Pathogens of Concern in Penaeid Shrimp Aquaculture

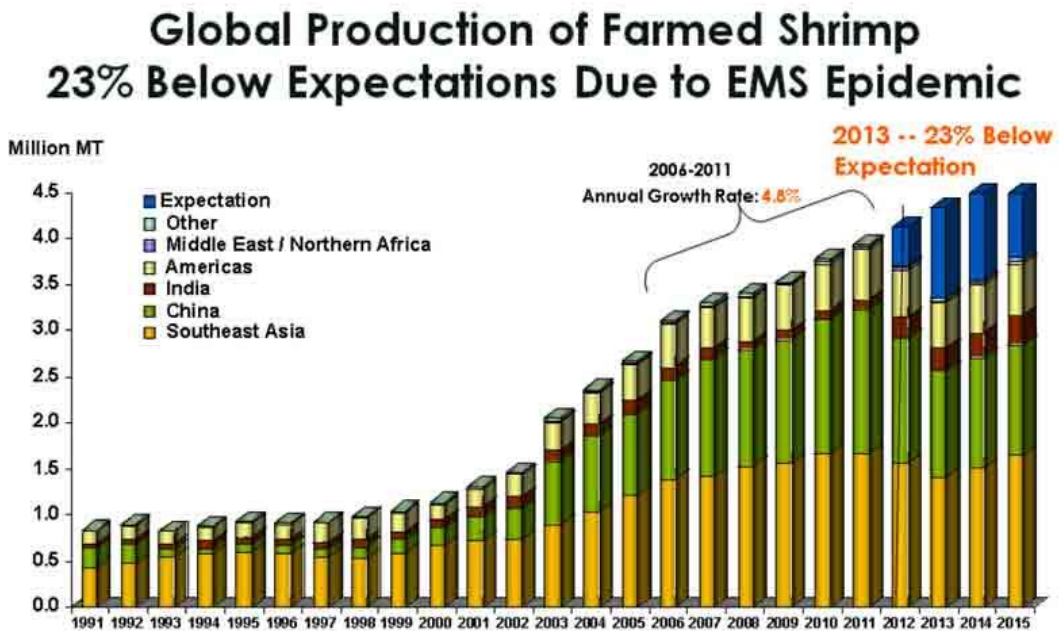
Susan Laramore, PhD

Florida Atlantic University, Harbor Branch Institute

Aquatic Animal Health Laboratory

Disease Impacts in Shrimp Culture

- 55% of shrimp consumed are produced by aquaculture
- Industry stakeholders cite feed cost, market prices, disease and broodstock quality as the most pressing issues (GSA 2022)
- Estimated industry losses of $4 billion/year (2009-2018) due to disease (Shinn 2018)
  - White Spot Syndrome Virus (WSSV)
  - Acute hepatopancreatic necrosis disease (AHPND)



Types of Diseases

Pathogenic

- Bacterial
- Fungal
- Parasitic
- Viral

Non-Pathogenic

- Water Quality
- Nutrition

WOAH Reportable Crustacean Diseases

Decapod iridescent virus 1 (DIV1) 2021

Infectious hypodermal and hematopoietic necrosis (IHHNV)

Infectious myonecrosis (IMNV)

Macrobrachium rosenbergii nodavirus (White tail disease) (WTD or MrNV)

Taura syndrome (TSV)

White spot disease (WSSV)

Yellow head disease (YHV 1)

Acute hepatopancreatic necrosis disease (AHPND) 2019

Hepatobacter penaei Necrotising hepatopancreatitis (NHP)

Aphanomyces astaci (Crayfish plague)

Enterocytozoon hepatopenaei (EHP) "emerging disease"

WOAH Diseases of Concern (Reports from 2018 to 2023)

50% limited distribution = 2 to 3 countries

DIV1, IMNV, MrNV, TSV, YHV1

30% = 8 to10 countries

Crayfish plague, NHP, AHPND

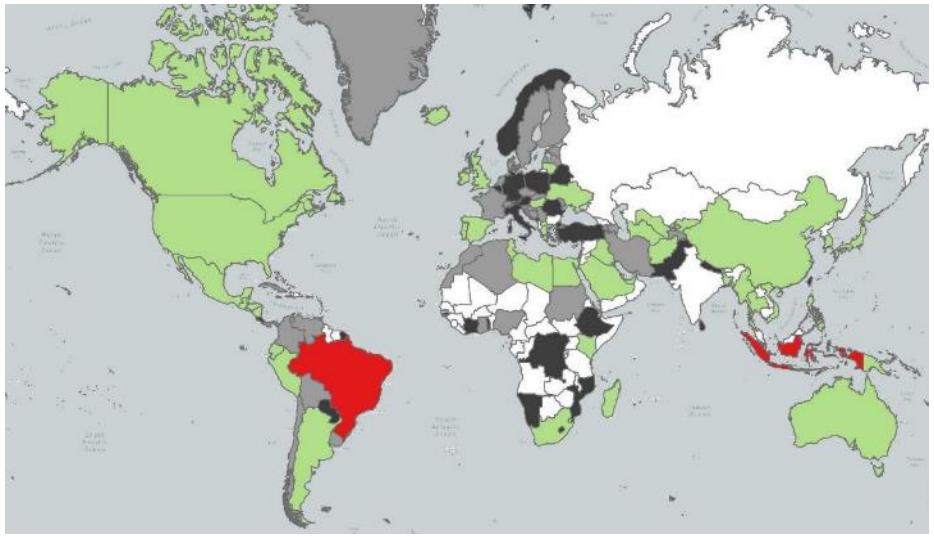
20% = 22 to 26 countries

IHHNV, WSSV

IMNV

First Report: Brazil 2002

2018 to 2023: Brazil & Indonesia (WOAH)



<u>Species Affected</u>:

- ***Penaeus vannamei*** **juveniles & adults**

<u>Clinical signs</u>:

- **White necrotic areas in muscle tissue**
- **Slow persistent mortality**

<u>Associations</u>:

- **Extreme temperature & salinity**
- **Low quality feed**

TSV

First Report: 1992 Ecuador

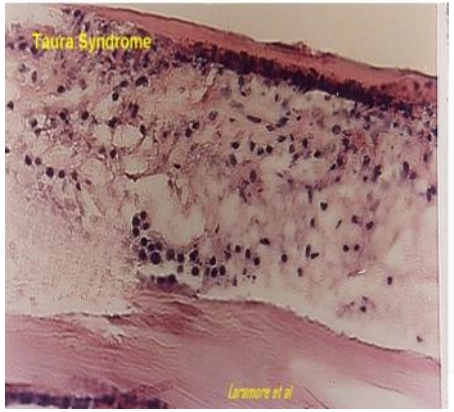
2018 to 2023: Honduras, Madagascar, Thailand

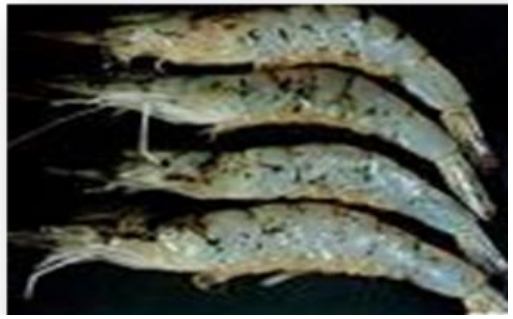
<u>Species Affected</u>:

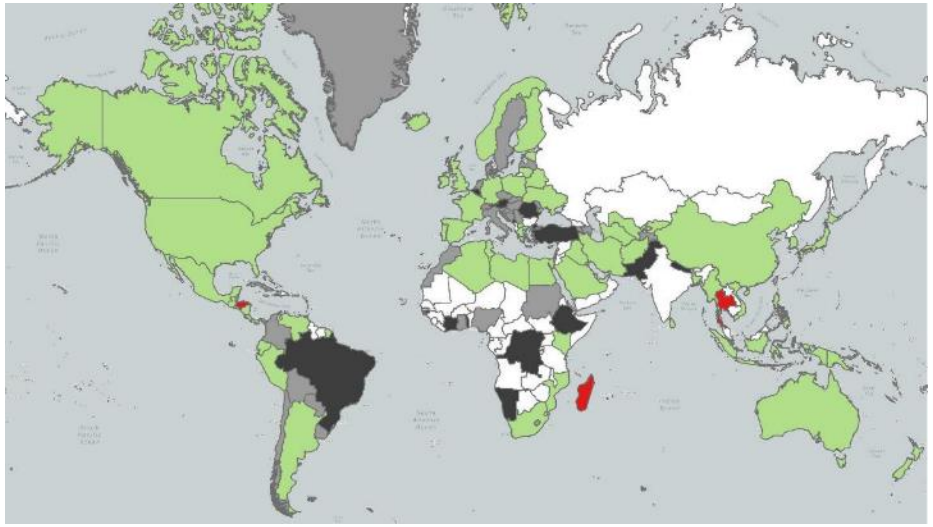
- **Penaeid species**
- **Post-larvae and juveniles**

<u>Clinical Signs</u>:

- **Red coloration, melanized “buckshot” lesions, soft shells**







Crayfish Plague

First Report: Italy 1860

Introduced from North America

2018 to 2023: 10 countries; US & Europe

<u>Species Affected</u>:

- **All crayfish species**

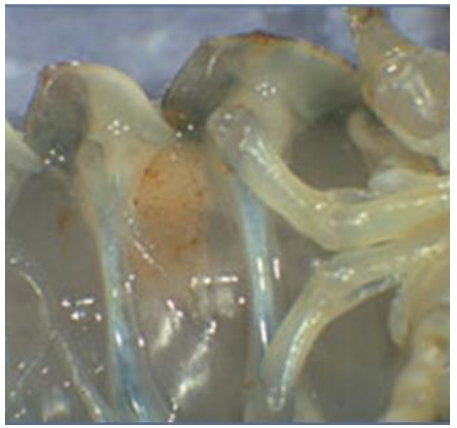
<u>Clinical Signs</u>:

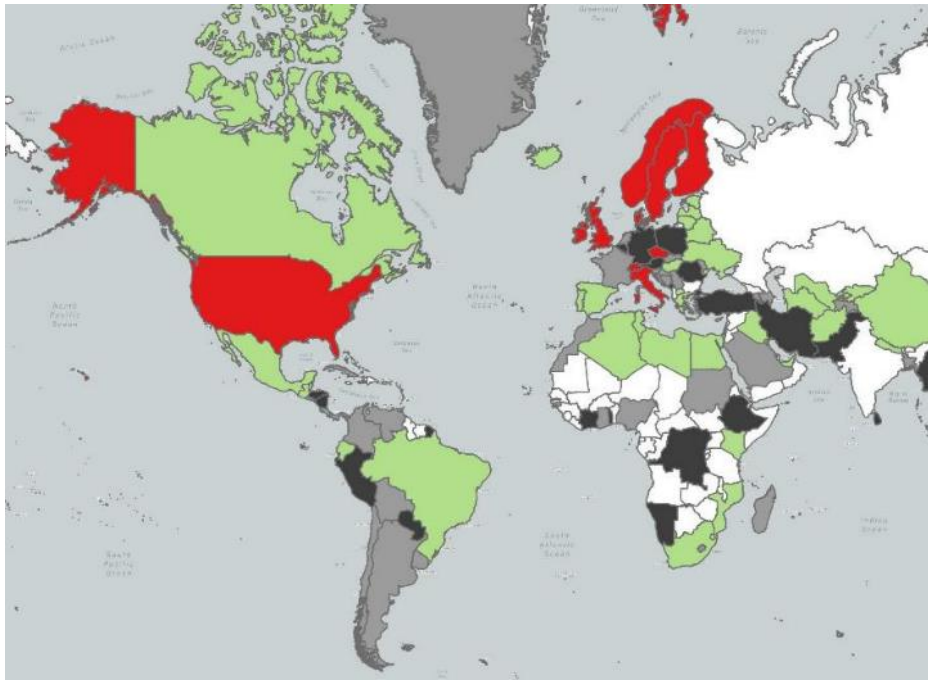
- **Walk with unsteady gait,**

<u>Associations</u>:

- **Temperature**

<u>Treatment</u>: none





NHP

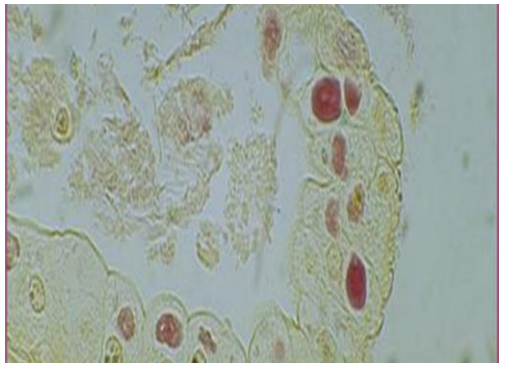
First Report: America (TX) 1985
2018-2023: 8 countries in the Americas

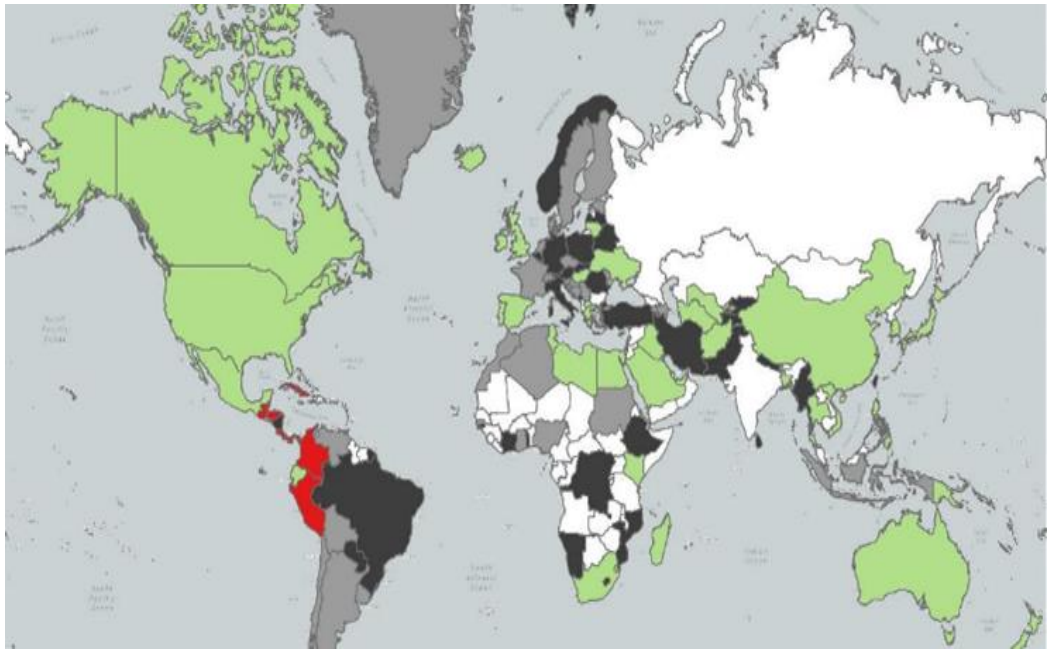
Species Affected:
- ***P. vannamei*; other penaeid species**

Clinical Signs:
- **Lethargic, off feed, pale or streaked hepatopancreas, soft exoskeleton**

Associations:
- **High salinity**

Treatment:
- **Medicated feeds**
- **Avoid salinities >25 ppt**





AHPND

First Report: 2009 China

2018-2023: 10 countries

<u>Species Affected</u>:

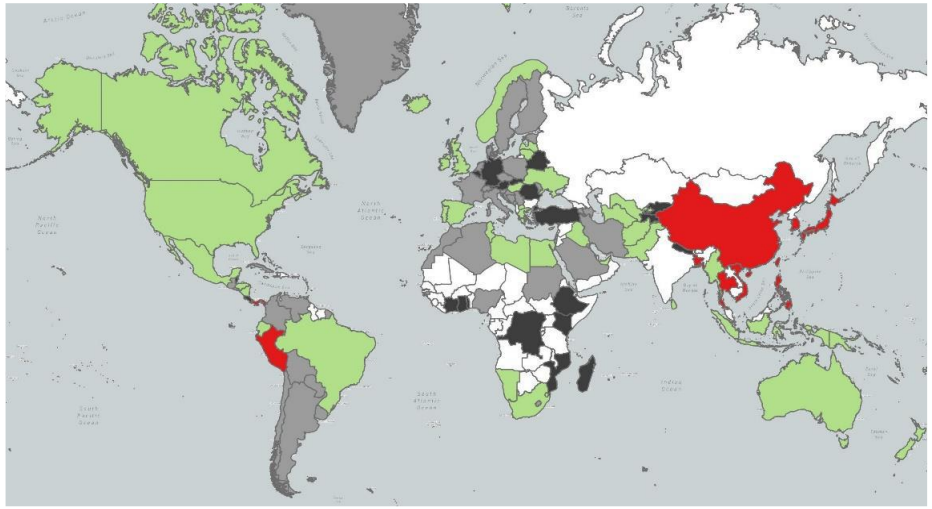
- **Penaeid shrimp**

<u>Clinical Signs</u>:

- **Lethargy, pale and atrophied HP, off feed**

<u>Associations</u>:

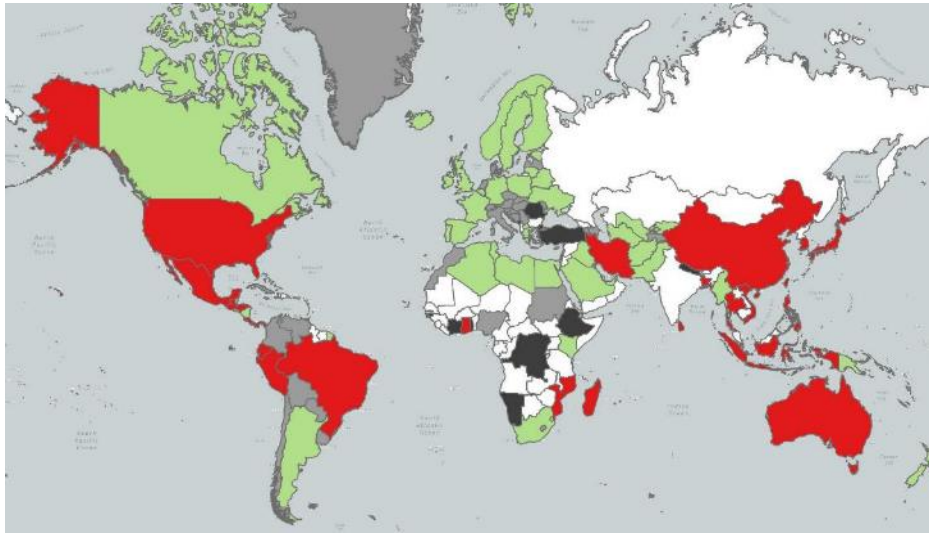
- **Salinity, poor management**



WSSV

First Report: 1992 Asia

2018-2023: 26 countries



Species Affected:

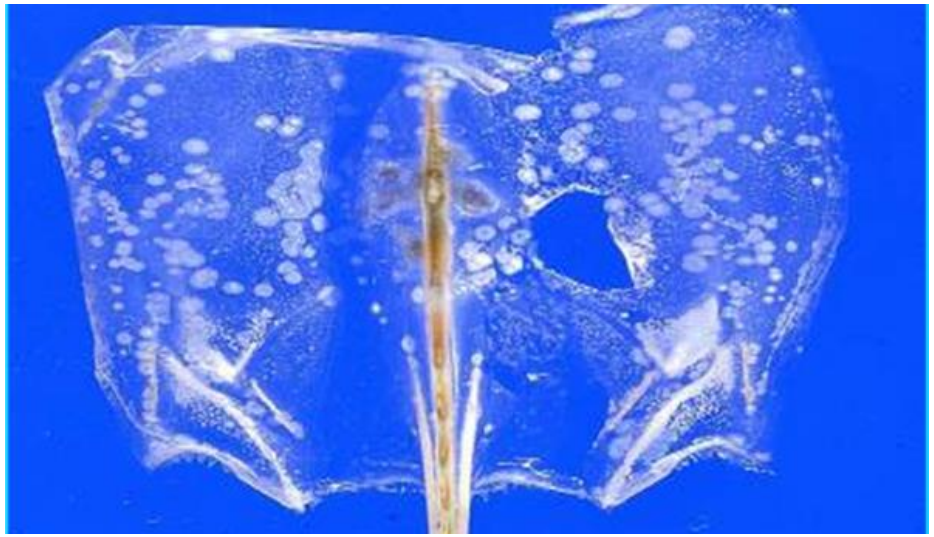
- **All decapods & life stages**

Clinical Signs:

- **White spots on carapace, color variation**

Associations:

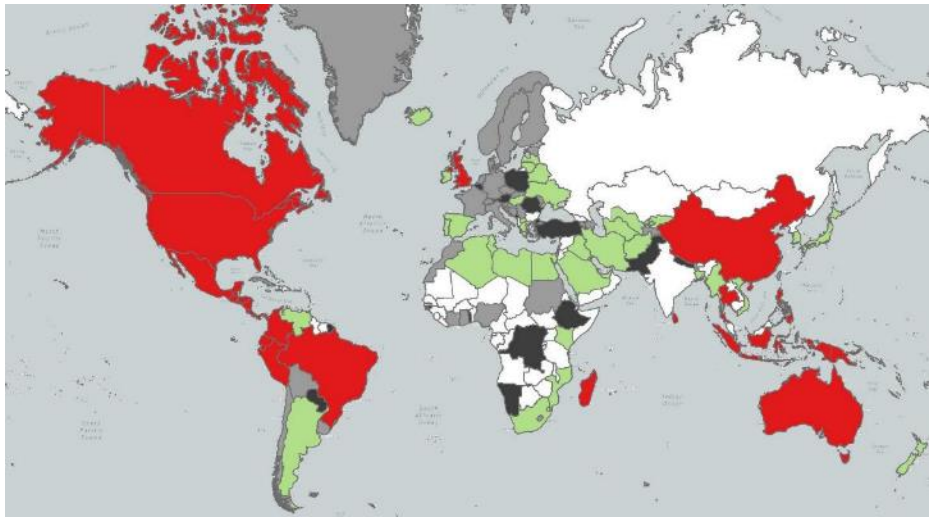
- **Temperature**
  - **Reduced at higher temperature >30°C (86°F)**



IHHNV

First Report: 1981 America (HI)

2018-2023: 22 countries



Species Affected:

- ***P. stylirostris, P. vannamei, P. monodon***

Clinical Signs:

- **Acute – blue color, opaque abdomen**
- **Chronic – Runt deformity syndrome (30-50% CV), bent rostrum, wavy antenna**

Non-reportable Diseases (Bacteria)

Opportunistic Diseases

- *Vibriosis – V. alginolyticus, V. campbelli, V. harveyi, V. parahemolyticus, V. splendidus, V. vulnificus*, etc.

Clinical signs:

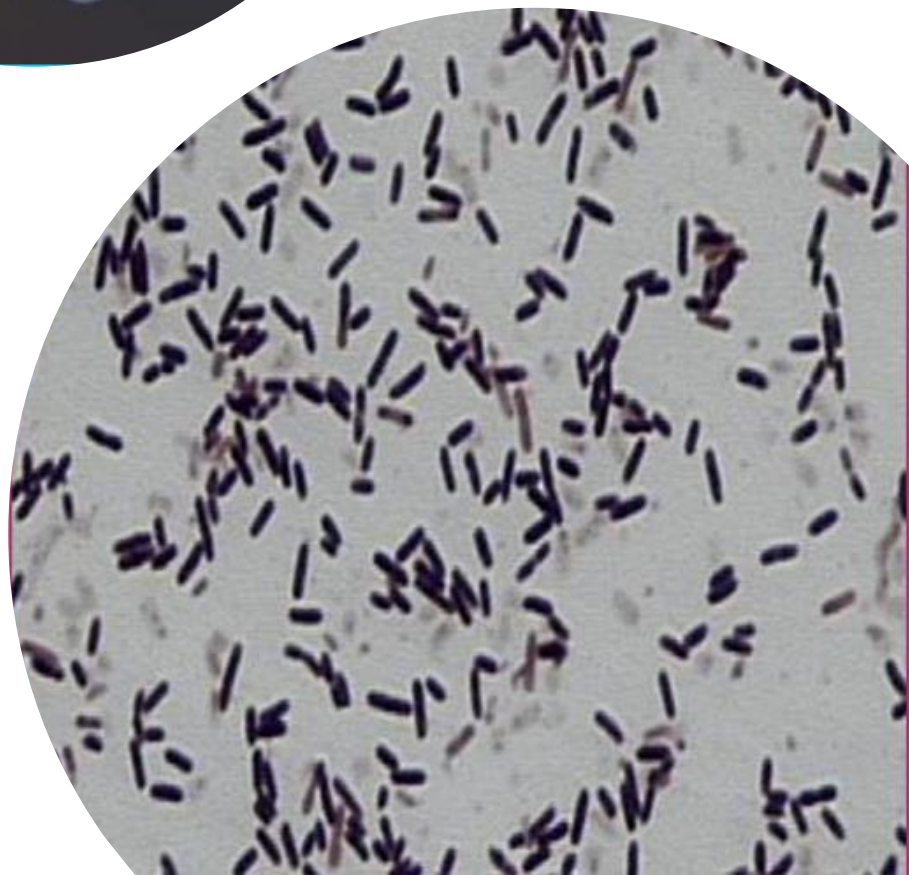
- Melanized spots on cuticle, shrunken hepatopancreas, off feed

Associations:

- Temperature

Treatment:

- Medicated feed…but prevention is better
  - Avoid high temperatures
  - Use of probiotics



Non-reportable Diseases (Fungus)

Opportunistic

- *Lagenidium* spp., *Sirolpidium* spp.,
- Postlarvae and earlier stages

Clinical signs

- “Fuzzy appearance”

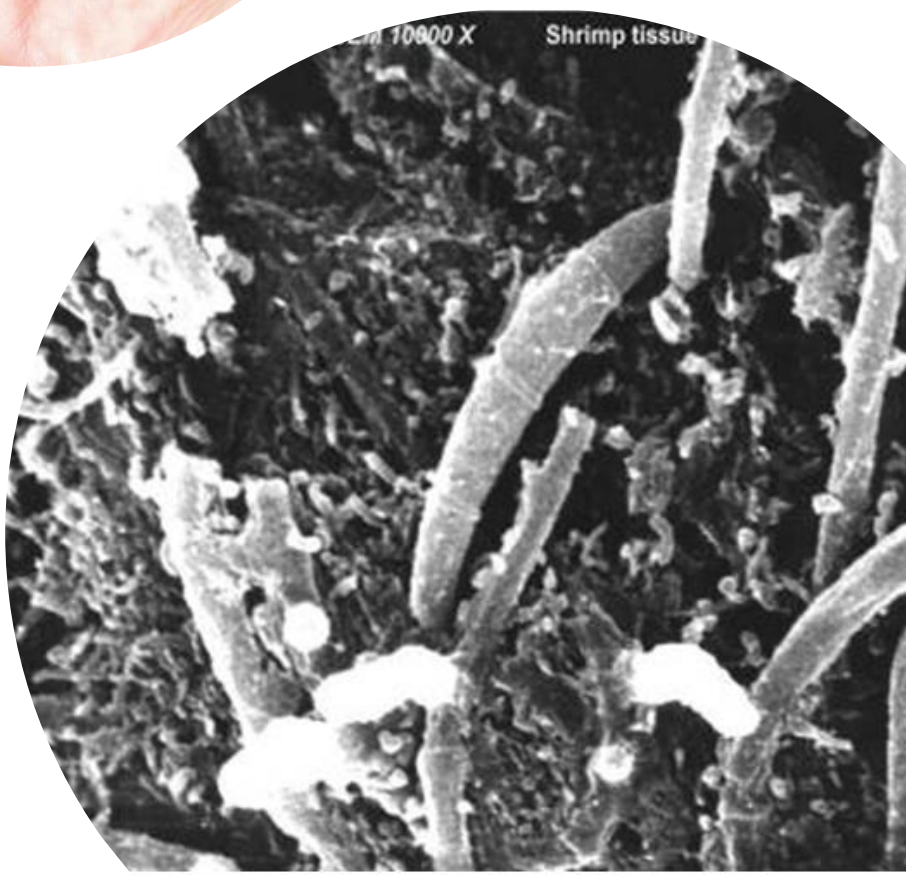
Associations

- High organics

Treatment

- Chemicals (i.e. formalin)
- Disinfect tanks, reservoirs, water lines

Non-reportable Diseases (Fungus)



Pathogenic

- Black gill disease (*Fusarium* sp.)
  - Adults

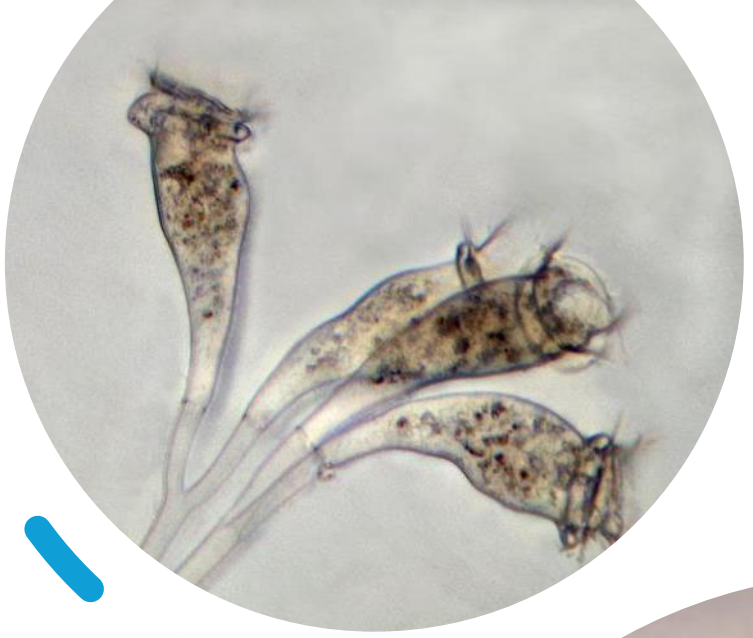
Clinical Signs:

- Blackening and destruction of gills and cuticle

Treatment

- None, lower densities

Non-reportable Diseases (Parasites)



External & Opportunistic

- *Zoothamnium, Epistylis, Vorticella*, etc.

Clinical signs

- “Fuzzy appearance”
- Affects respiration, restricts movement, difficulty molting

Associations

- Poor water quality, high organics

Treatment

- Chemicals (i.e., formalin)

Non-reportable Diseases (Parasites)

Internal

Worms

- Pond culture
- 2ndary host; obstruct the digestive tract
  - Gregarines (*Nematopsis* spp.)
- Treatments = wormers (thiobendazole)

Microsporidians

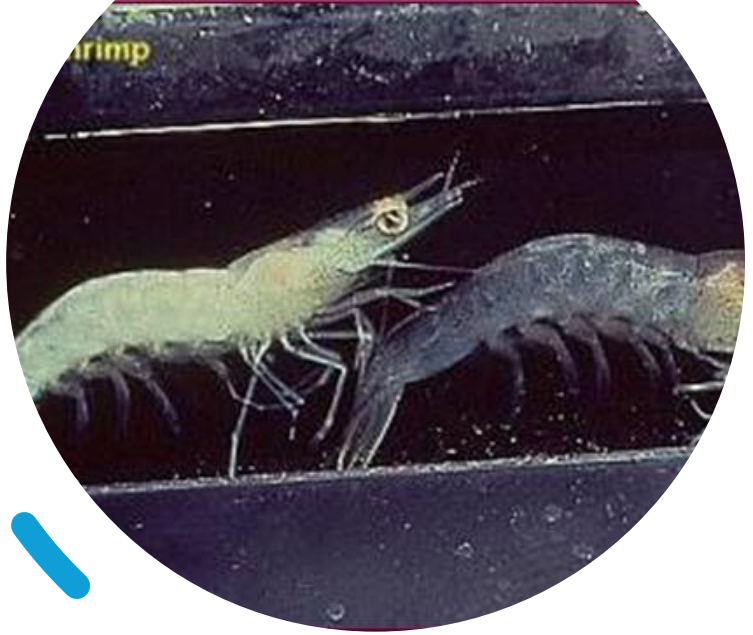
- Pond culture
  - Associated with high organics, live feeds
- Spores that invade & replace host tissue

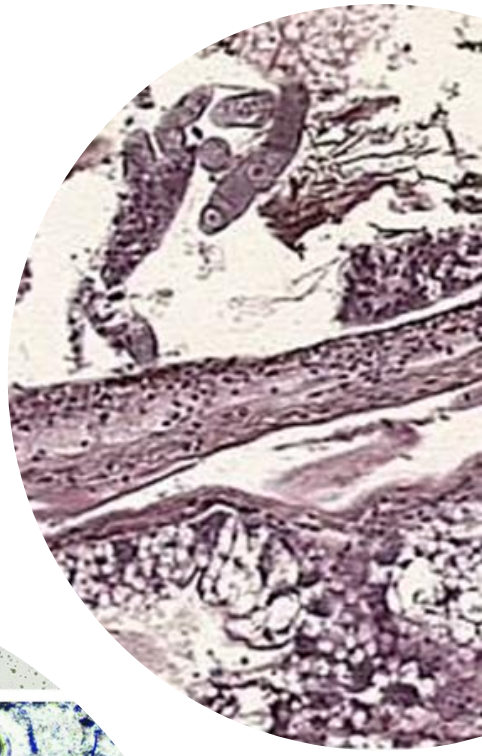
Cotton Shrimp (*Agmasoma sp.*)

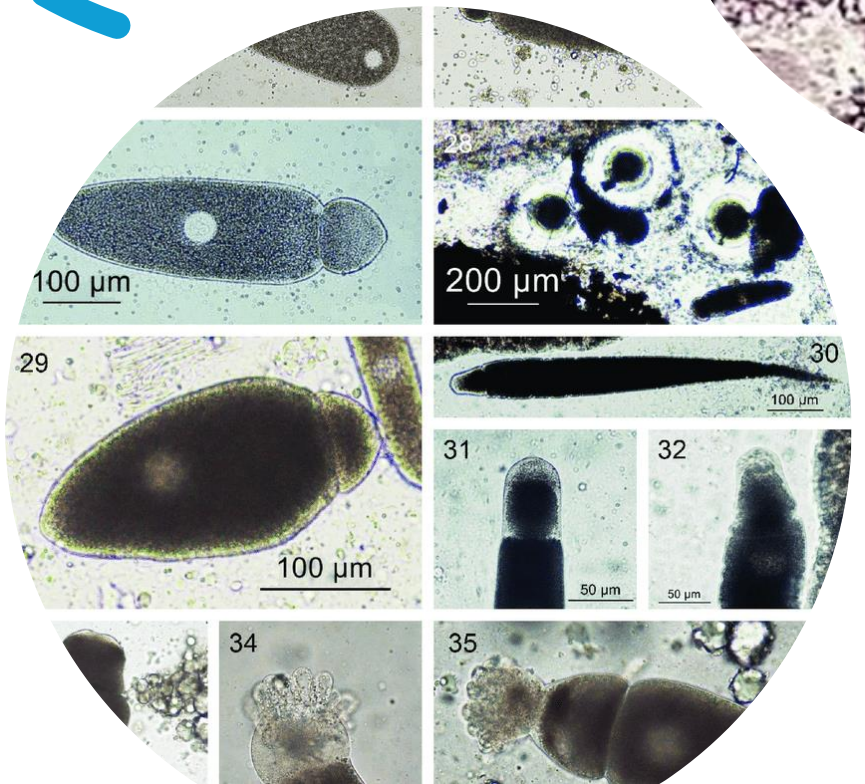
- Spores replace muscle & gonads, pond raised, off flavor, cottony texture

EHP = emerging disease

- Spores found in the hepatopancreas







Water Quality Diseases

Associated with more mortalities than pathogens!

- Low dissolved oxygen (Hypoxia)
  - Clinical signs: gasping for air, mass mortalities overnight
  - Treatment: Vigorous aeration
- Elevated nitrogenous compounds (ammonia, nitrite)
  - Clinical signs (acute): erratic swimming
  - Chronic exposure: reduced growth, burnt or swollen gills, decreased tolerance to low DO and diseases
  - Treatment: Increase aeration, reduce organic matter

Submitting Shrimp for Disease Analysis

- **Contact the lab before sending….**
  - **<u>Provide the following</u>:**
    - **Name, address, phone number**
  - **<u>Additional information</u>:**
    - **water quality issues, recent treatments, # of mortalities, physical or behavioral changes, etc.**
- **Contact the lab after shipment with estimated time of arrival**

	Parasites (External)	Parasites (Internal)	Bacterial Isolation	Viral Isolation	Histology (Cellular)
Live	Best	Best	Best	Best	Best
Dead	Poor	Good	Poor	Fair	Poor
Iced	Fair/Good	Best	Fair	Good	Fair
Frozen	Fair	Good	Good	Good	Poor
Fixed	Fair/Good	Fair/Good	Poor	Poor	Best

Submitting Samples for Certification

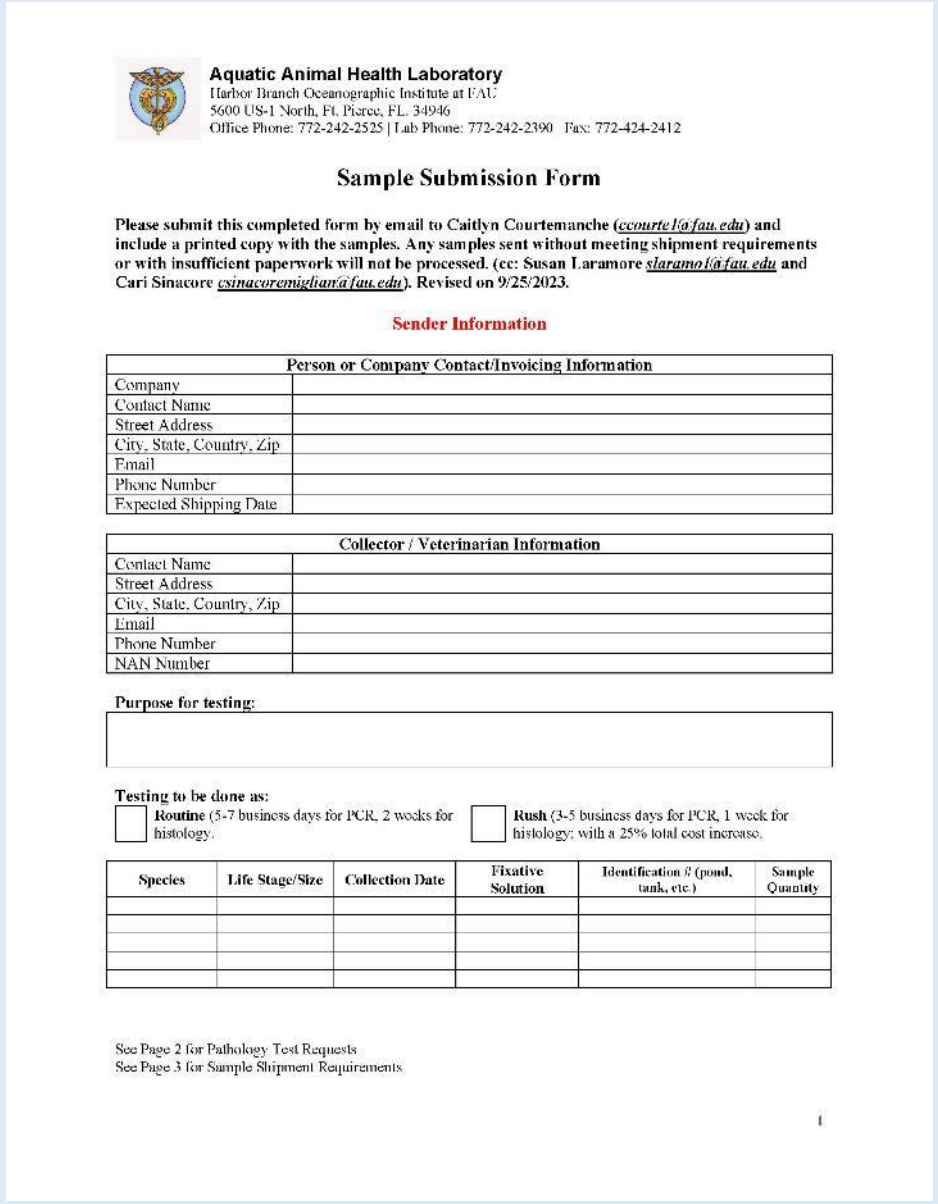
Aquatic Animal Health Laboratory
Harbor Branch Oceanographic Institute at FAU
5600 US-1 North, Ft. Pierce, FL. 34946
Office Phone: 772-242-2525 | Lab Phone: 772-242-2390 | Fax: 772-424-2412

Sample Shipment Requirements

Bivalves	
Tissue	**Fixative Method**
Whole	Must be living. Include an icepack and list "PERISHABLE" on the package.
Shrimp	
Feed	Sealed and labelled with info needed for certification.
Tissue	**Fixative Method**
Post-Larvae (PL)	95% Ethanol
Pleopods	95% Ethanol
Hepatopancreas (HP)	95% Ethanol
Whole Shrimp for Histology	The shrimp must be fixed while alive. **1)** Inject Davidson's fixative solution into the HP and each segment of the tail. Cut slits in the cuticle to allow the solution into the muscle. Allow it to sit submerged in Davidson's for 48 hours. **2)** Transfer the shrimp into 70% Ethanol for 24 hours. **3)** Ship the shrimp wrapped in paper towels soaked in 70% Ethanol, double-bagged. Include paper labels written in PENCIL.

Shrimp tissues for WOAH certification		
Postlarvae	**Pleopods**	**HP**
DIV1/SHIV	DIV1/SHIV	AHPND
IHHNV	IHHNV	NHP
IMNV	IMNV	EHP
MrNV/WTD	MrNV/WTD	
WSSV	WSSV	
YHV1	YHV1	
CFP	CFP	
AHPND		
NHP		
EHP		

Here to Help!



Aquatic Animal Health Laboratory
Harbor Branch Oceanographic Institute at FAU
5600 US-1 North, Ft. Pierce, FL. 34946
Office Phone: 772-242-2525 | Lab Phone: 772-242-2390 Fax: 772-424-2412

Sample Submission Form

Please submit this completed form by email to Caitlyn Courtemanche (*ccourte1@fau.edu*) and include a printed copy with the samples. Any samples sent without meeting shipment requirements or with insufficient paperwork will not be processed. (cc: Susan Laramore *slaramo1@fau.edu* and Cari Sinacore *csinacoremigliari@fau.edu*). Revised on 9/25/2023.

Sender Information

Person or Company Contact/Invoicing Information	
Company	
Contact Name	
Street Address	
City, State, Country, Zip	
Email	
Phone Number	
Expected Shipping Date	

Collector / Veterinarian Information	
Contact Name	
Street Address	
City, State, Country, Zip	
Email	
Phone Number	
NAN Number	

Purpose for testing:

Testing to be done as:
☐ **Routine** (5-7 business days for PCR, 2 weeks for histology.
☐ **Rush** (3-5 business days for PCR, 1 week for histology; with a 25% total cost increase.

Species	Life Stage/Size	Collection Date	Fixative Solution	Identification # (pond, tank, etc.)	Sample Quantity

See Page 2 for Pathology Test Requests
See Page 3 for Sample Shipment Requirements

1

[Aquatic Animal Health Laboratory | Florida Atlantic University (fau.edu)]

https://www.fau.edu/hboi/research/aquaculture-innovation/center-for-marine-and-warm-water-aquaculture/research/aquatic-animal-health/histology-lab/