CURRENT SHRIMP DISEASES IN SOUTHEAST ASIA

by: **Stephen Newman**

In the past 10 years, losses due to widespread diseases on shrimp farms in Southeast Asia have well exceeded a billion US dollars in export income. The author opines that disease is natural, and at any given time in shrimp culture, there are several microorganisms present which are opportunistic. This article is a useful summary of the diseases currently prevalent in the region.

Introduction

Disease is natural. Bacteria, viruses, protozoa, fungi and a myriad of multicellular organisms routinely affect all animals and plants. Aquatic animals, including bivalves, fish and shrimp are no exceptions. Crowding animals, the widespread use of monoculture production systems, failing to reduce stressors, poor quality production environments, and pseudo-scientific approaches to biosecurity and sustainability all contribute to susceptibility.

Only a few pathogens are obligate i.e. their presence in the production environment invariably results in disease. Most are opportunistic and typically the ultimate cause of mortality. Animals are weakened and become susceptible to a myriad of organisms that take advantage of a ready food source that cannot defend itself.

Shrimp farmers are constantly struggling with established pathogens and it seems as if new pathogens are being characterised with depressing regularity. It is well understood that many pathogens are carried over from broodstock through the hatchery into the farm. Some become established in the environment in carriers and vectors and in the immediate production environment, such as the pond bottoms, making them even more challenging to manage.

Table 1: Examination of 200 Thai ponds chosen at random for prevalence of disease, 2014 *(Flegel at al.)*

Pathogen	Number positive	Total	Percentage
EHP	72	148	49
EMS	21	148	14*
WSSV	8	148	5
CMNV	64	148	43
Early mortality with no lesions	5	148	3

**Characterised as mortality within first three weeks, post-stocking*

At any given time there are many diseases affecting shrimp farmers. Currently, SE Asia (and elsewhere) is reeling from two primary pathogens: (i) one is responsible for Acute Hepatopancreatic Necrosis (AHPNS) also widely known as Early Mortality Syndrome (EMS) although this name is not particularly descriptive as we know that animals can be impacted at almost any size; (ii) the other is a fungal pathogen, *Enterocytozoon hepatopenaei,* responsible for EHP.

Covert mortality noda virus (CMNV), white spot syndrome virus (WSSV) and likely a number of as-yet not characterised pathogens are present as well. Running Mortality Syndrome in India is a chronic low level mortality issue with a yet unidentified cause. Additionally there are many other problems being reported. It is beyond the scope of this brief summary to detail them all.

AHPNS or Early Mortality Syndrome (EMS)

EMS, caused by *Vibrio parahaemolyticus*, was initially observed within a few weeks of stocking post-larvae from the hatchery into ponds, thus the term.

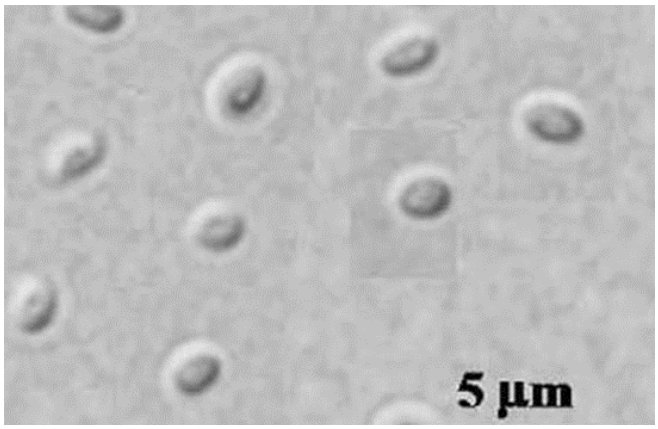
Some strains of *V parahaemolyticus* have been found to carry the genes for the production of a pair of protein toxins that are very similar to those produced by certain strains of insecticidal bacteria. Recently it has been reported that *V owensii* and *V harveyi* can carry the genes as well. At high enough levels, these toxins damage the animals' hepatopancreas (HP), ensuring loss of integrity with a massive bacterial invasion finishing off any shrimp that survive. It is important to bear in mind that the toxin causes the disease process and that this should be considered a toxicosis rather than a typical acute *Vibrio* infectious process.

There is still much we do not know about this disease process. There are several geographical areas where the PCR (polymerase chain reaction) probe that reacts with the toxin genes lights up everywhere and yet there are few, if any, reports of acute disease. There are also reports where high levels of impact have been noted and in subsequent stockings the severity has been greatly reduced. There are also instances where the same stocks produced in two different hatcheries behaved in two different ways, one with acute problems and the other with minimal, if any, problems. Until we better understand the factors that impact toxin production as well as the role of biofilms and quorum sensing in production of the toxin, it will be difficult to determine what the best methods of control might be.

Although there are some paradigms, use of tilapia, closed systems, rapid removal of sediments, etc. which seem to be at least partially successful in mitigating the impact, it appears that paying attention to fundamentals may be just as, if not more, important.

EHP due to *Enterocytozoon hepatopenaei*

Microsporidians are ubiquitous. They affect virtually every animal, and aquatic animals are not immune. Typically most of these parasites have complex life cycles requiring various hosts for different life stages. To date, the evidence suggests that *E hepatopenae* may be different. It is also likely that this particular organism has been around for much longer than observations suggest. As is typical of many of the microsporidians, the disease process is more a result of the accumulation of the pathogen in the host as it gradually reproduces or is ingested, than of an acute pathologic process. As the loads in the animals increase and the critical functioning of the target organ - the HP - is affected, the animals lose the ability to grow and convert feed normally. This can be a disaster to farmers where high priced feeds must result in optimal shrimp growth or the crop is an economic failure.



EHP spores

Control consists ultimately of eradication. This is not simple and to date, it appears that this organism is largely refractive to the use of classical chemical attempts at control. The critical step is to ensure that the broodstock are not carrying it any level. This entails the use of broodstock from nuclear breeding facilities that are not being fed live fresh or frozen feeds that contain the spores. Pond-reared animals are potentially carriers. This very important step will ensure that the hatchery is not the source of the pathogen. Ponds must be properly treated between cycles to lessen the load of spores. There are several very caustic approaches that have been advocated, although physical removal of the top layers of sediment is a viable approach as well.

White Spot Syndrome Virus (WSSV)

The virus responsible for white spot syndrome is ubiquitous and endemic to many areas where shrimp are farmed. It is not likely that it can be eradicated without drastic cost-prohibitive measures.

Classic shell lesions seen in shrimp affected by WSSV

This virus does not impact animals at warmer water temperatures and there are indications that production at temperatures above 32 ^{0}C or so can in fact eliminate the virus from populations. A number of workers in the field believe that while this virus certainly does impact the population on its own, it also opens the door for massive secondary infections with opportunistic *Vibrios*. Controlling stressors and pathogen loads through proactive management strategies can lessen the impact. It has been widely observed as well that over time the virulence is moderated to some extent. Recent studies have implicated sudden drops in salinity in combination with molting as critical stressors in the pathogenesis. Eradication is not feasible although in some instances crop rotation between fish and shrimp could be useful in lessening the environmental loads. While there will be some progress in the selection of strains that are more tolerant to the virus, it is very important to bear in mind that none of the pathogens affecting farmed shrimp operate in a void.

Vibriosis

There are few workers in this field who do not agree that strains have by far the greatest negative impact on farmed shrimp. There are more than 100 strains of *Vibrio*, with more being characterised all the time. A dozen or so are implicated in shrimp disease and a handful of these would be considered to be obligate pathogens. Controlling *Vibrios* in open systems is at best challenging and at worst, not possible. The continued insistence on the part of many workers in the field to base risk upon sucrose fermentation (yellow versus green colonies) does not help. While there is no doubt that these are useful overall indicators, in fact sucrose fermentation has nothing to do with virulence and care must be taken not to create niches that allow highly virulent strains to evolve.

Classic vibriosis due to Vibrio alginolyticus

Vibrios serve a critical function in the recycling of chitin and, at least in open systems, while there are some microbial products that have been shown to impact loads, there are no practical ways to totally eliminate them. As long as stress and poor biosecurity are consistent elements of production of farmed shrimp even if a microbial genus could be controlled, there would be niches available for other bacteria that could readily replace the *Vibrios* as opportunistic pathogens.

Covert Mortality Nodavirus (CMNV)

CMNV has relatively recently been characterised as being widely present in many areas. First reported in China in 2009, it likely is widespread and part of the overall disease pattern noted in many areas. The shrimp typically die on the pond bottoms with cumulative low levels of mortality eventually resulting in potentially disastrous crop losses. The total impact is not clear although there is no doubt that its presence contributes to overall susceptibility to other problems.

Classic CMNV appearance

Running Mortality Syndrome (RMS)

This is a general term describing low levels of constant mortality in ponds. This is likely due to a combination of factors and could be due as well to many different pathogens. More work is needed to be done to characterise the disease process and to ascertain what, if any, specific pathogens might be involved.

Other pathogens

Jie et al

Like an iceberg with most of the ice below the surface, what we see in disease management is only a small portion of what actually goes on

There are many potential pathogens present in and near production environments. The best way to look at this is like one would view an iceberg. What we see is only a very small portion of what is actually going on. Some diseases that we commonly hear about are the subject of this article although others include the cause(s) of milky muscle disease, loose shell syndrome, white faeces and far too many others.

Focusing solely on those that we know about is part of the challenge that enlightened managers understand is ultimately not sustainable. Pathogens move through production systems in a variety of ways and it is incumbent on those with the greatest to lose to ensure that proactive management strategies are put in place and are a routine component of daily management. Without this, farmers are going to see an endless repetition of diseases cycling through their production systems. This is not conjecture. Disease is natural. Keeping it out of production systems by mitigation, prevention and appropriate reactive management strategies is essential for true sustainability.

Summary

There is a common theme with many disease issues. The weak link in all of this is the broodstock. Using pond-reared broodstock regardless of their PCR status is a biosecurity risk. The reliance on animals that are not from biosecure nuclear breeding facilities with a proven track record and history of field performance will ensure that shrimp farmers will continue to be affected by these pathogens and those waiting for the right moment and environmental conditions.

Table 2. Summary of major pathogens currently affecting SE Asia

Disease	Pathogen (type)	Control	Comments
AHPNS/Early Mortality Syndrome (EMS)	Bacterial (toxin)	Minimise factors that allow toxin to be produced	Pattern of disease is not consistent in the field suggesting that there may be other control factors not yet clearly understood
EHP *(Enterocytozoon hepatopenaei)*	Fungal *(microsporidian)*	Eliminate spores from environment and stop transmission. Control begins in the maturation facility	Very difficult to eliminate. Requires diligence at all stages of production and caustic pond bottom treatments
White Spot Syndrome Virus (WSSV)	Virus	Reduce stressors, minimise impact of secondary infections	Vector elimination problematic. Control begins in the maturation facility
Vibriosis	Bacterial (many different species)	Typically cause of secondary infections	Ubiquitous. Minimise stressors and control obligate pathogens in maturation facility and hatchery. Use PRO 4000X
Covert Mortality Nodavirus (CMNV)	Virus	Control by using clean broodstock	Possible two viruses causing syndrome
Running Mortality Syndrome (RMS)	Unknown	Unknown	Likely similar to others. Control starts in the maturation facility
Others	Many	Use Sustainable Management Practices (SMPs)	Proactive disease management strategies and stress management

It is important that regulators and all stakeholders drive the changes that need to become a part of routine sustainable management practices (SMPs). Many third parties purport that their best management practices are consistent with sustainability, yet they inevitably fail to prevent problems that SMPs would prevent. Limiting the movement of animals that are not from completely closed biosecure nuclear breeding facilities; minimising the existence of subsistence-based maturation and hatchery facilities; acknowledging the limitation of PCR for detection pathogens; and regulating the product and sales of broodstock and post-larvae are all useful tools.

Dr. Stephen Newman *is a marine microbiologist whose early career focused on the development of the first commercial fish vaccines. Since the early 1990s, he has been working closely with shrimp farmers in almost every country that farms shrimp. In 1996 he founded Aquaintech Inc., to provide a wide variety of products and consulting services to the international aquaculture community. He is an internationally recognized expert in aquaculture and has extensive experience in product development and sales and consulting with clients on a wide variety of topics ranging from business plan preparation and due diligence to auditing of operations with the goal of improving productivity. More details are available at www.aqua-in-tech.com and www.sustainablegreenaquaculture.com.*