Negros Prawn Producers Cooperative (NPPC) in Cooperation with Bureau of Fisheries and Aquatic Resources (DA-BFAR)

Updates in Shrimp Diseases

April 19, 2017

Current Disease Threats in Asian Shrimp Culture

1. Slow Growth
   - White Feces
   - Microsporidian (*Enterocytozoon hepatopenaei*, **EHP)**
2. White spot syndrome virus (WSSV)
3. EMS/AHPND
4. IMNV

Aquaculture Asia Pacific Magazine
Jan-Feb 2017 Issue

India

1. WSSV -- major threat throughout the year
2. EHP – co-occurrence with WSSV

   2016 -- slow recovery from WSSV
   -- lower production due to slow growth
   WFS and EHP in pond reared brood stock.

3. WFS
4. High Vibrio loads.

China, Vietnam, Thailand and Malaysia

- EMS/AHPND - a major problem

It co-occured with other diseases such as yellow head virus (YHV), WFS and EHP.

Thailand

- recovery phase from EMS/ AHPND.
- successful in managing EMS by changing culture practices

- new production losses resulted from EHP and WFS…After 2months of culture, 90% of shrimp were only in the 80-100/kg size. 50-80/kg at 2 months is considered good.

Vietnam

- EMS/AHPND, WSSV, EHP and WFS.

  Crop failures (2016) due to EMS and/or EHP outbreaks in 20 - 80% of the ponds.

  EHP -- production cost increased by 20%, if a harvest was possible.

  WSSV and EMS-- difficult to calculate with 100% mortality before 50 days after stocking.

Malaysia

--lower production (2016) between 35,000 to 40,000 tons, due to EMS.

--EHP was also a major threat.

--WSSV outbreaks (last quarter of 2016)

Philippines

-Production slightly increase from 50,000-55,000 MT (2015) to 60,000 MT (2016)

-Documented disease cases are primarily WSSV and EMS

-New Cases of **Hepatopancreatic Microsporidiosis caused by the newly emerged pathogen** *Enterocytozoon hepatopenaei* **(EHP)**

Philippines

Summary of EHP Analyses for Jan-Dec. 2016 and Jan- March 2017

National Summary of EHP Analyses for Year 2016

Lab	No. of Samples	Spl type	Sp	Method of Analyses	No. + Smpl	% + Smpl	Origin of Positive Samples (Province)	Type of (+) Samples in 21 cases
CL	250	mysis,PL Jv, BS	*Pm* *Pv* *Pmgs* *Pi*	IQ REAL IQ2000	23	9%	Cebu	2 Pv : Jv 2 Pm : PL
							Batangas	4 Pv : PL
							Bohol	2 Pm : PL
							Agusan del Norte	7 Pm : PL
							Leyte	1 Pv : PL 1 Pm : PL
							Iloilo	1 Pv : PL
							Surigao del Sur	1 Pm : PL

Legend:

CL	: Central Lab of BFAR
Pv	: *P.vannamei*
Pm	: *P. monodon*
Pmg	: *P. merguensis*
Pi	: *P. indicus*

Sp	: Species
Jv	: juvenile
BS	: broodstock
Pl	: post larvae
Spl	: Sample

National Summary of EHP Analyses for Year 2016

Regional Lab	No. of Samples	Smpl type	Sp.	Method pf Analyses	No. +	% +	Province	Type + sample
I	16	PL	*Pv*	IQ Plus	0	0%		
II	10	-	*Pv*	IQ Plus	0	0%	-	-
IV-A	46	PL mysis	*Pv* *Pv*	IQ Plus	2	4%	Quezon	2 Pm : PL
IV-B	9	-	*Pv* *Pm*	IQ Plus	0	0%	-	-
VI	32	PL	*Pm*	IQ Plus	0	0%	-	-
VII	58	Jv BS	*Pm* *Pv*	IQ 2000	1	2%	Cebu	1 Pv : Jv
VIII	6	Jv	*Pm* *P. mgs*	IQ Plus	0	0%	-	-
X	6	Jv	*Pm*	IQ Plus	0	0%	-	
XI	69	PL Jv BS	*Pv*	IQ Plus	0	0%	-	-
XIII	8	PL	*Pm*	IQ Plus	2	25%	Agusan del Norte	2 Pm : PL
Total	510				28	5%		

EHP positive comprise 5% of the samples analyze in year 2016 by BFAR laboratories

National Summary of EHP Result from January to March 2017

Lab	No.of Spls	Spl type	Sp.	Method of Analyses	No. + Spls	% + Spls	Province	Type of (+) Samples
CO	97	mysis PL jv BS	Pm Pv	IQ Real, IQ2000	10	10%	Camarines Norte	1 Pm: Jv
							Quezon	1 Pv : PL
							Zambales	1 Pv : PL
							Bulacan	1 Pv : PL
							Surigao del Norte	1 Pm : Adult
							Agusan del Norte	1 Pm : Adult
							Bacolod, Neg. Occ.	4 Pv : Jv

National Summary of EHP Result from January to March 2017

Region	No. of Spls	Spl type	Sp.	Method	No. + Spls	%+ Spls	Province	Type of + Spls
IV-A	40	nauplii mysis, zoea, PL BS	*Pv* *Pm*	IQ Plus	0	0%	-	-
VII	59	nauplii, PL, ad BS	*Pm* *Pv*	IQ 2000	0	0%	-	-
X	1	Jv	*Pm*	IQ Plus	0	0%	-	-
XI	5	PL	*Pv*	IQ Plus	0	0%	-	-
XIII	6	PL	*Pm*	IQ Plus	2	20%	Butuan City	1 Pm : PL 1Pv: Jv
TOTAL	208				12	5%		

National Summary of EHP Result from January to December 2016

Month	No of EHP Positive Samples	Regions/Provinces with + samples
January	0	-
February	0	-
March	0	-
April	0	-
May	2	Iloilo, Agusan del Norte
June	1	Cebu
July	2	Bohol
August	6	Batangas, Agusan del Norte
September	3	Surigao del Sur, Cebu
October	5	Leyte
November	2+2	Oriental Mindoro, Quezon
December	5	Agusan del Norte, Leyte

National Summary of EHP Result from January to March 2017

Month	No of EHP Positive Samples	Regions/Provinces with + samples
January	1	Camarines Norte
February	7	Negros Occidental, Quezon, Zambales, Bulacan
March	4	Surigao del Norte, Agusan del Norte

Cases of EHP in the Philippines
January 2016-March 2017

Negros Prawn Producers Cooperative Lab Documented Lab Results

2016	Samples Analyzed 1,044								Summary of Results			
	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL WSSV	TOTAL EMS	WSSV/EMS (+)	WSSV/EMS (+)
MONTH	SAMPLES	FRY	ADULT/JUV	Crustaceans	Worms	BREEDER	NAUPLII	BAC'L ISO.	POSITIVE	POSITIVE	ADULT/JUV	FRY
January	52	34	17	1	0	0	0	4	3	0	3	0
February	74	66	8	0	0	0	0	3	0	0	0	0
March	98	78	13	0	0	0	0	7	4	0	4	0
April	149	122	16	0	0	0	0	11	8	0	8	0
May	119	81	16	0	0	0	0	22	0	0	0	0
June	99	75	14	0	0	0	0	10	0	0	0	0
July	95	72	15	0	0	0	0	8	0	0	0	0
August	86	62	18	0	0	0	0	6	1	0	1	0
September	81	49	22	0	0	0	0	10	4	0	4	0
October	78	59	8	0	0	0	0	11	0	0	0	0
November	55	27	13	0	0	0	0	15	3	2	5	0
December	58	23	16	0	0	0	0	19	5	2	7	0
TOTAL	1044	748	176	1	0	0	0	126	28	4	32	0

January 2017 (NPPC)

DATE	Tank	Sample	WSSV			EMS	EHP			AREA
	Pond #		Coop	Japanese Kit	BFAR		Coop	Japanese Kit	BFAR	
1/3/17	1	av	(+)							Bago
1/4/17	4	Vp iso				ND				
1/5/17	1	vf	ND			ND				
1/6/17	2	av	2(+)							Batangas
	1	vf	ND							
1/10/17	1	av	(+)							Aklan
1/11/17	2	Vp iso				ND				
1/11/17	2	Vp iso				ND				
1/11/17	4	vf	ND			ND				
1/17/17	1	av	(+)							Sagay
1/19/17	5	av	5(+)							Sagay
1/23/17	4	jv	ND							
1/23/17	3	vf	ND			ND				
1/23/17	T-3	vf	ND			ND				
1/26/17	3	mf	ND							
1/26/17	3	vf	ND			ND				
1/30/17	5	vf	ND			ND				
1/31/17	4	jv	3 ND, 1(+)	3 ND, 1(+)	2 ND, 2(+)		4 (+)	4 (+)	2 (+)	Sagay

February 2017 (NPPC)

DATE	# of Samples	SAMPLE DESC	WSSV	EMS	EHP		IHHNV	AREA
					Coop	Japanese Kit		
2/1/17	1	av	(+)	ND	ND	ND	ND	Batangas
2/6/17	4	jv	3 ND, 1 (+)	ND	4 (+)	4 (+)	ND	Sagay
2/7/17	2	vf	ND	ND				
2/8/17	1	av	(+)	ND	ND		ND	Batangas
2/10/17	6	vf	ND	ND				
2/14/17	4	jv	3ND,1(+)	ND	4(+)	4(+)	ND	Sagay
2/16/17	3	mf	2(+)					Cebu
2/16/17	2	vf	ND	ND				
2/17/17	2	vf	ND	ND				
2/20/17	1	av	(+)					San Carlos
	3	vf	ND	ND				
	4	jv	3ND,1(+)	ND	4(+)	4(+)	ND	Sagay
2/27/17	4	jv	3ND,1(+)	ND	4(+)	4(+)	ND	Sagay

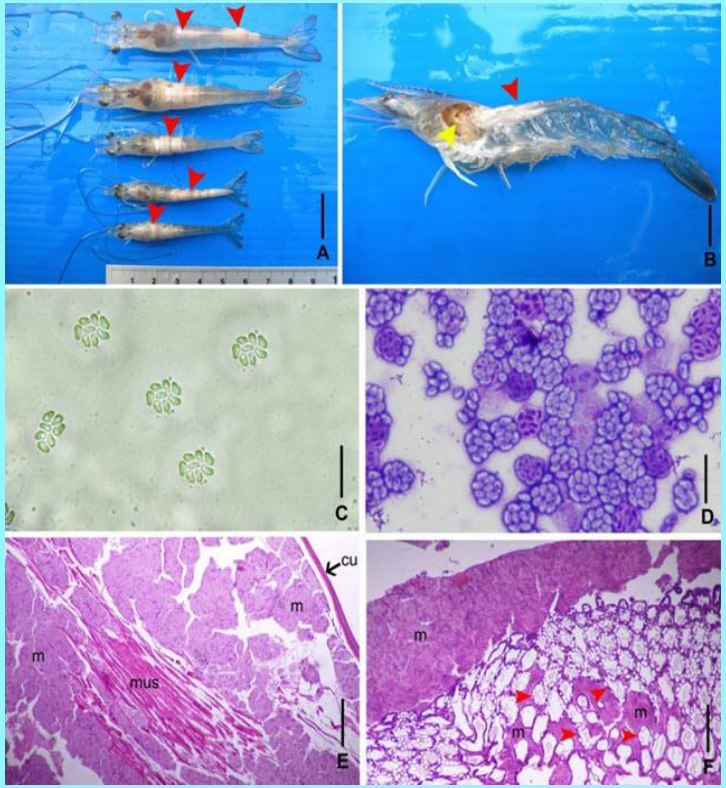
March 2017 (NPPC)

Specimen---- Fry, Soil, *Vp* isolates, water
Sample Origin – Cebu, Aklan, Batangas, Negros

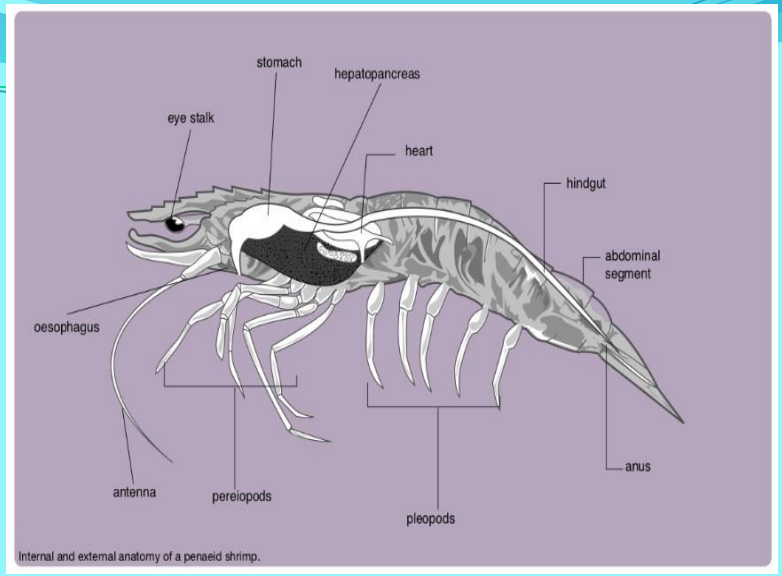
Total Samples – 101
WSSV + -- 15
EHP (+) -- 10
EMS/APHND -- 0
IHHNV -- 0

Important Facts about EHP

- EHP is a microsporidian, a spore forming parasite. It is a type of fungal infection.



- EHP does not infect muscle tissue, but infects the hepatopancreatic tissue, the same organ that the toxin in EMS targeted.



- EHP also requires a intermediate host for infection.

-Polychaetes, being benthic feeders can be PCR positive for EHP… extreme caution should be exercised while using polychaetes as live feed in the hatcheries.

Source: enaca.org (11/24/2014)

Disease signs at pond level

- No specifically distinctive gross signs of infection by EHP

- Infection may be suspected with the occurrence of unusually retarded growth in the absence of other gross signs of disease

http://enaca.org/publications/health/disease-cards/ehp-disease-card-2015.pdf

Host Range

EHP affects both *P. monodon* and *P. vannamei* and is suspected to also infect P. Japonicus (Tangprasittipap, et al., 2013) (Hudson, et al., 2001).

Presence in Asia Pacific (NACA)

EHP was first detected in *P. monodon* in Thailand in 2004, later reported from Vietnam (Ha, et al., 2010 ; Ha, et al., 2010; Tang, et al., 2015);

PCR positive results were also obtained from *P. vannamei* cultivated in Indonesia and India (unpublished).

EHP has been reported from Vietnam as associated with white feces syndrome (WFS) (Ha, et al., 2010 ; Ha, et al., 2010), and from China (Liu et al., in press).

EHP may be present in shrimp exhibiting WFS or other diseases such as WSSV.

EHP can be transmitted horizontally among shrimp in a rearing ponds (Tangprasittipap, et al., 2013) meaning that infections can spread progressively as cultivation continues.

How EHP is transmitted?

-Vertical transmission: broodstock to offspring

-Hotizontal transmission: EHP could be transmitted directly from shrimp to shrimp by the oral route (Tangprasittipap et al., 2013).

Infected animals can release spores that enter the environment by the decomposition of the dead animal, cannibalism, scavenging etc. which will remain infective for some time depending on environmental conditions.

Biggest difference between EMS and EHP (McIntosh, 2015)

•EMS typically kills shrimp while EHP causes them to grow slowly and vary in size.

•EMS, caused by a toxic bacteria that affects shrimp like a dose of insecticide would, EHP, by contrast, is a tiny fungus related spore that's "very resistant to the environment and to chlorination."

- EMS grows on shrimp feed, on waste and on molts led to the realization that it could be treated by limiting the growth of bacteria by installing “shrimp toilets” that reduce sludge.

EHP requires clean, specially disinfected hatcheries, clean ponds and clean broodstocks.

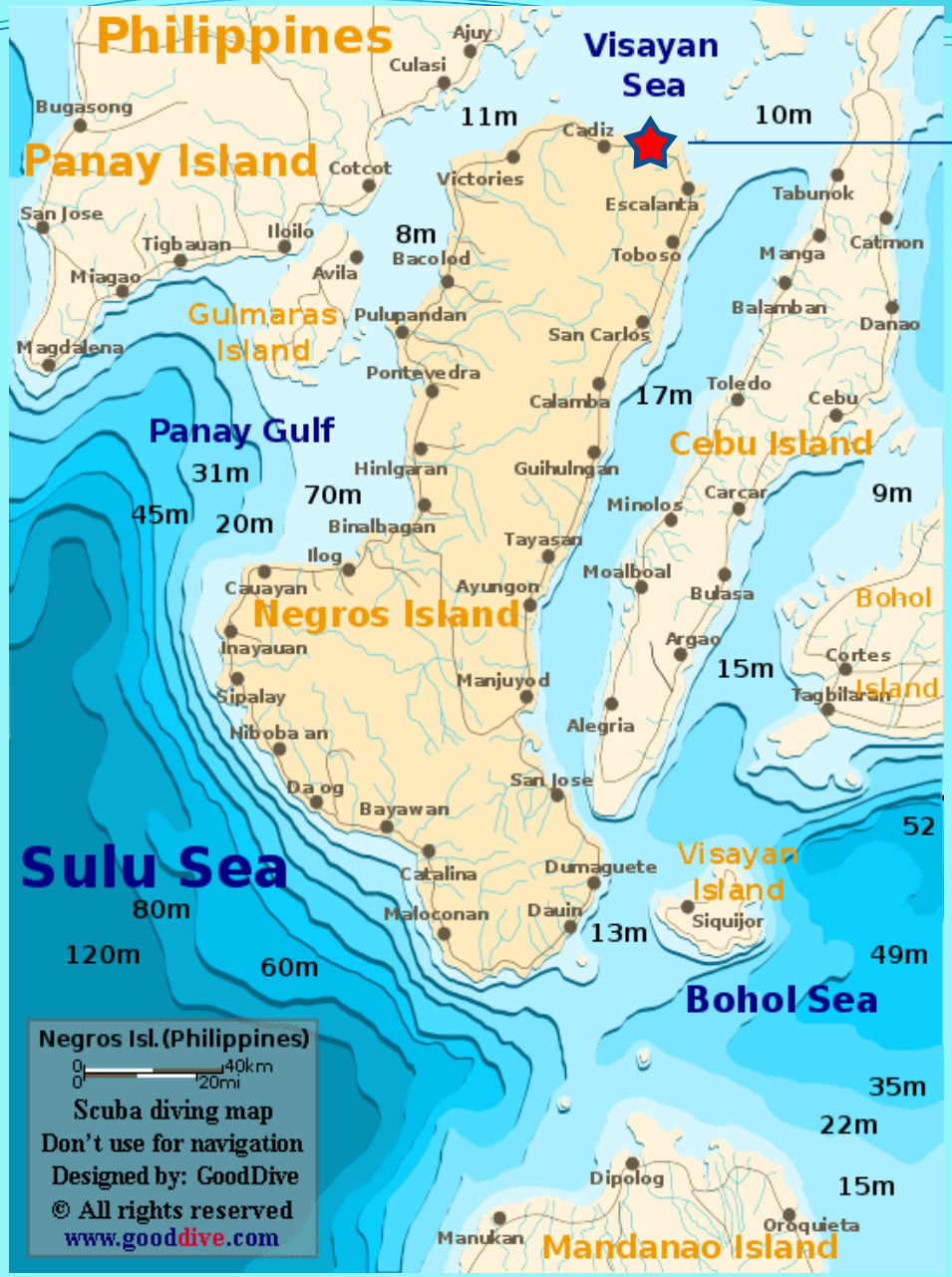
https://www.undercurrentnews.com/2015/10/29/cp-foods-ehp-now-a-bigger-risk-for-shrimp-than-ems/

1st Documented EHP Case

Site : Sagay City, Negros Occidental

Site Characteristics:

Soil Texture	: Clay Loam
Soil pH	: 7.9-8.6
Organic Matter Content	: Low
Available Iron	: Low
Water Source	: Deepwell
Salinity	:12-15 ppt



Brgy. Bulanon,
Sagay City
Negros Occidental

Farm Data (2013-2016)

Feeds used : CP/INVIVO

Fry Source : CP Dumaguete

Probiotics : Biosolutions/INVE

Number of Productive Ponds : 21

No. of Crop Cycle : 1.5 to 2 per year

Mean Survival : 95-100%

Stocking Density range : 90-100pcs/sq. meter

Mean Days of Culture : 120 days

Inputs from December 2013 to date

- Disinfectant – Chlorine
- Probiotics

  Pro W (water) – to improve and maintain good bacterial flora

  Pro 2 (Feeds) – to improve and maintain beneficial gut flora
- Vitamins/Immuno-Enhancer – TOP S
- Other inputs

Nutri-Lake – for beneficial phytoplankton development

Agricultural Lime – for pH correction

Molasses
Rice Bran
Yeast
} to improve water transparency during water culture

Disease History

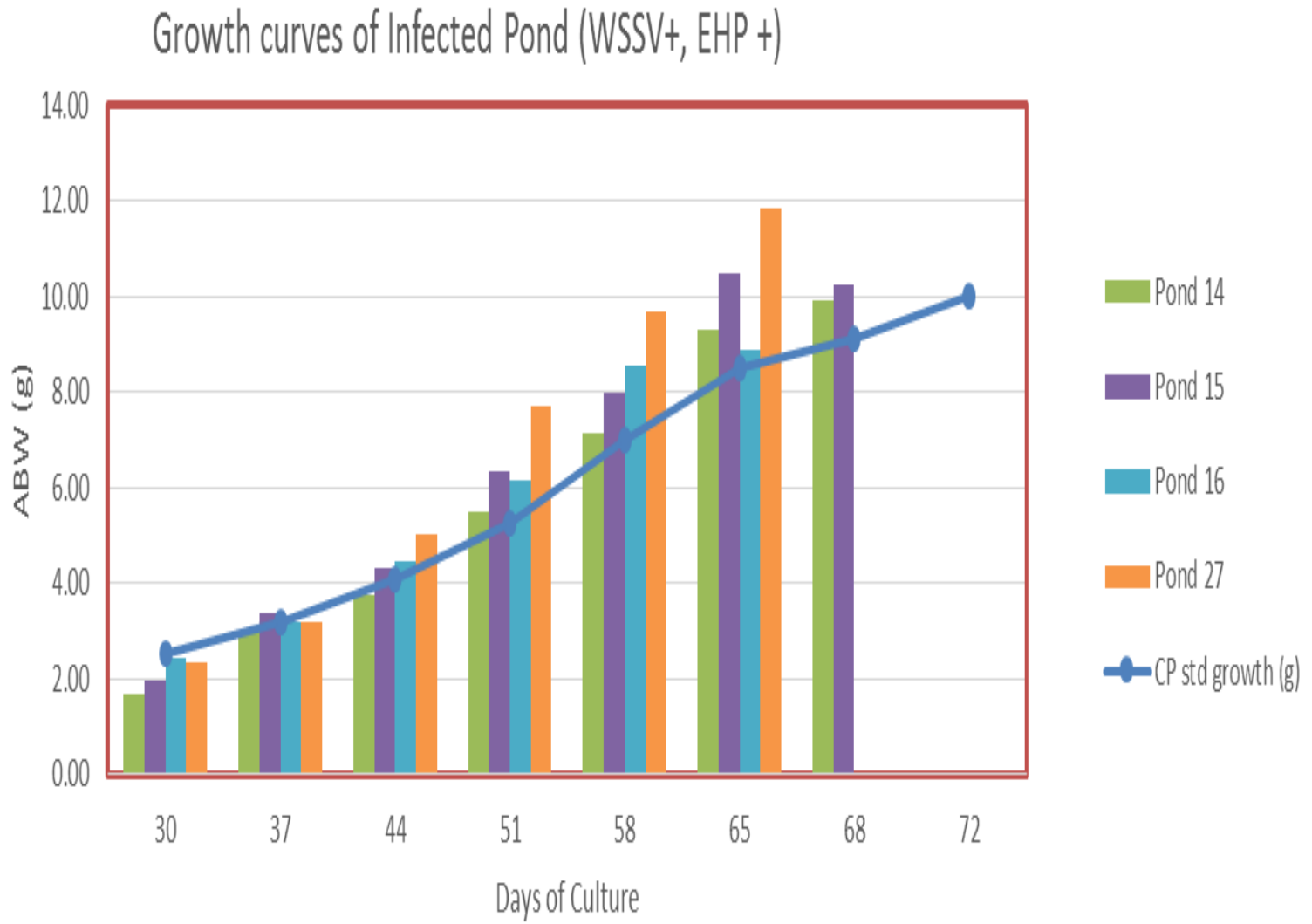
- 2013 – WSSV (Dec) later part of the year (satisfactory crop performance)
- 2014 – None (Good Crop Performance)
- 2015 – None (Better Crop Performance)
- 2016 – None (Best Crop Performance)
- 2017 – January WSSV, EHP

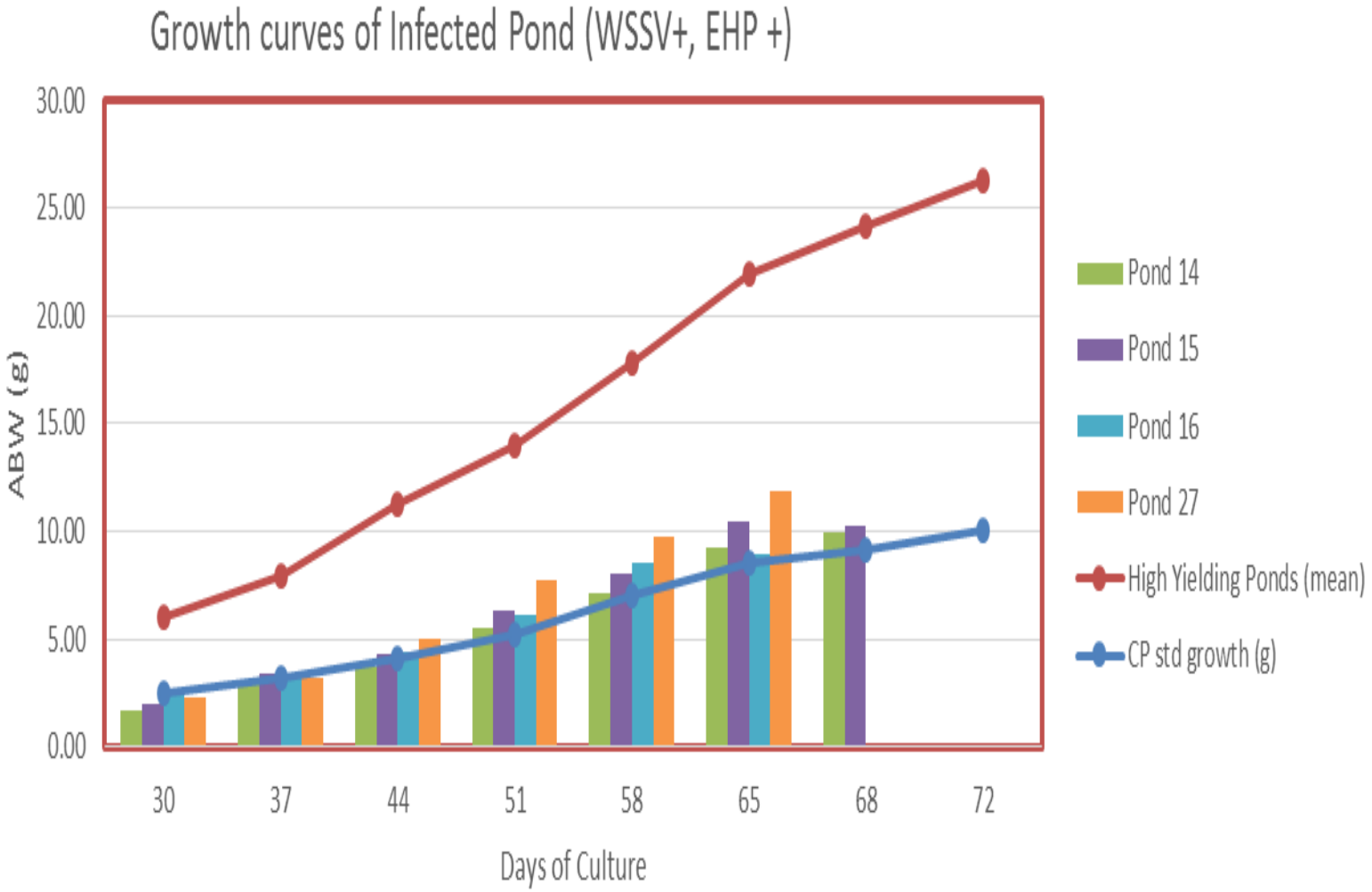
2017 – WSSV and EHP Case

WSSV + and EHP + Ponds	Farm Data			
	Pond 14	Pond 15	Pond 16	Pond 27
Area (ha.)	0.66	0.66	0.59	0.59
Fry Source	CP-Dumaguete	CP-Dumaguete	CP-Dumaguete	CP-Dumaguete
Date Stocked	1/7/2017	1/7/2017	1/13/2017	1/13/2017
Number of pieces	710,000.00	710,000.00	618,800.00	529,800.00
Stocking Density (pcs/sq.m)	108.58	107.58	104.76	105.96
Feeds	INVIVO	CP	INVIVO	CP

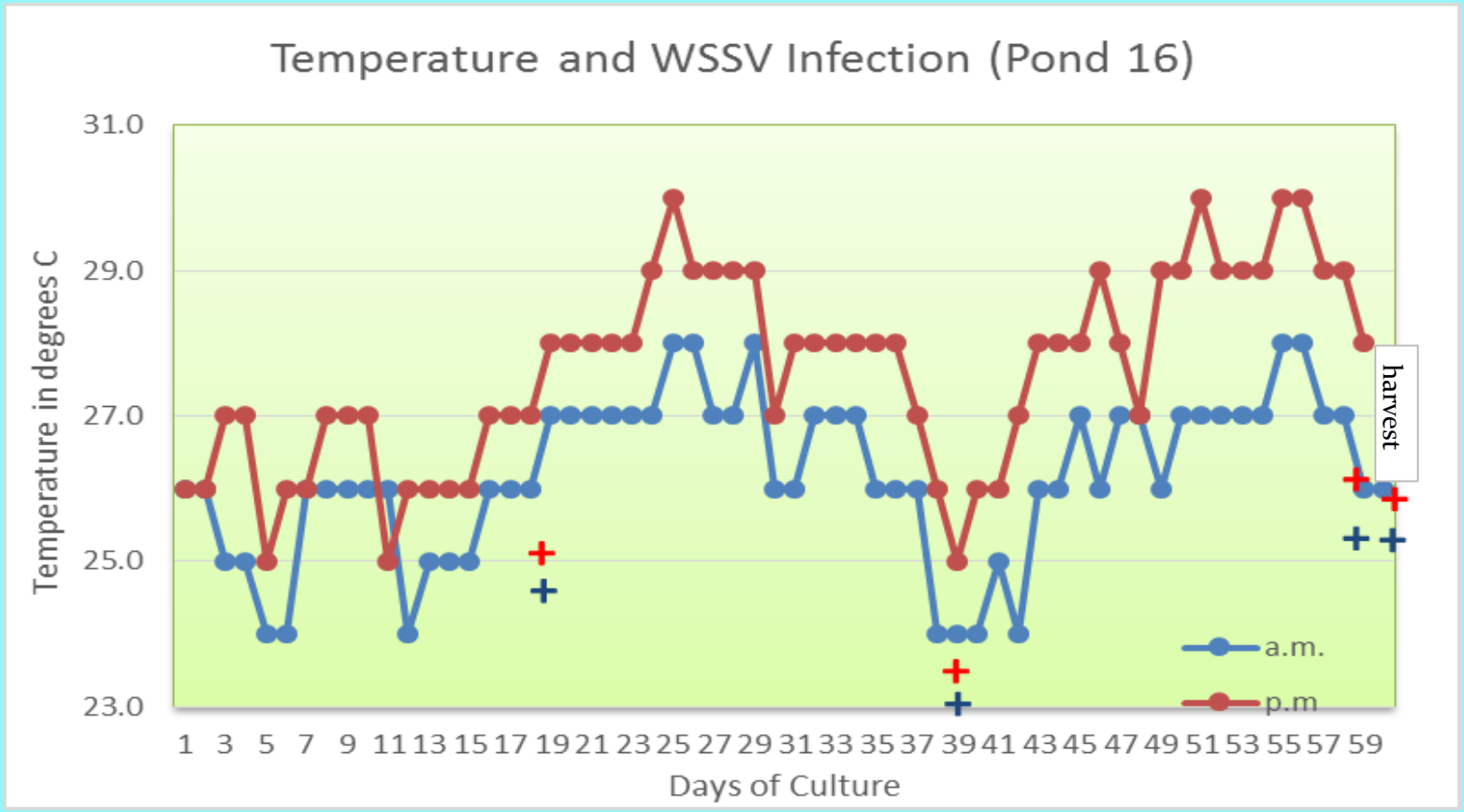
Date of Analysis	Days of Culture	Results						
		WSSV		EMS	EHP			IHHNV
Pond 16		Coop	BFAR	Coop/BFAR	Coop	Japanese Kit	BFAR	Jap/BFAR
1/13/2017	1	ND						
1/31/2017	19	(+) light	(+)	ND	(+)	(+)	(+)	(-)
2/6/2017	25	ND	(-)	ND	(+)	(+)		(-)
2/14/2017	33	ND		ND	(-)	(+)		(-)
2/20/2017	39	(+) light		ND	(-)	(+)		(-)
2/27/2017	46	ND		ND	(+)	(+)		(-)
3/6/2017	53	ND		ND	(+)	(+)		(-)
3/10/2017	57	(+)		ND	(+)	(+)		(-)
3/13/2017	60	(+)		ND	(+)	(+)		(-)
Pond 27								
1/13/2017	1	ND						
1/31/2017	19	(+) light		ND	(+)	(+)	(+)	(-)
2/6/2017	25	(+) light		ND	(+)	(+)		(-)
2/14/2017	33	ND		ND	(+)	(+)		(-)
2/20/2017	39	ND		ND	(+)	(+)		(-)
2/27/2017	46	ND		ND	(+)	(+)		(-)
3/6/2017	53	(+) light		ND	(+)	(+)		(-)
3/10/2017	57	(+) light		ND	ND	(+)		(-)
3/13/2017	60	(+)		ND	(+)	(+)		(-)

Date of Analysis	Days of Culture	Results						
		WSSV		EMS	EHP			IHHNV
		Coop	BFAR	Coop/BFAR	Coop	Japanese Kit	BFAR	Jap/BFAR
Pond 14								
1/13/2017	7	ND						
1/31/2017	25	(+) light		ND	(+)	(+)	ND	(-)
2/6/2017	31	ND		ND	(+)	(+)		(-)
2/14/2017	39	ND		ND	(+)	(+)		(-)
2/20/2017	45	ND		ND	(+)	(+)		(-)
2/27/2017	52	ND		ND	(+)	(+)		(-)
3/6/2017	60	ND		ND	(+)	(+)		(-)
3/10/2017	63	ND		ND	(+)	(+)		(-)
3/13/2017	66	ND		ND	(+)	(+)		(-)
Pond 15								
1/13/2017	7	ND						
1/31/2017	25	(+) light		ND	(+)	(+)	ND	(-)
2/6/2017	31	ND		ND	(+)	(+)		(-)
2/14/2017	39	(+) light		ND	(+)	(+)		(-)
2/20/2017	45	ND		ND	(+)	(+)		(-)
2/27/2017	53	(+) light		ND	(+)	(+)		(-)
3/6/2017	60	ND		ND	(+)	(+)		(-)
3/10/2017	63	(+)		ND	(+)	(+)		(-)
3/13/2017	66	(+)		ND	(+)	(+)		(-)


Growth curves of Infected Pond (WSSV+, EHP +)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
ABW (g)
30
37
44
51
58
65
68
72
Days of Culture
Pond 14
Pond 15
Pond 16
Pond 27
CP std growth (g)

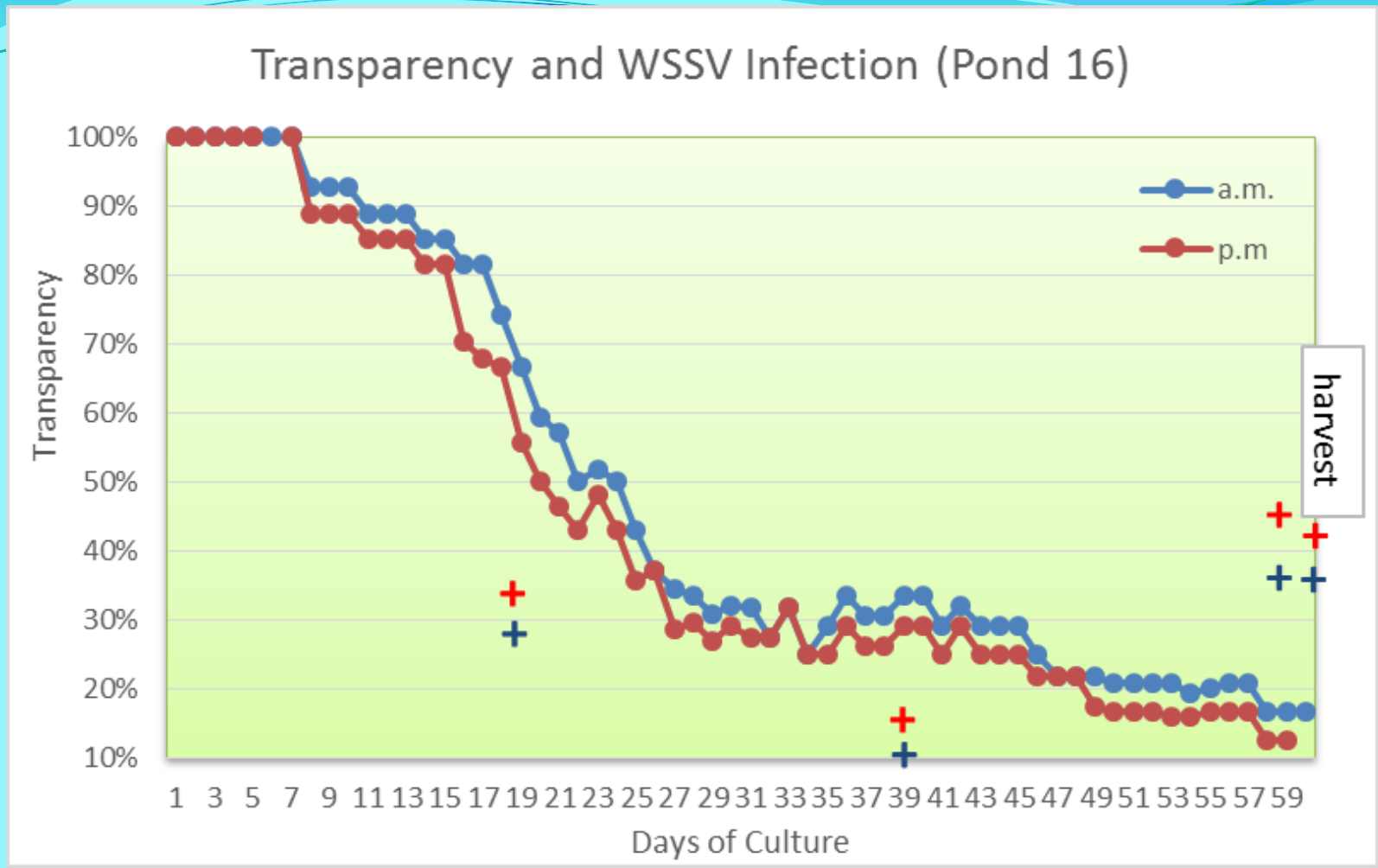

Growth curves of Infected Pond (WSSV+, EHP +)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
ABW (g)
30
37
44
51
58
65
68
72
Days of Culture
Pond 14
Pond 15
Pond 16
Pond 27
High Yielding Ponds (mean)
CP std growth (g)

Stress Factors Attributable to Early Harvest



+ -- EHP Positive

+ -- WSSV Positive



+ -- EHP Positive

+ -- WSSV Positive

Ponds with dual infection (EHP+, WSSV +)
January 7-March 17, 2017

WSSV + and EHP + Ponds	Production Data				Total	Mean	Per ha. Basis
	Pond 14	Pond 15	Pond 16	Pond 27			
Area (ha.)	0.66	0.66	0.59	0.59		0.63	1.00
Date Harvested	3/17/2017	3/16/2017	3/13/2017	3/16/2017			
Days of Culture	63	67	60	63		63.25	
Average Body Weight (g)	10	10.26	8.9	11.85		10.25	
Biomass (kg)	7,469.95	7,717.18	5,230.5	5,817.8	26,235.43	6,558.86	10,494.17
Feed Conversion Ratio (FCR)	1.47	1.44	1.38	1.28		1.39	
% Survival	106.27	105.94	96.39	92.66		100.32	

Disease management strategy

applied in the 4 ponds infected with WSSV and EHP:

- Prevention of further stress or minimizing stress
- Low Salinity
- **Extended use of feed probiotic (Pro 2) and TOP S in feeds everyday from day 1 up to harvest.**
- **Use of probiotic Prow W in water**
- **Regular laboratory analysis at least once a week and timely feedback system**
- Effective communication between the owner and the farm team.
- Dedicated and responsive farm staff.

Advantage of using the following interventions:

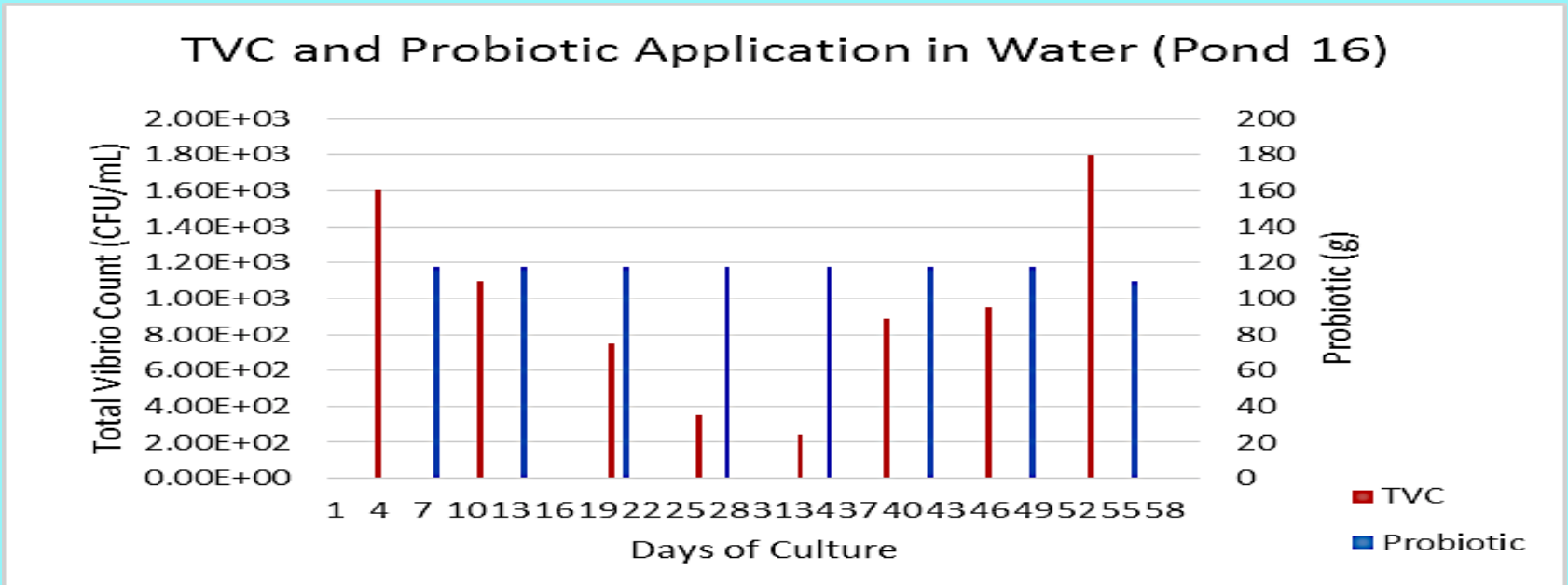
- Based on crop performance records, the incorporation of the probiotic and Top-S in the protocol since Dec. 2013 had proven cost efficient inputs and resulted to high production. It was also observed that no disease incidence for the past 3 years.

- The relatively high survival despite of the documented incidence of EHP and light + WSSV infection in the four ponds stocked last January 2017 proved that the management strategy adapted in the farm is sustainable and successful.

- The use of nutri-lake managed to directly maintain beneficial phytoplankton density and suitable pond environment.

Lab results of infected ponds

Pond 16	WATER BACTERIAL ANALYSIS					
DATE	TPC	TVC	% Yel	% Grn	Vp	LBC
12/19/2016	7.30E+02	2.20E+02	74.00%	26.00%	(-)	(-)
12/27/2016	1.00E+03	2.20E+02	65.10%	34.90%	(-)	(-)
1/3/2017	7.50E+02	2.10E+02	82.30%	17.70%	(-)	(-)
1/10/2017	1.20E+03	6.20E+02	65.10%	34.90%	(-)	(-)
1/16/2017	2.30E+03	9.80E+02	35.00%	65.00%	(-)	(-)
1/23/2017	2.90E+03	9.20E+02	0.00%	100.00%	4.00E+02	(-)
2/1/2017	3.10E+03	7.50E+02	43.20%	56.80%	(-)	(-)
2/6/2017	2.60E+03	1.10E+03	51.80%	48.20%	(-)	(-)
2/13/2017	6.50E+03	7.80E+02	46.00%	54.00%	(-)	(-)
2/20/2017	8.50E+03	8.90E+02	59.40%	40.60%	(-)	(-)
2/27/2017	8.90E+03	9.50E+02	65.80%	34.20%	(-)	(-)
3/6/2017	9.80E+03	1.80E+03	68.10%	31.90%	(-)	(-)



Lab results of infected ponds

Pond 27	WATER BACTERIAL ANALYSIS					
DATE	TPC	TVC	% Yel	% Grn	Vp	LBC
12/19/2016	2.20E+02	4.40E+01	100.00%	0.00%	(-)	(-)
12/27/2016	1.90E+03	5.40E+02	79.00%	21.00%	(-)	(-)
1/3/2017	2.80E+03	1.20E+03	99.18%	0.82%	(-)	(-)
1/10/2017	1.30E+03	1.00E+03	93.00%	7.00%	(-)	(-)
1/16/2017	2.00E+03	5.20E+02	92.31%	7.69%	(-)	(-)
1/23/2017	9.80E+02	1.70E+02	17.65%	82.35%	(-)	(-)
2/1/2017	2.80E+03	9.20E+02	100.00%	0.00%	(-)	(-)
2/6/2017	1.90E+03	9.40E+02	14.68%	85.32%	(-)	(-)
2/13/2017	4.60E+03	1.00E+03	65.00%	35.00%	(-)	(-)
2/20/2017	8.70E+03	9.50E+02	79.00%	21.00%	(-)	(-)
2/27/2017	9.80E+03	8.60E+02	75.60%	24.40%	(-)	(-)
3/6/2017	1.80E+04	7.50E+02	61.90%	38.10%	(-)	(-)

Soil Analysis

Date of Analysis	Pond Number	EHP Test Result	Remarks
Feb. 27, 2017	1	+	Positive
	2	ND	Not Detected
	3	ND	Not Detected
	4	ND	Not Detected
	5	ND	Not Detected
	6	ND	Not Detected
	7	ND	Not Detected
	8	+	Positive
	9A	ND	Not Detected
	9B	ND	Not Detected
	10	ND	Not Detected
	11	ND	Not Detected
	12	ND	Not Detected

Soil Analysis

Date of Analysis	Pond Number	EHP Test Result	Remarks
Feb. 27, 2017	17	ND	Not Detected
	18	ND	Not Detected
	19	ND	Not Detected
	20	+	Positive
	21	ND	Not Detected
	23	ND	Not Detected

Date of Analysis	Pond Number	EHP Test Result	Remarks
March 21	Irrigation Canal 1	ND	Not Detected
Crabs	Irrigation Canal 2	ND	Not Detected
March 29 Soil	6	ND	Not Detected
	9B	ND	Not Detected
	10	ND	Not Detected
	23	ND	Not Detected
April 12	Irrigation Canal 1	ND	Not Detected
Crabs	Irrigation Canal 2	ND	Not Detected
	Irrigation Canal 3	ND	Not Detected
Soil	1	ND	Not Detected
	8	ND	Not Detected
	20	ND	Not Detected

SUGGESTED PREVENTIVE AND MANAGEMENT MEASURES

Strengthening of the implementation of Government Policy related to transboundary shipments to prevent the entry of emerging shrimp diseases by:

1. Improving the quarantine facilities of importing hatcheries.

2. Importing hatcheries should submit samples of broodstocks of every shipment to BFAR laboratories for screening of economically important shrimp diseases.

If necessary:
Establishment of government operated quarantine facilities,

Although there are isolated and site-specific concerns that affect productivity in some areas, the petition to lift the import ban of *shrimp* broodstock from Asian countries and other countries infected with EMS/APHND and IMNV is not a felt-need priority because there is no broodstock scarcity as attested by majority of the BFAR certified hatchery operators.

The fry shortage being currently experienced could be due to limited volume of production by accredited hatcheries which can be attributed to the size of the hatcheries.

EHP: Control is only by preventing infection

First and foremost is the sanitation of the hatchery because once the infection occurs, it is hard to eliminate

The spore is nearly indestructible. Some industry experts believe that the spores can withstand 50 years of drying, or 200 ppm of chlorine disinfectant.

The infection starts with broodstock. If the broodstock comes in contact with the spore, all the nauplii it produces will carry a spore that will then infect the post larvae and then the farm (*Sackton, 2015)*.

It is possible that even the SPF shrimp broodstock can harbor EHP spores (observations by Flegel's group). It is advisable that ponds are stocked with EHP free fry. If broodstock are infected, the growth in the number of parasites is accelerated.
(CIBA, 2016).

- **Disinfection of hatchery facility prior to starting new production cycle will help in minimizing EHP risk.**

- **Cleaning hatchery facility including all the surfaces, tanks, pipelines and implements, with 2.5 % NaOH solution with a minimum of 3 hrs of contact time and then drying for about a week followed by rinsing with acidified chlorine (200 ppm) is advocated to prevent EHP**

(CIBA, 2016)

The lower the density, the less impact from the spores.

Low salinity favors less impact and better growth; high salinity appears to correlate with poor growth and greater impact.

The severity of EHP impact is directly related to the number of spores in the hepatopancreas of the shrimp. The higher the number of spores, the greater impact in stunted growth.

The spore count generally increases with the time the shrimp are in the ponds, so that after 40 days there is a higher parasite load than initially.

The spores of EHP have thick walls and should be inactivated before the next cultivation cycle. Even high levels of chlorine alone are not effective.

(CIBA, 2016)

- **To maintain farm productivity, adhere to better management practices, providing adequate time (at least 3-4 weeks) for the ponds to dry after every harvest.**

- **To disinfect earthen ponds of EHP spores, apply CaO at 6 Ton/ha. Plow the CaO into the dry pond sediment (10-12 cm) and then moisten the sediment to activate the lime.**

- **Then leave for 1 week before drying or filling. After application of CaO, the soil pH should rise to 12 and then fall back to the normal range as it absorbs carbon dioxide and becomes $CaCO_3$.**

Source: enaca.org (11/24/2014)

Capacity of Class A Hydrated Lime to raise soil pH to 12

		Initial pH		
soil		8.6		
Pond water (12 ppt)		8.16		
Lime-1 (1:1 lime to water ratio)	ABC	13.2		
Lime-2 (1:1 lime to water ratio)	DEF	13.16		

Results of pH after lime application (Soil 15-20 cm plow layer + 5 cm water)

		Dose of Lime		
	Time elapsed	**6 tons/ha**	**4tons/ha**	**2tons/ha**
	from initial	Duplicate	Duplicate	Duplicate
Lime 1				
	After broadcasting	A	B	C
	Initial	11.50	11.40	11.30
	40 minutes	11.70	11.60	11.40
	1 hr 40 mins	**12.00**	**12.00**	**11.80**
	3 hrs 40 mins	**12.00**	**12.00**	11.20
	4 hrs 40mins	11.60	11.50	11.20
	6 hrs 10 mins	11.50	11.50	10.80
	48 hours	11.50	11.50	10.20
Lime 2		D	E	F
	Initial	11.70	11.70	11.60
	1 hr	12.00	11.90	11.70
	2 hrs	12.00	11.40	11.20
	3 hrs	11.50	11.40	11.20
	4.5 hrs	11.40	11.40	11.20
	48 hours	11.30	11.20	9.80

Observations:

4.0 tons/ha is the cost effective dosage. There is no significant difference in the pH values between 6.0 tons/ha and 4.0 tons/ha based on the results. This is maybe because of the buffering capacity of the soil.

Clay soils tend to have greater buffering capacities but may differ due to difference in CEC and organic matter per area.

CONCLUSION

The shared documented experiences and management measures on how to deal with the disease and a well prepared risk management program including an effective monitoring protocol is important and vital in updating the strategies in dealing with EHP.

CONCLUSION

The producers' performance and sustainability are being at stake whenever there are new emerging diseases. The Negros experience is a call to towards an urgent need for thorough researches of effective inputs/strategies in dealing with EHP and other emerging diseases.

NPPC

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1st and only private Environmental Laboratory recognized by the EMB-DENR for the Negros Island Region and Region V1, one of the few in the Philippines.

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DOST, Region V1

DA-BFAR

Accreditations:

- PAB accredited Testing Laboratory PNS ISO/IEC 17025:2005 LA-2016-288A LA-2016-289A
- DOH accredited laboratory for drinking water analysis (Accreditation # 06-00712LW2)
- EMB-DENR Recognized Environmental Laboratory (C.R. # 010/2012)
- Bureau of Soils Licensed Laboratory (License # 001-008)
- BFAR Satellite Laboratory

THANK YOU!