



Outbreak of Shrimp Viral Disease in Central America: Situation Report Veterinary Services, June 1999

Summary: Since late January 1999, the white spot syndrome virus (WSSV) has been detected in tissue samples from shrimp farms in Nicaragua, Honduras, Guatemala, and Panama. This detection constitutes the first confirmed occurrence of WSSV on the Pacific coast of the Americas. In February 1999, the U.S. Department of Agriculture's (USDA), Animal and Plant Health Inspection Service (APHIS) received word that yellow head virus (YHV), another virulent shrimp pathogen indigenous to Asia, was also present in samples from these Central American countries. However, the presence of YHV remains unconfirmed. Although WSSV poses no danger to human health, the virus has a history of causing catastrophic economic losses on shrimp farms. Its presence is considered a potential threat to shrimp industries in Latin America and the United States because WSSV is not indigenous to this hemisphere. Nicaragua, Honduras, and Guatemala together produce about 8 percent of total Western Hemisphere farmed shrimp, roughly equal to 3 percent of world farmed shrimp, primarily for the U.S. market.

This situation report focuses on potential impacts of imported frozen shrimp on U.S. shrimp aquaculture, in order to complement ongoing efforts by parties currently assessing other transmission pathways and the potential risk to wild native species. Imported frozen shrimp are one of numerous pathways by which WSSV could be transmitted to U.S. farmed shrimp. In 1998, the United States imported over \$1.3 billion worth of frozen shrimp, wild and farmed, from Central and South America. All U.S. shrimp exports, frozen and nonfrozen, were valued at \$94 million that year.

Increasing consumer demand for shrimp continues to attract imports and also to increase frozen shrimp volumes that are processed at U.S. packing plants. If birds come in contact with contaminated waste or effluent from a shrimp packing plant, they may perpetuate an ongoing epizootic by moving the virus to nearby aquaculture facilities. Effluent discharge and also WSSV-infected shrimp used as bait are two direct pathways for virus transmission to wild shrimp stock, and they also increase risk to farmed shrimp. Farmed and wild shrimp in the United States are

highly susceptible to WSSV, and researchers have also isolated the virus in other crustacean species including crawfish and crabs. Although farmed shrimp aquaculture is a small piece of total U.S. shrimp production, the United States is a recognized world leader in providing expertise in intensive and semi-intensive shrimp farming.

APHIS and its partners can help limit the further spread of WSSV to U.S. aquaculture by (1) reviewing the existing import controls relevant to frozen and fresh shrimp from Central America to clarify their effectiveness in preventing U.S. imports of shrimp carrying WSSV; (2) promoting proper waste heating and disposal and safe release of effluents by US packing plants that process crustaceans; (3) telling U.S. producers of shrimp, crawfish and crab about the current outbreak and its implications; and being prepared to inform U.S. consumers; (4) assessing the need for Federal policy or guidelines to promote greater uniformity in diagnostic methods and technical standards; and (5) developing an APHIS protocol to certify live larvae and broodstock as free of specific viruses.

Situation Report

White spot syndrome virus in shrimp has been confirmed in four Central American countries.

Since January 1999, the presence of white spot syndrome virus (WSSV) has been detected in tissue samples from shrimp farms in Guatemala, Honduras, Nicaragua and Panama. These detections constitute the first occurrence of WSSV on the Pacific Coast of the Americas. Previously, WSSV near the United States was apparently limited to farmed and wild shrimp in the Gulf of Mexico off Texas and in Atlantic waters off South Carolina. WSSV is not indigenous to the Western Hemisphere. However, genetic comparisons of WSSV isolates from Asia, Texas, South Carolina, and the National Zoo in Washington, DC, and from imported shrimp, have shown little or no difference among the isolates. According to experts, these results suggest that the same or a few closely related strains of WSSV have spread from the East Asian epicenter of the disease, and that WSSV has become pandemic.

At the time WSSV was initially confirmed, the Office International des Epizooties (OIE) reference lab indicated that yellow head virus (YHV) was also present in two independent tissue samples from an affected Central American shrimp farm; however, this initial report has not been verified. The OIE communication had informally reported that routine histological examination "provided a diagnosis of severe infections by WSSV and YHV." Since then, the University of Arizona-based OIE Reference Laboratory for Crustacean Pathogens identified false positives in the YHV samples. It is still possible that YHV is present in the samples, and that possibility

should not be ignored. At this time, however, molecular tests by the laboratory have not confirmed the presence of YHV in the samples.

Nicaragua, Honduras, and Guatemala together produce about 8 percent of total Western Hemisphere farmed shrimp or about 3 percent of world farmed shrimp.

In countries affected by the current outbreak, Honduras (5.8 percent) and Nicaragua (1.9 percent) together produced an estimated 7.7 percent of farmed shrimp in the hemisphere in 1998. Guatemalan production was less than 1 percent of the regional total. Nicaragua, Honduras, and Guatemala are net exporters of frozen and fresh crustaceans, primarily shrimp for the U.S. market. Their trade activity in crustaceans is small by world standards (see tables 1 and 2).

Table 1-Trade in frozen crustaceans by Nicaragua, Honduras, Guatemala, and Panama, 1996

Country	Exports (\$1,000)	Imports (\$1,000)
Nicaragua	57,189	0
Honduras	54,756	364
Guatemala	36,105	15
Panama	84,577	362
World	10,004,600	11,592,260

Table 2-Trade in fresh crustaceans by Nicaragua, Honduras, Guatemala, and Panama, 1996

Country	Exports (\$1,000)	Imports (\$1,000)
Nicaragua	6,655	71
Honduras	2,175	2,507
Guatemala	32	0
Panama	9,703	38
World	1,376,841	1,592,699

Source for tables 1 and 2: United Nations Food and Agricultural Organization.

WSSV has a history of causing catastrophic economic losses on shrimp farms.

The total negative economic impact of WSSV and YHV has averaged about \$1 billion (U.S.) annually since 1994 in major shrimp-growing countries, including China, Thailand, India, Indonesia, Bangladesh, Malaysia, Taiwan, Vietnam, and Japan. Mortality rates for shrimp populations experiencing WSSV symptoms can reach 100 percent within 3 to 10 days from the onset of symptoms. Widespread epizootics due to WSSV and YHV emerged in the 1990's in the Asian shrimp-farming industry.

OIE's Fish Disease Commission recently proposed that OIE elevate the status of shrimp viral diseases caused by WSSV from "other significant disease" to "notifiable disease." Two other viral agents that affect Penaeidae shrimp, YHV and Taura syndrome virus (TSV), were also proposed to be elevated to the OIE notifiable list. Globally, all farm-raised shrimp and much of the shrimp caught in open waters belong to the Penaeidae family, commonly referred to as "penaeids." A statement released from Central America indicated that the current outbreak "is reported to be affecting penaeid shrimp in a manner inconsistent with that previously reported in Asia."

In the United States, outbreaks of shrimp viruses including WSSV caused 50 to 95 percent loss of production on affected shrimp farms. Losses experienced by the largest shrimp farm in South Carolina put that operation out of business. Prior to November 1995, there had been no documented occurrences of either WSSV or YHV in U.S. commercial facilities. Lethal outbreaks of these viruses had been previously confined to Asian production facilities.

White spot syndrome is caused by a baculo-like virus. The disease typically occurs in juvenile shrimp but sometimes manifests itself in later adult stages. Clinical signs include shell spotting from abnormal deposits of calcium salts, and occasionally a reddish discoloration due to expansion of cuticular chromatophores. When farmed shrimp are infected, they become lethargic, stop feeding, swim slowly near the pond surface, and eventually sink to the bottom and die. No treatments currently exist for WSSV or YHV; therefore, shrimp farmers must rely on preventive management practices.

WSSV does not appear to endanger human health.

Shrimp testing positive for WSSV are now routinely found in U.S. retail markets. One reason for this may be that some foreign aquaculture operations harvest their ponds immediately upon finding disease and export the infected shrimp. Freezing does not inactivate WSSV infectivity.

Several pathways exist by which WSSV can be transmitted to farmed U.S. shrimp, including imported frozen shrimp.

Although most viral outbreaks in U.S. shrimp aquaculture facilities do not have confirmed sources, recent U.S. experience has led to speculation that birds may be involved in transmission of the virus to affected aquaculture facilities. Nearby shrimp packing plants, major importers, and reprocessors of large quantities of imported frozen shrimp from the Far East were suspected as the initial source of imported viruses including a 1995 outbreak of TSV in Texas. Packing plants may discharge contaminated effluents into estuaries, thereby increasing risk of virus transmission to both wild and farmed shrimp. There are approximately 400 firms in shrimp-related industries located along the Gulf of Mexico, and 268 of those are located in Texas or Louisiana. Many of the packing plants operate all year.

In addition to discharged liquid effluent, solid waste material must also be properly treated (by heating) before disposal by U.S. plants that repackage shrimp and crabs. Otherwise, the waste material may become available to sea birds or flying insects. WSSV frequently survives in bird intestinal systems, and the birds may then defecate in aquaculture ponds or in some manner move the infected material from landfill to shrimp farm.

Imported frozen shrimp to be used as bait for coastal fishing is also a hazard. Leftover bait shrimp that is discarded can be picked up by wild shrimp or crabs, thereby creating immediate risk for those populations. The same risk to wild crawfish exists when frozen imported shrimp are used for bait in inland fresh waters. Virus transmission pathways to wild shrimp are currently being assessed by a working group within the Joint Subcommittee on Aquaculture (JSA) Shrimp Virus Work Group, a Federal interagency advisory group. Also, new hypotheses are emerging that ballast water exchange, for example in the Panama Canal, is a significant pathway for shrimp virus transmission to wild stock.

Other pathways by which virus can potentially be transmitted to aquaculture facilities include infected broodstock or contaminated vehicles or transport containers. Wild shrimp stock may serve as a vector to transmit WSSV to farmed shrimp via these pathways. Viral outbreaks in aquaculture facilities in turn heighten the risk for wild shrimp stock. Potential pathways for viral transmission from farmed aquaculture to native shrimp species include pond effluent, pond flooding, escape by infected shrimp, transport to processing facilities, use of imported shrimp as bait, sediment or solid waste disposal, and birds.

U.S. imports of frozen shrimp have increased steadily in recent years.

Currently, more than 60 countries export both pond-raised and wild shrimp to the United States. The total value of shrimp imports (frozen, fresh, prepared) reached \$3.1 billion in 1998. Frozen products accounted for 86 percent of U.S. shrimp product imports. Import and export statistics for fishery products generally do not distinguish between farmed and wild-caught animals, so discussion of trade necessarily combines both types.

Table 3-U.S. imports of frozen and nonfrozen shrimp from the world, 1996-98

Commodity	Value by year (\$million)			Weight by year (kg)		
	1996	1997	1998	1996	1997	1998
Shrimps and prawns, frozen	2,136	2,558	2,638	230,344,842	259,507,100	271,919,232
Peeled	756	944	1,045	93,170,769	106,268,736	119,250,084
With shell	1,380	1,614	1,593	137,174,073	153,238,364	152,669,148
Shrimps and prawns, nonfrozen	20	21	23	7,641,853	3,212,527	3,084,406
Peeled	12.44	13.16	14.3	572,011	575,825	671,188
With shell	7.41	7.64	8.51	7,069,842	2,636,702	2,413,218
Total	2,156	2,579	2,661	237,986,695	262,719,627	275,003,638

Source: World Trade Atlas, December 1998

Countries' roles as shrimp suppliers to the United States vary with shrimp sizes. Central American countries dominate U.S. imports of the smallest shrimp. Ecuador and Thailand dominate imports of middle-sized farmed shrimp. Mexico, India, and Bangladesh are major suppliers of large shrimp. In Western Hemisphere production, the western white shrimp *Penaeus vanamei* dominates. In the Eastern Hemisphere, *Penaeus monodon* is the most popular species. In 1998, the United States imported more than \$1.3 billion worth of frozen shrimp products from Central and South America. Honduras, Nicaragua, and Guatemala together accounted for \$117 million of that amount (see table 4).

Table 4-U.S. frozen shrimp imports from Central and South American countries, 1996-98

Country	1996	1997	1998
Ecuador	370	582	570
Mexico	325	369	380
Panama	68	86	91

Venezuela	48	76	48
Honduras	70	70	67
Peru	18	46	45
El Salvador	38	30	31
Nicaragua	25	29	31
Colombia	27	28	21
Guatemala	30	19	19
Costa Rica	15	16	11
Brazil	7	5	7
Suriname	0	0	4
Chile	1	1	2
Total	1,042	1,356	1,327

Source: World Trade Atlas, December 1998.

Western Hemisphere shrimp production may be at increased risk.

In the Western hemisphere, penaeid shrimp are very highly susceptible to WSSV and YHV. According to the University of Arizona shrimp viral research team leader, "Introduction and establishment of either or both of these pathogens could cause very serious disease epizootics and economic hardships to the shrimp farming industries of the Americas." Western Hemisphere countries produced an estimated 28 percent of the world's farmed shrimp in 1998, or 207,000 metric tons (see table 5). Ecuador alone accounted for 63 percent of total hemispheric production; Mexico accounted for 8 percent. The region's shrimp farms market 65 percent of their shrimp in the United States and 30 percent in Europe, primarily to France, Italy, and Spain.

Table 5-Production of farmed heads-on shrimp in the Western Hemisphere, 1998

Country	Percent of production	Metric tons
Ecuador	62.8	130,000
Mexico	8.2	17,000
Colombia	5.8	12,000
Honduras	5.8	12,000
Other	4.8	10,000

Panama	3.9	8,000
Peru	2.4	5,000
Belize	1.9	4,000
Nicaragua	1.9	4,000
Venezuela	1.4	3,000
United States	1	2,000
Total	99.9	207,000

Source: World Shrimp Farming 1998, Shrimp News International.

Evidence is emerging that the WSSV may already be established in Gulf of Mexico wild penaeid shrimp, but not necessarily as a result of the current outbreak in Central America. Over the last year, WSSV-positive shrimp and crabs have been found regularly through Texas Parks and Wildlife Department sampling in nonadjacent major Texas bays. Further testing is necessary to determine if these WSSV positives are carrying a previously undetected strain of the virus.

Problems in trade and cooperation with Mexico came to a head in April 1999. Mexico is citing WSSV and YHV as its reason for at least temporarily closing its borders to some U.S. aquatic products, including shrimp and crab. Mexico is currently requiring that any crustacean product from Texas be certified free of WSSV and YHV. Shrimp and crab producers in the United States are feeling the impact of this action as they are unable to export shrimp to maquiladora-style processing plants in Mexico. Given that Mexico also harvests wild shrimp in the Gulf of Mexico, some parties speculate that the new certification requirements are intended as a nontariff trade barrier.

US farmed aquaculture production is small relative to total U.S. shrimp production.

The U.S. shrimp industry, valued at between \$3 billion and 4 billion, is dominated by the wild shrimp fishery. Domestic aquaculture operations account for a very small percentage of U.S. production. In 1996, estimated U.S. aquaculture production was valued at just under \$11.5 million. Texas, South Carolina, Hawaii, and Florida are the primary States that produce both wild and farmed shrimp.

To reduce an annual \$2.5 billion trade deficit in shrimp and to develop a shrimp-farming industry in the United States, the U.S. Department of Agriculture funds the U.S. Marine Shrimp Farming Program. Over the past decade, the United States has invested \$50 million in basic and applied shrimp farming research. Although still a small player in world farmed shrimp production, the United States has become a recognized world leader in supplying capital, feeds, expertise,

equipment, drugs, education and research to shrimp farmers in 50 countries and throughout the Western Hemisphere. The United States is a leader in intensive and semi-intensive systems, shrimp genetics, disease research, closed systems, and hatchery technology.

In 1998, the United States exported about \$105 million worth of wild and farmed shrimp and products, including \$77 million worth of frozen shrimp and \$17 million worth of nonfrozen shrimp (e.g., canned or prepared).

Table 6-U.S. exports of frozen and nonfrozen shrimp to the world, 1996-98

Commodity	Value by year (\$million)			Weight by year (kg)		
	1996	1997	1998	1996	1997	1998
Frozen shrimp and prawns	93.32	84.86	77.47	10,347,777	9,355,218	8,486,995
Peeled	21.98	21.59	25.84	2,428,362	2,430,902	2,900,968
With shell	71.34	63.25	51.63	7,919,415	6,924,316	5,586,027
Nonfrozen shrimp and prawns	17.1	17.71	16.76	2,328,209	2,485,613	2,539,219
Total	110.42	102.57	94.23	12,675,986	11,840,831	11,026,214

Source: World Trade atlas, December 1998

Other crustacean species, including crawfish and crabs, have been reported with white spot syndrome virus.

WSSV has been reported in a variety of crustaceans, including wild and cultured penaeid shrimp, crabs, and crawfish. For example, crawfish at the National Zoo in Washington, DC, became infected with WSSV. Because the zoo routinely feeds captive crawfish frozen shrimp, they were suspected as the source of the virus, but this was not confirmed. Reports that nonshrimp animal species may have been vectors for transmission of WSSV, YHV, or TSV have been unsubstantiated. Crabs, crawfish, squid, and other crustaceans have only recently been subjected to testing for these viruses. The YHV does not appear to readily spread from shrimp to other crustaceans.

Freshwater crawfish are currently the only crustacean species, besides shrimp, that are farmed on a large-scale basis in the United States. The estimated value of U.S. farmed crawfish production

in 1996 was just under \$35 million. Louisiana produces most U.S. farmed crawfish. Texas, South Carolina, and Florida are also farming crawfish on a more limited scale, as are Mississippi, Maryland, North Carolina, Georgia, and California. The red swamp crawfish is the principal crawfish species farmed in the United States; it and other important crawfish species are highly susceptible to a mutated form of WSSV. The crawfish industry should therefore take precautions to prevent WSSV introduction.

Sources

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