Growing together: what part will you play?

WISDOM?

Robins Mcintosh
Charoen Pokphand Foods, Public Company
Bangkok Thailand
1985: I am an expert Shrimp Culturist!!

Not Really:
In Hindsight- this is a life of learning how much you really don’t know
No Doubt: Successful Aquaculturists must be dedicated and passionate

• Mrs. Nantana: Founder of CPF SPF

Keeping Shrimp Clean is HARD
Shrimp Health is moving from being disease centric to preventative care

Dr. Lightner
• PCR, Diagnostics, Post mortem

Dr. Alday-Sanz
• Reduce the risk; health, biosecurity:
• Goal is to protect the Investment
Why do Shrimp Farms get Disease?
Risk of Disease=Pathogen level x Shrimp Susceptibility/tolerance

• Pathogen level= presence of pathogen at what “density”
  (strategy is to exclude the pathogen (virus) or minimize the prevalence)

• Shrimp Susceptibility= genetic tolerance of the shrimp x stress level of that shrimp
  (strategy is to minimize stress in any system and to stock shrimp with sufficient tolerance for the stress levels of the system)
Priorities:
Shrimp Health, Shrimp Health, Shrimp Health

Survival
A shrimp must survive to be sold
(Disease resistance, tolerance, Health)

Growth
the singular most important economic impact
for the farmer (Genetic potential, Health)
1995: I was stuck
And then I learned experts are not always correct

11,000 kgs/Ha: Are you kidding?

HDPE Liners: Can't grow shrimp on plastic.

Zero Water Exchange: Not possible for intensive culture- increase water exchange- only way to go.

Genetics: Are you going to fall for that O.I. propaganda?

Shrimp farming in Belize: Cant do it; no wild brooders.
My world changes:
This was my Enlightenment
Belize Aquaculture was “My Enlightenment”

Healthy shrimp are almost everything; Health is not just mortality rate, but the overall productivity and efficiency of the system

1. Healthy Broodstock and PLs
2. Biosecurity: protect shrimp health and to increase and protect shrimp production through the prevention and management of biological risk factors
Before Belize: I forgot or I never knew the appearance of a healthy Shrimp

Shrimp are not Dead: Survival =<65%, the normal expectation
And then: Healthy Shrimp

Healthy Post Larvae

Healthy Shrimp

Hatchery Survival >60%

Survival >85%
History of Farming:
Challenge followed by Technology advances

- Feed/Hatchery
- Viruses (YHV, TSV, WSSV)
- Domestication
- Biosecurity
- Bacterial Micorsporidea
- Toxicosis

Years: 85-98
- Monodon
- Vannamei
Shrimp Culture Economic Failure drove the move away from wild to domesticated shrimp.
The World Changes:
Domesticated, Captive Stocks replace Wild

Wild

Domesticated

Vannamei: Domestication 2000

Monodon: Wild
And the most successful Domesticated Programs were SPF
SPF Domestication requires a Nucleus Breeding Concept

1. Founders, Pathogen Free
2. Nucleus Breeding Concept
3. Constant Surveillance
# Nucleus Breeding

Must have constant Surveillance

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**MSBC-SPF Disease Monitor (PCR)**

Update 31 Dec 2018

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<th>Year</th>
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<td>Total</td>
<td>6,532</td>
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With SPF stocks: Genetic Selection can be very precise

**Growth Potential**

- **Vannamei**
  - AGE vs GENERATION graph showing growth potential.

- **Monodon**
  - Growth chart with AGE vs GENERATION.

**Tolerance /Robustness**

- **APHNS**
  - Bar chart showing tolerance.

- **WSSV**
  - Bar chart showing WSSV levels with years 2015 and 2019.
Selective Breeding: Changes the Economics

Vannamei 2004
Monodon 2009
Selective Breeding: Changes the Economics

ABW (g)

Day of Culture

Vannamie 2004
vannamie 2018
Monodon 2009
Selective Breeding: Changes the Economics

- **Vannamei 2004**
- **Vannamei 2018**
- **Monodon 2009**
- **Monodon 2018**
What Are We Talking About?

- **SPF** stocks are animals coming from a population that has tested negative for **SPECIFIC PATHOGENS** for at least 2 years (a suitable surveillance program in place), that is raised in highly biosecure facilities (water treatment and enclosed environment) following biosecure management measures and have been fed with biosecure feeds.

- **Specific Pathogen Resistant (SPF)** is an animal/population resistant to infection by a specific pathogen.

- **Specific Pathogen Tolerant (SPT)** is an animal/population susceptible to infection by a specific pathogen but tolerant to the development of the disease. The degree of expression of disease will depend on the degree of tolerance (quantitative) and the environmental/stress factor influencing it.
Tolerance is not Resistance

Comparison of WSSV Tolerance and Resistance

Inoculate WSSV virus
Temperature 27°C

Drop temperature To 24°C

% Survival

DOC

low tolerance  high tolerance  resistance
Does development of Fast Growth genetics decrease shrimp survival?

Fast growth has no correlation with survival rates; Positive or Negative

Mortality Rates as a function of DOC is Equivalent Between fast and low growers
Wild / Domesticated Monodon in the world
<350,000 Tons, <10% world shrimp

Thailand: domesticated
Vietnam: domesticated + wild
Bangladesh: Wild
India: Wild
Malaysia: domesticated + wild
Madagascar: domesticated
China: domesticated
Indonesia: Wild
Australia: Wild
Very few monodon domesticated programs that have commercialized

Because: it is Difficult and therefore not EASY

Issues with creating SPF monodon populations

These Issues were not encountered with *Vannamei*
PCR checking is no substitute for SPF Stocks

- Monodon SPF (2004) by

Response to introduction of Healthy SPF Domesticated Stocks

Not a Healthy Population; PCR cannot substitute for Nucleus Breeding
Question for Australia:
How are non bio-secured waters, more secure than a bio-secure, designated compartments

- Australia surrounded by Seas with ocean currents and known shrimp virus
- CPF nucleus breeding surveilled as virus free zone
The World Changes!
Everyone talks Biosecurity?
“But what is it”

Biosecurity must be Practical

Probability of Disease = Pathogen level x Shrimp Tolerance

Tolerance is the inherent ability of a shrimp to withstand stress and maintain a strong innate immune system
All biosecurity protocols should start with SPF seed

Specific pathogen free (SPF)  With appropriate robustness/tolerance

No Pathogen Introduction  Increase tolerance to stress

Harvest size increases
One Farm Biosecurity Concept does not fit all

Exclusion: virus/microsporidea

Limitation: Bacteria/toxin
Exclusion Model:
Virus, Intracellular Bacteria and Microsporidea

Bird Net, Crab Fence, Sealed

Effective Carrier Removal

Ultra Filtration for Microsporidea Spores

Fine Insect Netting for Yellow Head Virus
Limitation Model: Reducing the level of the pathogen
Bacteria and Toxic Bacteria (APHNS)

Probability of Disease = Pathogen level x Shrimp stress (innate immune) level
Reducing Probability of Introduction of Pathogen
Closing the Farms: Recirculation vs Open

Ponds have no gates, reduce to 0 water change

Typical recirculating Farm

Small Farmer; Recirculating Farm
In our pursuit of to reduce risk; we forget
A diverse microbial ecology is more healthy than a disturbed ecology

Disinfection- removes virus, but also
Enhances biofil and vibrio development

Mature Water: Inoculate the disinfected water

Biosecurity is about maintaining an “environment for healthy shrimp”

Viruses maybe excluded; but a farmer will never exclude all pathogens; i.e. vibrio
Biosecurity should include maintaining a non stress environment
Shrimp Health: Stable Ponds = Lower Stress = Higher Innate Immunity Levels = Higher survival

Minimize STRESSES:
- Low oxygen
- Nitrites
- pH fluctuation
- Temperature fluctuation
- Sulfides
- High CO2
- Toxicity
- Nutrient deficiency

Presence of Pathogens do not mean Disease!!
And Finally:
Never Stop Questioning;
Never Stop Learning

Geonomics
Epigenetics
Metageonomics
Shrimp Immune system
Microbial Ecology
Predictive Health Diagnostic
Microbiom
Quorum sensing
Are we Enlightened!!!

Seeking Enlightenment!!!