



Is white shrimp (*Penaeus vannamei*) a threat to Asian shrimp culture?

Simon Funge-Smith
FAO Regional Office for Asia and the Pacific,
Bangkok, Thailand
simon.fungesmith@fao.org

Matthew Briggs
5/16 Fisherman Way, Vises Road, Rawai,
Phuket, Thailand
koygung101@yahoo.co.uk

Rohana Subasinghe
FAO Fisheries Department, Rome, Italy
rohana.subasinghe@fao.org

This article is based on a paper presented at the workshop on "International Mechanisms for the Control and Responsible Use of Alien Species in Aquatic Ecosystems", 26-29 August 2003, Jinghong, Xishuangbanna, People's Republic of China. Further information on this subject will be available soon through a comprehensive review of the introduction of penaeid shrimp species (*Penaeus vannamei* and *P. stylirostris*) to the Asia-Pacific Region that is currently being prepared under the FAO/Network of Aquaculture Centres in Asia-Pacific (NACA)/World Wildlife Fund (WWF)/World Bank (WB) Consortium Programme on Shrimp Farming and the Environment. (<http://www.enaca.org/Shrimp/index.htm>).



Simon Funge-Smith

Penaeus vannamei

The use of exotic animal species to increase food production and income has a long history and has been an established practice since the middle of the 19th Century. Controversy over the use of exotic species arises from the many highly publicized and spectacular successes and failures. Experimental introductions of white shrimp, *Penaeus vannamei*, to Asia began in 1978/79 to the Philippines and in 1988 to the People's Republic of China (Mainland China). Of these first trials, only Mainland China maintained production and started an industry. However, beginning in 1996, *P. vannamei* was introduced into Asia on a commercial scale. This started in Mainland China and Taiwan Province of China and quickly spread to the Philippines, Indonesia, Viet Nam, Thailand, Malaysia and India.

CONTRIBUTION TO PRODUCTION

Penaeus vannamei has been introduced and farmed in Asia since the mid-1990s, with production in Mainland China being particularly significant. There have been several reasons for the introduction and subsequent movement of this species: availability of specific pathogen free (SPF) stocks, perceived differences in susceptibility to White Spot Syndrome Virus (WSSV) from *P. monodon*, a shortage of *P. vannamei* in the international market



Simon Funge-Smith

P. vannamei hatchery

(mainly the United States of America) caused by reduced production in Latin America, and the relative ease with which animals can be cultured and bred in captivity. In some countries, *P. vannamei* has been promoted for culture by some private-sector suppliers as being tolerant or resistant to WSSV, leading to introductions based on a mistaken belief that they are safe.

Mainland China has a large and flourishing industry for *P. vannamei*, producing >270 000 mt in 2002 and an estimated 300 000 mt (71% of total shrimp production) in 2003, which is higher than the current production of the whole of Latin America. Other Asian countries with

developing industries for this species include Thailand (120 000 mt estimated production for 2003), Viet Nam and Indonesia (30 000 mt estimated for 2003 each), with Taiwan, the Philippines and Malaysia also producing thousands of tonnes each.

Total production of *P. vannamei* in Asia was approximately 316 000 mt in 2002, and it is estimated that this will increase to nearly 500 000 mt in 2003, which would be worth some US\$4 billion on the export market. However, not all of the product is exported outside of the region, and a large local demand exists in some Asian countries.

WHY CULTURE *PENAEUS VANNAMEI* IN ASIA?

There are many reasons for the introduction of *P. vannamei* outside its natural range. Despite the presence of various international, regional and country-specific regulations, the private sector (and/or government) often initiates introductions due to problems with the culture of their indigenous species and the (rightly or wrongly) perceived production benefits of the exotic species. There may be marketing advantages, and a desire to expand, intensify and/or diversify aquaculture systems. Additionally, improved transportation efficiency has removed some old limitations and encouraged international trade in exotic species.

The main reason behind the importation of *P. vannamei* to Asia has been the poor performance, slow growth rate and disease susceptibility of the major indigenous cultured shrimp species, *P. chinensis* in China and *P. monodon* virtually everywhere else. Cultured shrimp production in Asia has been characterized by a series of outbreaks of disease caused by viral pathogens that have caused significant losses to the culture industries of most Asian countries over the past decade. These diseases have not been confined to single countries but have spread throughout shrimp culture regions, apparently as a result of transfers of infected stock. It was not until the late 1990s, spurred by the production of the imported *P. vannamei*, that Asian (and therefore world) production levels began to increase again.

ADVANTAGES AND DISADVANTAGES OF *PENAEUS VANNAMEI*

Penaeus vannamei offers numerous advantages over *P. monodon* for the Asian shrimp farmer. These are largely associated with the ability to close the life cycle and produce broodstock within the culture ponds. This removes the necessity of returning to the wild for broodstock or postlarvae (PL) and permits domestication and genetic selection for favourable traits such as growth rate, disease resistance and rapid maturation. Through these means, domesticated stocks of SPF and specific pathogen resistant (SPR) shrimp have been developed and are currently commercially available from the USA. Other specific advantages include: rapid growth rate, tolerance of high stocking density, tolerance of low salinity and temperature, lower protein requirements (and therefore production costs), certain disease resistance (related to SPR stocks), high survival during larval rearing, and some marketing advantages.

There are, however, also disadvantages to the importation of *P. vannamei*, including its ability to act as a carrier of various viral pathogens exotic to Asia, a lack of knowledge of culture techniques (particularly for broodstock development) in Asia, a smaller final size and hence lower market price than *P. monodon*, the need for high technology for intensive ponds, competition with Latin America for markets, and a lack of support for farmers due to their often illegal status.

The major disadvantage of using exotic aquatic species such as *P. vannamei* is the potential to transfer serious pathogens. Transboundary pathogen transfers in newly imported species often result in the establishment of infections in naturally susceptible indigenous hosts and may lead to the adaptation of pathogens to a new range of hosts. Due to their inherent genetic variability, rapid rate of replication, and common occurrence as low-level latent infections in apparently healthy animals, the transfer of viral pathogens is of particular concern.

Since it is clear that the culture of *P. vannamei* is already established and growing fast in the Asian Region, it is important that informed decisions regarding these advantages and disadvantages be made and appropriate actions taken. This would ideally develop through a close dialogue between governments, the private sector and other concerned organizations.

RISKS AND THREATS

As discussed above, *P. vannamei* is now farmed and established in several countries in East, Southeast and South Asia and is playing a significant role in shrimp aquaculture production. On the other hand, it is also evident that viruses previously confined to Latin America, such as Taura Syndrome Virus (TSV), are taking a toll within *P. vannamei* shrimp aquaculture in many countries in Asia. Also, there have been reports of "runt deformity syndrome" (RDS) in *P. vannamei* caused by Infectious Hypodermal and Haematopoietic Necrosis Virus (IHHNV), which is endemic in *P. monodon* in the region.

The overall performance of *P. vannamei* as a candidate species within the shrimp aquaculture sector in Asia is still unclear. An understanding of the social, economic, and environmental impacts resulting from the introduction of this species into Asia is still lacking. As a newly introduced species, it is uncertain how *P. vannamei* will behave and perform in the region, and what impacts it will have on the regional economy, environmental sustainability, rural livelihoods and biodiversity.

Taura Syndrome Virus (TSV), which was initially identified in *P. vannamei* shrimp farms near the Taura River in Ecuador in early 1992, caused severe production and economic losses to the shrimp sector in the Americas and remains a major constraint to sectoral development. Similarly, White Spot Syndrome Virus (WSSV), which was initially identified in *P. monodon* in Mainland China and Taiwan, severely affected the Asian shrimp industry and subsequently spread to the Americas where it affected *P. vannamei* production systems. Although there is no evidence that TSV has spread to the major indigenous farmed shrimp species (*P. monodon* and *P. chinensis*), there has been a report of infection in wild metapenaeid shrimp in Taiwan and an accompanying genetic adaptation of the virus.

In Asia, first Yellowhead Virus (YHV) from 1992 and later WSSV from 1994 caused continuing direct losses of approximately US\$1 billion per year to the native cultured shrimp industry. In Latin America, first TSV from 1993 and later, particularly WSSV from 1999, caused direct losses of approximately \$0.5 billion per year. Ancillary losses involving supporting sectors of the industry, jobs, and market and bank confidence put the final loss much higher.

It is widely believed that these three most economically significant viral pathogens (and a host of other pathogens) have been introduced to the Asian and Latin American countries suffering these losses through the careless introduction of live shrimp stocks. Except for China, most Asian countries have legislated against the introduction of *P. vannamei* due to fears over the possibility of importing new pathogenic viruses and other diseases from Latin America to Asia.

Many governments have allowed the importation of supposedly disease-free stocks of *P. vannamei* that are available from the USA. The encouraging trial results; the industry-perceived benefits, including superior disease resistance, growth rate and other advantages, allied with problems controlling the imports from other countries, has led to the widespread introduction of this species to Asia, primarily by commercial farmers. Unfortunately, importation of cheaper, non-disease free stock has resulted in the introduction of serious viral pathogens (particularly TSV) into a number of Asian countries, including Mainland China, Taiwan, Thailand, Indonesia, and possibly elsewhere. There are now many hatcheries established in Asia that are producing PL for stocking, although the original sources of the stocks and their current health status are quite uncertain. What can be assumed is that many of the hatcheries are not able to maintain their stocks as SPF and invariably they become infected with local viral diseases and quite possibly, with diseases that are typical to the species when in Latin America (e.g. TSV). This is partly due to private-sector hatcheries being unaware of the requirements for maintaining clean stocks and partly due to corner cutting due to the rising demand for postlarval *P. vannamei*.

BIODIVERSITY AND IMPACTS ON WILD STOCKS

Although TSV does not yet seem to have affected the indigenous cultured and wild shrimp populations, time and research effort have been insufficient to prove this. TSV is also a highly mutable virus, capable of mutating into more virulent strains that are able to infect other species. In addition, other viruses probably imported with *P. vannamei*, for example, a new Lymphoid Organ Vacuolization (LOVV)-like virus, have been implicated as causing the slow growth

problems currently being encountered with the culture of the indigenous *P. monodon*. There remain many unanswered questions regarding the possible effects of introduced species on other cultured and wild shrimp populations in Asia. For example, at present there is still no information available regarding whether or not *P. vannamei* has established in the wild and if so, the impacts of its interactions with native crustacean species.

WHAT IS NEXT?

Since it is clear that the many of Asian countries have already introduced *P. vannamei* (either legally or illegally) to some extent, there is now some determination to try to ensure that any negative impacts are minimized. Some countries are considering enforcing their official bans and destroying all stocks found within their borders (i.e. the Philippines and Malaysia). Short of this difficult (and perhaps legally unenforceable) procedure, the species, and in most cases, its attendant viruses will remain in most countries.

A more pragmatic approach would be the investigation of all stocks and the elimination of those found to be infected with serious pathogens, followed by an opening of the borders only to certified disease-free stocks. This assumes that the capability to test stocks for pathogens and the necessary border controls would be strengthened, since it is the inability to effectively control imports that has allowed the introductions that have so far occurred. This approach at least offers a working solution to the reality that *P. vannamei*

is already present in many countries and being cultured at significantly economic levels in several of them. This also allows countries to take advantage of the potential benefits offered by this exotic species and would encourage a more responsible approach to the issue of shrimp movements and disease in the region. What is certain is that blanket bans on the importation of species such as *P. vannamei* that are desired by the commercial sector are ineffective at preventing introductions under the current conditions in Asia

Increased awareness regarding the potential for SPF stocks and reduced disease risks is encouraging some farmers to think again about the production and culture of SPF *Penaeus monodon*. Also, since *P. vannamei* tends to be harvested at a relatively small size, this is creating new marketing challenges and also negatively affecting prices in the region. The larger-sized *P. monodon* compete in a different part of the market and often have a better market price.

The next few years in Asia will inevitably see much more emphasis on good broodstock and hatchery control for the production of healthier shrimp PL. In turn we can hope that this will lead to increased reliability of growout production and a more stable industry.

To learn more about penaeid introductions to the Asia-Pacific, please contact Mr Simon Funge-Smith, at FAO Regional Office for Asia-Pacific – simon.fungesmith@fao.org



Matthew Briggs