extremely interesting and from previous personal experience are more often than not more valuable educationally than other types of lectures as it allows for greater engagement and utilising knowledge from multiple areas to piece together a case.

Interestingly eye issues and age-related diseases are the most common issues with marine mammals in captivity. Like many animals kept in captivity they tend to live significantly longer than their wild compatriots so age-related diseases such as osteoarthritis are a real concern in managing these animals in captivity.

Day 25

Today was spent at the Woods Hole Oceanographic Institute (WHOI) conducting marine mammal necropsies. 4 animals presented for full necropsy and diagnostic work up; 2 cetaceans (1 Atlantic bottlenose dolphin and 1 Atlantic White-sided dolphin) and 2 pinnipeds (1 juvenile harp seal and 1 grey seal). All animals examined had been found dead on a beach in the Cape Cod Region or had been found stranded and subsequently died.

Necropsy can be an incredibly rewarding procedure, whilst there can be a wider sadness associated with the death of large charismatic megafauna and it's association with human effects on the environment, there is so much we can learn and understand through necropsy and use that knowledge to further our understanding of our impact on the oceanic environment as well as natural challenges that face these species.

The evening lecture was presented by Dr Sarah Sharp, a veterinarian and Northern Atlantic Right Whale researcher at WHOI. Entanglements are a huge issue for Northern Atlantic Right whale

populations and a point of contention for the American lobster industry with a number of whales becoming entangled in lobster pot lines as well as what is teamed as 'ghost' gear or discarded commercial fishing gear. There has been great success in taking whale disentanglement to a new unprecedented level. Veterinarians have started sedating wild whales to allow for far safer and more successful disentanglement procedures. A number of great studies have been conducted to be able to estimate a whale's weight from its dimension and then combined with veterinary experience with large animal sedation has revolutionised our ability to free these animals, this is particularly pertinent in Northern Right whales which are critically endangered.

With a good team I think this could also be achieved here in Australia.

Day 26

Back to fish! Today's lectures were primarily concerning pet fish and some case studies from public aquaria.

Dr Jessie Sanders, an ornamental fish veterinarian working in California, presented lectures on common diagnostic techniques for working up pet fish cases as well as treatments. For pet fish, correcting inappropriate husbandry makes up the majority of work for veterinarians working with pet fish. The other major issue that Dr Sanders saw was swim bladder disfunction in Fancy goldfish. Decades of intensive selective breeding for unusual desirable physical characteristics have left some breeds of goldfish with drastic changes to their internal anatomy which in turn affects their swim bladder making them far more predisposed to swim bladder issues.

The afternoon was spent on fish anaesthesia and surgical technique in preparation for the fish surgery practical.

Day 27

Last day!

Today was split between a practical fish surgery lab in the morning and lectures in the afternoon. The fish surgery practical was brilliant! When I transitioned from general veterinary practice into production aquatics medicine I never imagined myself having the opportunity to operate on a fish. We all had a chance to take the role of surgeon and anaesthetist. Three surgical procedures were conducted on the fish, an eye ablation, splenectomy and a gonadectomy. These procedures represent the three more common surgical procedures completed in pet fish.

Following this we had a chance to tour Roger Williams University shellfish hatchery; the university runs are modern research and commercially profitable hatchery on site. They spawn and grow a number of different shellfish species including razor clams, soft-shell calms, Eastern oysters and hard calms for use in commercial grow out operations as well shellfish restoration projects.

The afternoon lectures continued to build upon yesterday's talks on ornamental fishes. Dr Saint-Erne spoke of his experience working with importation facilities for ornamental fishes into the USA and the challenges he faced in treating and preventing disease. He went on to talk specifically on koi and their disorders and diseases. I found this to be extremely interesting, the domestic Koi industry is one that I have not yet encountered here in Australia and so the information being presented was very new to me. In consideration of Australia's controversial proposed release of Koi Herpesvirus in an effort to control the wild carp population, it was great to be able to talk with aquatic veterinarians who work in a country that has had the disease for some time and discuss the challenges that they face with the disease.

The last lecture of the course was delivered by Dr Ari Fustukjian, the chief veterinarian from Florida Aquarium. This lecture was aimed at the vet student who had yet to start their journey towards specialising in aquatics. He spoke of his journey into aquatics and the myriad of possible pathways as a veterinarian to specialise in aquatics, whether it be in aquaculture, pet fish, in public aquaria, marine mammals or conservation.

Outcomes

AQUAVET is a truly phenomenal course and having spoken to many international academics during the course itself, there is nothing like it anywhere else in the world. I have learned a huge amount of knowledge across a number of different groups of aquatic animals and a number of disciplines as well as practical hands-on techniques that I have brought back to put into use in practice on aquaculture farms. This course had also enabled me to make new contacts with other aquaculture veterinarians working internationally, these contacts are invaluable in improving the sharing of knowledge to solve problems that are common across the world as well as enabling collaboration to solve new problems. My new knowledge and skills have equipped me with both the ability and the confidence to take Panaquatic into new areas and to further strengthen our capabilities in the aquaculture sector.

There has been an ongoing call from all levels of aquaculture, from farmers to government departments, for more veterinarians to be involved in and adequately trained in aquatics. This course should be actively encouraged to veterinary science students who are interested in gaining knowledge and experience in aquatics. Better yet would to initiate the development of an AQUAVET-like course here in Australia for provide more accessible, Australian-specific aquatic training for veterinary students and veterinarians alike.