Gill Disease in Barramundi (*Lates calcarifer*)

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Declaration

I declare that this is my own account of my research, except where duly acknowledged and contains work that has not been submitted for a degree at any tertiary institution

Neil R Griffiths

PREFACE

A veterinary degree is the most versatile of the biological sciences and much is expected by the general public from a Veterinarian.

I had a successful single man small animal practice in Adelaide, until one fateful day when driving my motor vehicle, with my trusted canine friend who kept a watchful eye; watched me suffer a Grand mal seizure and then hit a tree. My dog suffered concussion and I a month in hospital, multiple operations and multiple specialists, 2 months unable to walk and unable to practice with substantial pain and seeing the world differently than before, having time to think without the rigors of veterinary practice. I have no regrets.

For I always wished to use my veterinary degree for food production and with God saving my life and that of Caleb, I decided to investigate aquaculture, realising I knew little and needed training, which initially came from a course work masters from a non veterinary university. I started to discover a new world under my microscope from typical cytology I used in my practice every day, particularly for avian species which I did mainly for interest. I met Barramundi re-circulating aquaculture farmers at a meeting of the Inland Aquaculture Association of South Australia, asking for help with disease issues. I helped a little, but realising they needed more than what I had to offer, finding organisms or cells I did not know what they were and to my surprise others also.

So I went home to Perth, back to Murdoch University Veterinary School and asked for help. There I met Shane Raidal who taught me a decade before with an avian medicine workshop and had developed a passion for aquaculture and kindly offered me a Veterinary Master's in Barramundi Gill Disease, Thank you Shane.

The skills developed from this Masters Degree with training, however long the road was from 2003 to 2008 have allowed me to fulfil what I wished to do in my second year of veterinary school, feed people rich or poor by developing an array of skills that any veterinarian can. Small animal practice served me well and I hope I served my clients and their pets well for nearly one and half decades, but the transition into intensive animal husbandry has put me on the frontier of where agriculture must go and I hope to contribute just a little and I thank my veterinary degrees and those that suffered me, Thank you Shane and my family, particularly my wife Leanne, who one day had the same husband, but with a different outlook.

Neil R Griffiths

ABSTRACT

Disease is a major impediment to world aquaculture, amplified by the increase of the intensity of aquaculture relieving pressure from over depleted wild stocks, but with intensity brings disease and particularly disease of the fragile gill organ, exposed directly to the water environment. There is little literature on barramundi biology and the various forms of culture impacting on health, particularly the gill and much research is required in gaining a further understanding of this popular eating fish.

The light microscope is a pivotal tool with cytology and histology mandatory in assessing gill health. The gill biopsy should be considered part of a clinical examination as the water medium surrounding the gill and on the gill contains often fragile organisms that would otherwise be lost in fixation for histology alone, but easily viewed with cytology. Barramundi are easily anaesthetised and recovered like many terrestrials and gill re-growth is rapid, healing within days. Biopsies should be viewed unstained with and without phase contrast and then stained and reviewed, recognizing some ectoparasites maybe lost with anaesthetic agents and stains. The sacrificing of the fish after a live gill biopsy is necessary with histology and microbiology our major tools for diagnostics, with no other non invasive methods readily available as for terrestrials. Every year many new water organisms related to aquaculture are described in the literature and the finding of novel and new organisms makes the veterinary examination of the live fish exciting yet imperative.

A major concern is the gill pathogens found in wild barramundi were similar to those found in culture. For example the prevalence of the parasite Henneguya a Myxosporidean was 90% in sea cages 60 km offshore from Darwin in the Bathurst Island river system and 66% for ponded fish with water drawn from the Darwin Elizabeth river, compared to 33% infected in the wild habitat of the Mary river system close to Darwin by road. However the bacterial disease Epitheliocystis had a prevalence of 66% in the sea cages and 18% of similarly sized fish in the Mary river system, yet nil found in the pond farm, but in this case sample numbers were restricted. Consequently the surveillance for new fish pathogens and monitoring for existing pathogens in the wild ecosystems and aquaculture facilities is necessary and must include the macro and micro flora and fauna surrounding such facilities as they are potentially affected from aquaculture waste streams. The sustainability of aquaculture in open water culture must be considered with great concern for many reasons, but disease by its nature could overwhelm a species and other aquatic life quickly disseminated in a dynamic water medium.

Freshwater culture of barramundi has problems with off flavour and disease, particularly re-circulating aquaculture systems due to undercapitalization and possibly at this stage with existing type farms not suited for the culture of barramundi with one farm having all fish

sampled diagnosed with systemic bacteraemia and gill Epitheliocystis. Commonly fish sampled from freshwater culture had suffered pathological changes to the gill, particularly hyperplasia indicating the fish are continually affected by issues of water quality and disease.

Pond culture appeared to control gill disease issues by affording lower stocking rates, high water exchanges from a river within metres, fallow and the flavour of the fish similar to wild catch or sea cage culture, when purged in brackish water. The decreased environmental and ecosystem risks, coupled with the pond farmer reporting good profits with a simple form of culture, also suitable for intensification is a success story for barramundi production for today and the future.

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This project was predominantly funded by the insurance company that kindly upon medical advice offered me a re-training package, of which funded the purchase of laboratory grade microscopes and a digital camera interface taking all of the photos for this thesis and most of the travelling expenses completing the survey.

I would like to thank Murdoch University for crediting the course work component from Deakin University, which gave me the necessary background, particularly in water quality, nutrition and the overall world stage of Aquaculture in performing this research project. Additionally thanking Murdoch Universities Fish Health Unit and Shane Raidal for supplying funding and facilities, for histology, TEM, SEM and staff facilitating a graduate from the 1980's with the necessary diagnostic tools and support to explore a new frontier for myself and a fledgling Australian aquaculture industry.

A Thankyou to Western Australian Fisheries Pathology Department headed by Brian Jones, who taught and encouraged many veterinarians with his thirty years of service in histopathology in aquatic science and encouraged me to keep looking at the unusual cells discussed and shown in the thesis beginning in 2003, when I asked him what are they?
I remember him saying 'I have seen them before, but have not the time to investigate them.'
Hopefully a little light has been shed for more research into these unusual cells found on gills of a few Australian major finfish species, particularly the icon Barramundi.

Mentoring is part of teaching and I thank Shane Raidal again for patiently leading me in the right directions of this thesis and through the skills and confidence gained not only bridging the gap into aquaculture, but also intensive animal husbandry of meat rabbits, both requiring an interface by a veterinarian at the farm level, to pathologists, laboratories and tertiary institutions.

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LIST OF ABBREVIATIONS

DE	Digitally enhanced
EGC	Eosinophilic granular cell
EUS	Epizootic Ulcerative Syndrome
FAO	Food and Agriculture Organisation of the United Nations
MFHU	Murdoch Fish Health Unit
MM	Melanomacrophage
MRC	Mitochondrial rich cells (also known as chloride cells)
NT	Northern Territory
PAAS	Periodic Acid Ammoniacal Silver
RAS	Recirculating Aquaculture System
SA	South Australia
SEM	Scanning Electron Microscopy
TEM	Transmission Electron Microscopy
TAN	Total Ammonia Nitrogen
WA	Western Australia