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SPF-defined pathogen-free status of shrimp limited



1 December 2003 Shaun M. Moss, Ph.D. Steve M. Arce Dustin R. Moss



SPF status depends on biosecurity levels



Although the value of SPF shrimp is widely recognized, misconceptions about the SPF concept are widespread.

The contribution of farmed shrimp to the global penaeid shrimp supply increased from less than 10 percent in 1980 to over 50 percent in 2001. Despite the increases in shrimp aquaculture production over the past two decades, shrimp farmers have suffered tremendous economic losses from viral pathogens. Pandemics due to White Spot Syndrome Virus and Taura Syndrome Virus cost the shrimp industry billions of dollars in lost crops, jobs, and export revenue.

Shrimp farmers adopted numerous biosecurity measures to mitigate these losses, including the use of specific pathogen-free (SPF) shrimp. However, the SPF concept is not clearly understood by many stakeholders in the industry. In short, SPF designation refers to present pathogen status only, and is a function of the level of biosecurity where the shrimp are cultured.

SPF listing

An SPF shrimp is a shrimp free of specified pathogens. To be included on an SPF list, pathogens must be reliably diagnosed, able to be physically excluded from facilities, and pose a significant threat to the industry.

To date, there is no single, internationally recognized SPF list. The current working list of specific pathogens for SPF penaeid shrimp in the United States includes eight viruses, one prokaryote, and certain classes of parasitic protozoa (Table 1). It is important to note that SPF lists are dynamic and will be revised as new pathogens are identified and more accurate disease diagnostic tools become available.

Table 1. Working list of specific pathogens for SPF penaeid shrimp in the United States.

Pathogen	Pathogen Type	Category
Virus		
Taura Syndrome Virus*	Picornavirus	C1
White Spot Syndrome Virus*	Nimavirus (proposed n.f.)	C1
Yellow Head Virus/ Gill-Associated Virus/LOV*	Roniviruses (proposed n.f.)	C1
Infectious Hypodermal and Hematopoietic Necrosis Virus**	Systemic parvovirus	C2
Baculovirus Penaei**	Occluded enteric baculovirus	C2
Monodon Baculo Virus**	Occluded enteric baculovirus	C2
Baculoviral Mid-gut Gland Necrosis Virus**	Nonoccluded enteric baculovirus	C2
Hepatopancreatic Parvo-like Virus	Enteric parvovirus	C2
Procaryote		
Necrotizing Hepatopancreatitis	(alpha-protobacteria)	C2
Protozoa		
	Microsporidia	C2
	Haplosporidia	C2
	Gregarines (Apicomplexa)	C3

* = Office International des Epizooties-notifiable ** = OIE listed

Pathogen Categories:

C1 = Excludable pathogens that potentially cause catastrophic losses in one or more penaeid species

C2 = Pathogens that are serious and potentially excludable

C3 = Pathogens that have minimal impact, but may be excluded from a biosecure facility

List modified from D. V. Lightner, U.S. Marine Shrimp Farming Program FY02 Progress Report.

SPF stock development

To develop an SPF stock from the wild, shrimp are collected and transferred to a primary quarantine facility, where they are analyzed for listed pathogens using appropriate diagnostic tools (Fig. 1). If shrimp test positive for any of the listed pathogens, they are destroyed in the primary quarantine facility. If shrimp test negative after several successive screenings, they are transferred to a secondary quarantine facility, where they mature and spawn to produce an F₁ generation of captive shrimp.

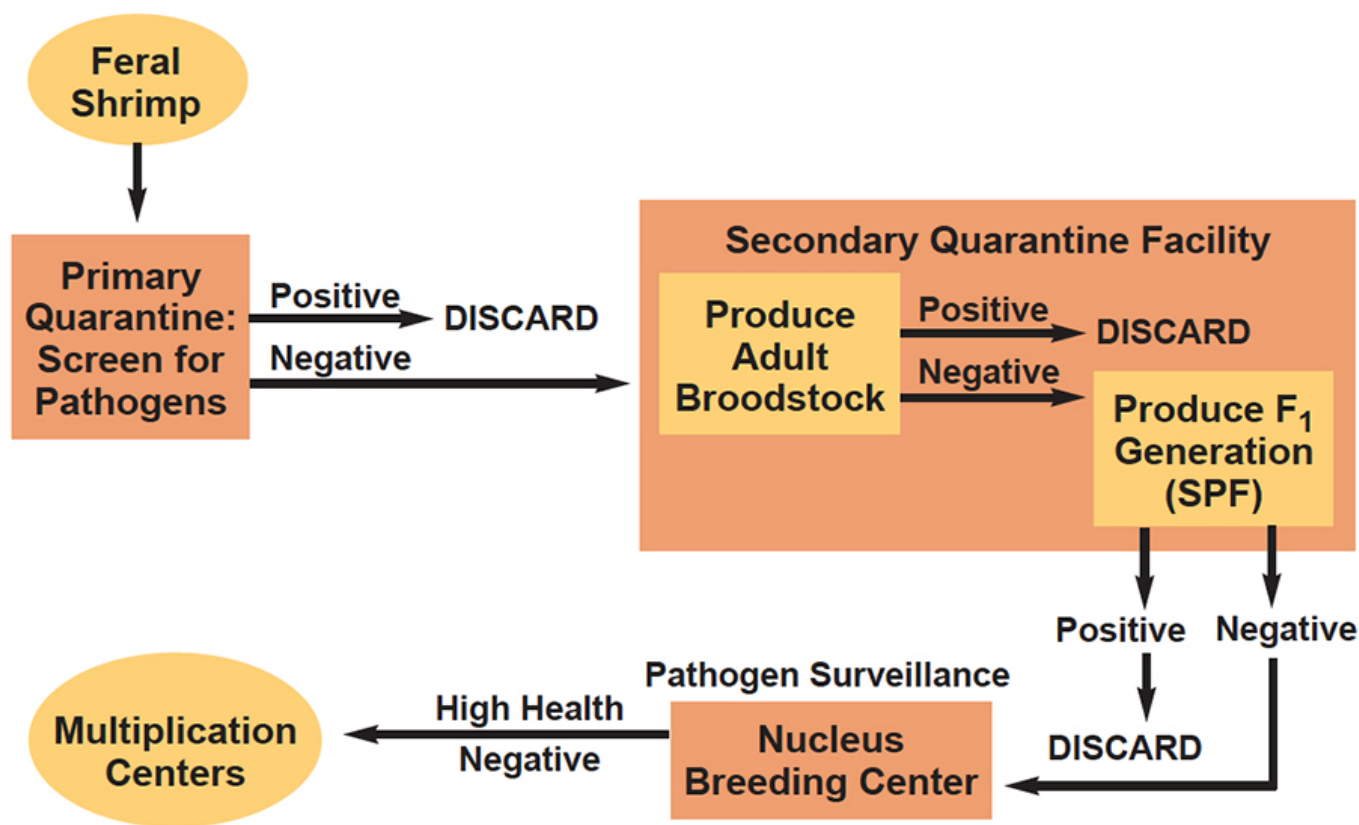


Fig. 1: Process of developing SPF shrimp stock from the wild.

Because some viruses can be transmitted from parent to offspring, representative shrimp from the F₁ generation are analyzed for specifically listed pathogens. Some shrimp pathogens are not detectable until the shrimp are juveniles, so it is critical to quarantine and continue monitoring them for signs of infection or stress until they attain weights of at least 5 g.

It is also recommended that cohabitation studies be conducted with the candidate animals and known SPF shrimp that also are monitored for infection and stress. If shrimp from the F₁ generation test negative for specifically listed pathogens after several screenings, they are transferred out of the secondary quarantine facility and can be included as part of the germ-plasm in a nucleus breeding center.

SPF status

Shrimp maintained in well-established breeding centers where there is a documented history of negative disease status can be designated SPF. However, once shrimp leave these facilities, they no longer are referred to as SPF, even though they may be free of specifically listed pathogens.

If shrimp are transferred from a documented SPF center to a medium-biosecurity facility, their new designation is “high health,” indicating the shrimp are at greater risk of pathogen exposure and infection. If shrimp are transferred to a low-biosecurity shrimp farm, they enter the commodity production stream, which is most vulnerable to pathogen outbreaks. These shrimp are neither SPF nor high health.

Status limitations

Although SPF shrimp are, by definition, free of all specifically listed pathogens, SPF shrimp can be infected with an unknown pathogen or a known pathogen not included on the SPF list of the shrimp supplier. Interestingly, although some members of the genus *Vibrio* can cause significant disease problems and be reliably diagnosed, they can not be included on an SPF list because, as ubiquitous members of shrimps’ normal flora, they can not be physically excluded from facilities.

Although a number of commercially important traits exhibited by shrimp are heritable, SPF status is not one of them. Offspring of SPF shrimp are not considered SPF unless they are produced and maintained at an SPF facility. SPF status changes with the pathogen condition of the shrimp, as well as the type of environment within which they are cultured.

SPF shrimp have no innate resistance to particular pathogens, nor are they innately susceptible. Disease resistance or susceptibility can be bred into a line of shrimp through selective breeding or other approaches, but this has no bearing on SPF status. SPF status is not an indication of shrimps’ genotypes.

Conclusion

Specific pathogen-free status depends on the presence or absence of specific pathogens in shrimp, and this status changes depending on the level of biosecurity where the shrimp are maintained. Shrimp farmers who want to purchase SPF shrimp need to ask what pathogens are on the supplier's SPF list, what disease diagnostic tools were used to screen the shrimp, when the most recent disease screening was performed and by whom, what disease surveillance program the supplier follows to monitor his stock, and the disease history of the facility. In addition, purchasers of SPF shrimp should receive a copy of the most recent disease-screening results and appropriate certification.

The successful future of the global shrimp-farming industry is predicated on using bona fide SPF shrimp. It is incumbent on shrimp farmers worldwide to understand what SPF means and enforce this critically important biosecurity concept.

(Editor's Note: This article was originally published in the December 2003 print edition of the Global Aquaculture Advocate.)

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