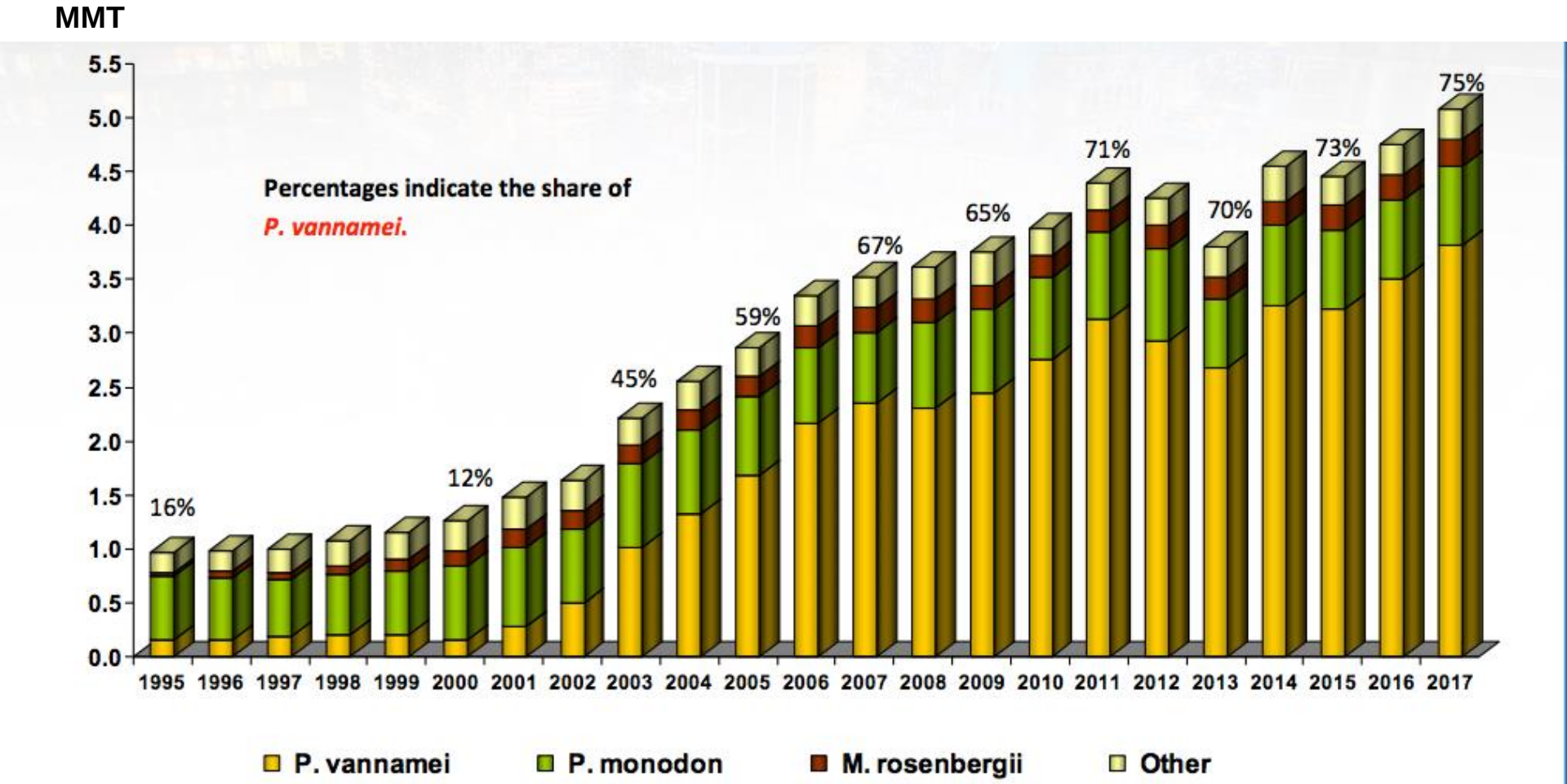
Warm Water Shrimp in a global perspective

George Chamberlain

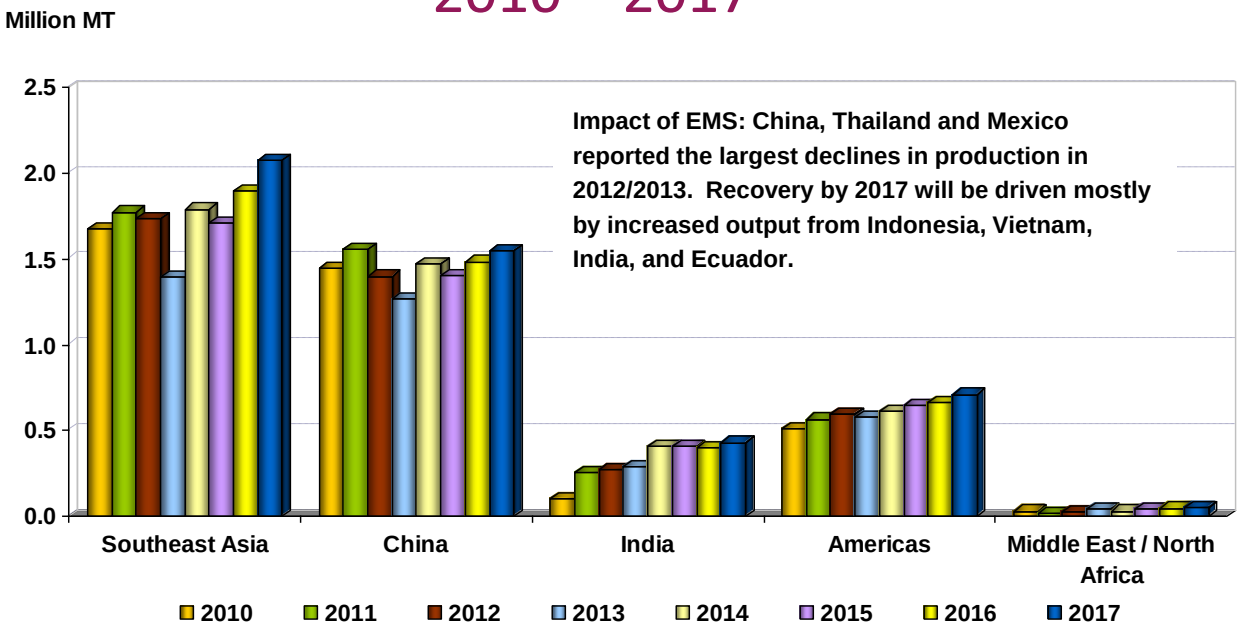
Shrimp

Shrimp is the most valuable sector of aquaculture ($20 billion), but growth has slowed due to disease and sustainability issues.



Sources: FAO (2015) for 1995-2011; FAO (2015) and GOAL (2014) for 2012-2013; GOAL (2015) for 2014-2017.

Shrimp Aquaculture by Major Producing Regions: 2010 – 2017

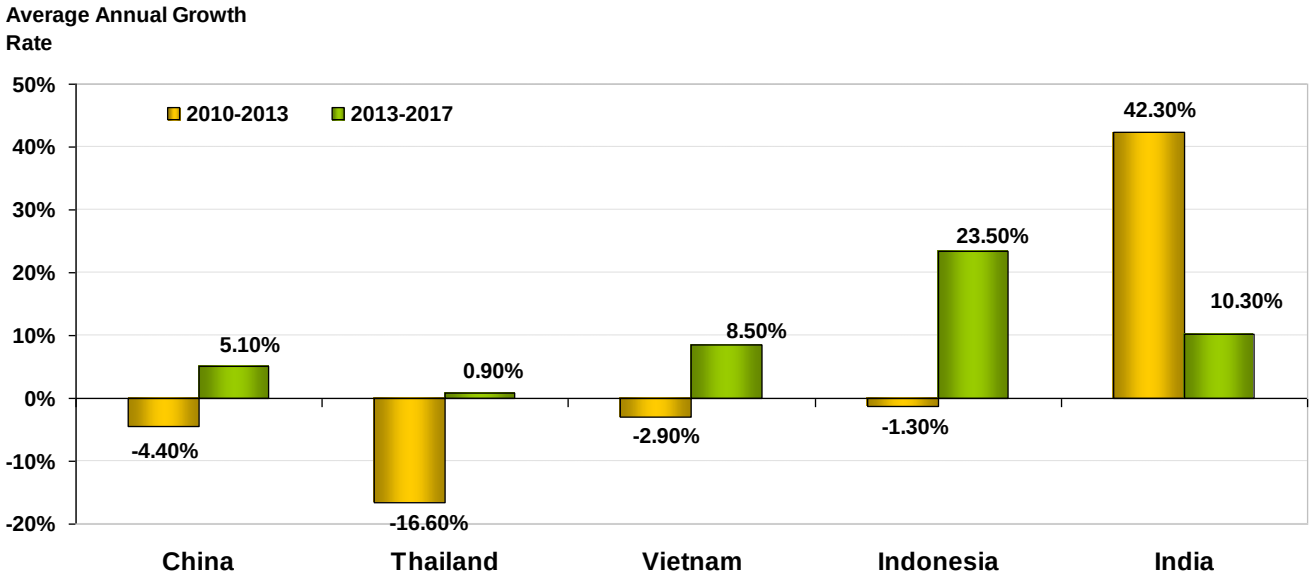


Sources: FAO (2015) for 1995-2011; FAO (2015) and GOAL (2014) for 2012-2013; GOAL (2015) for 2014-2017.

Southeast Asia includes Thailand, Vietnam, Indonesia, Bangladesh, Malaysia, Philippines, Myanmar and Taiwan.

***M. rosenbergii* is not included.**

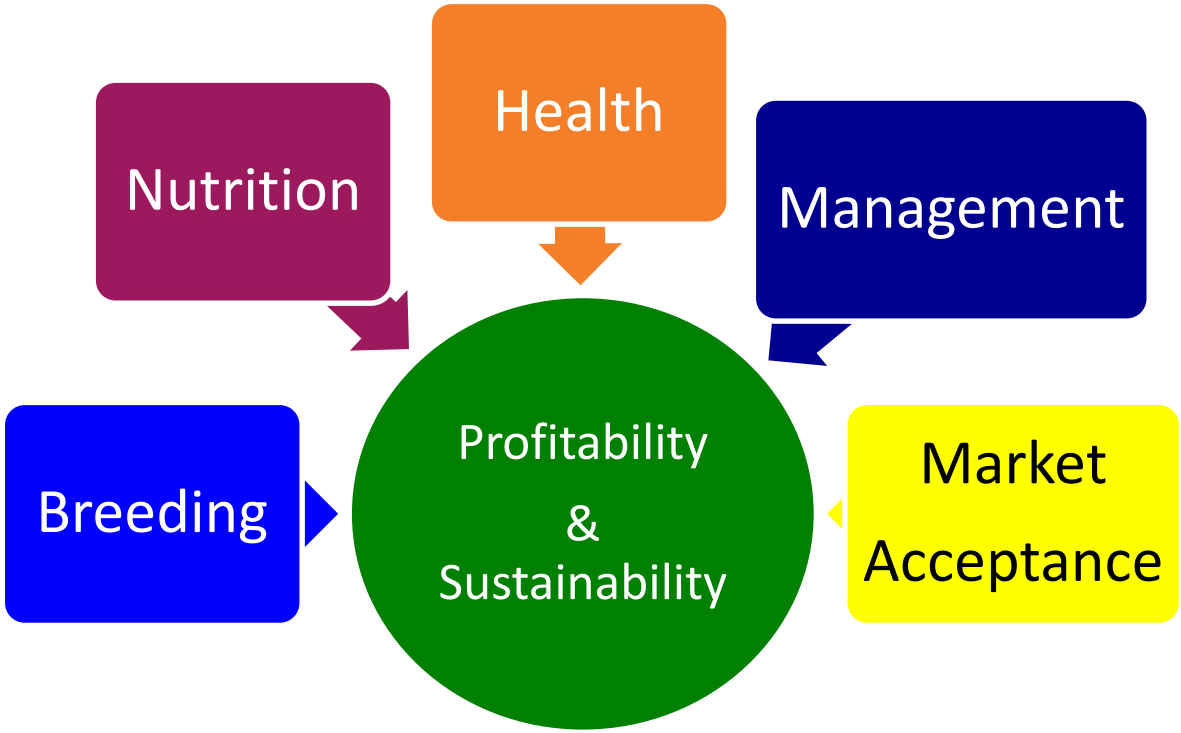
Shrimp Aquaculture in Asia:
2010-2013 vs. 2013-2017



Sources: FAO (2015) for 1995-2011; FAO (2015) and GOAL (2014) for 2012-2013; GOAL (2015) for 2014-2017.

***M. rosenbergii* is not included.**

The Way Forward is Multidisciplinary



Opportunity to transform the sector by breaking the bottleneck of disease

Essential Disciplines

1. **Health**
2. Breeding
3. Nutrition
4. Management
5. Market Acceptance

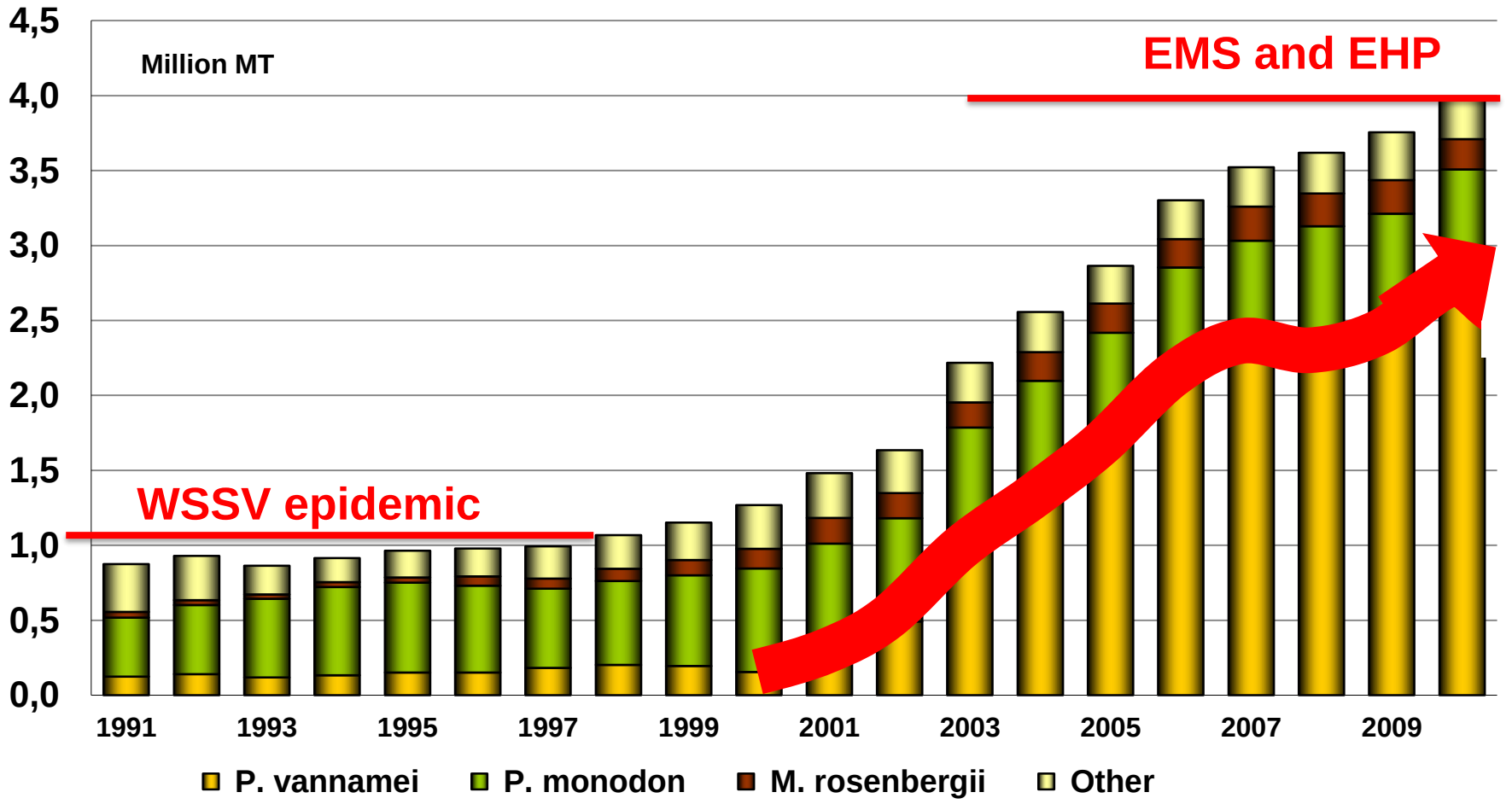
Shrimp Disease Outbreaks

Year	Countries	Disease
1982	Ecuador	BP
1988	Taiwan	YHV
1992	China, pandemic	WSSV
1994	Ecuador, Mexico	TSV
2002	Thailand, Indonesia	MSGV
2004	Brazil, Indonesia	IMNV
2006	Belize, Mexico,	PvNv
2010	China, Vietnam, Malaysia, Thailand, Mexico	EMS
2012	China, Vietnam, Malaysia, Thailand, India, Indonesia	EHP

Impact of SPF *L. vannamei*

- Specifc Pathogen Free stocks developed by Oceanic Institute in Hawaii and bred for resistance to TSV
- Farms could avoid WSSV by stocking clean PLs in a clean pond.
- Rapidly replaced infected *P. monodon*.
- Led to development of private breeding companies (e.g., CP, SIS, Kona Bay).

WSSV epidemic of the 1990's, introduction of SPF vannamei, and quadrupling of production

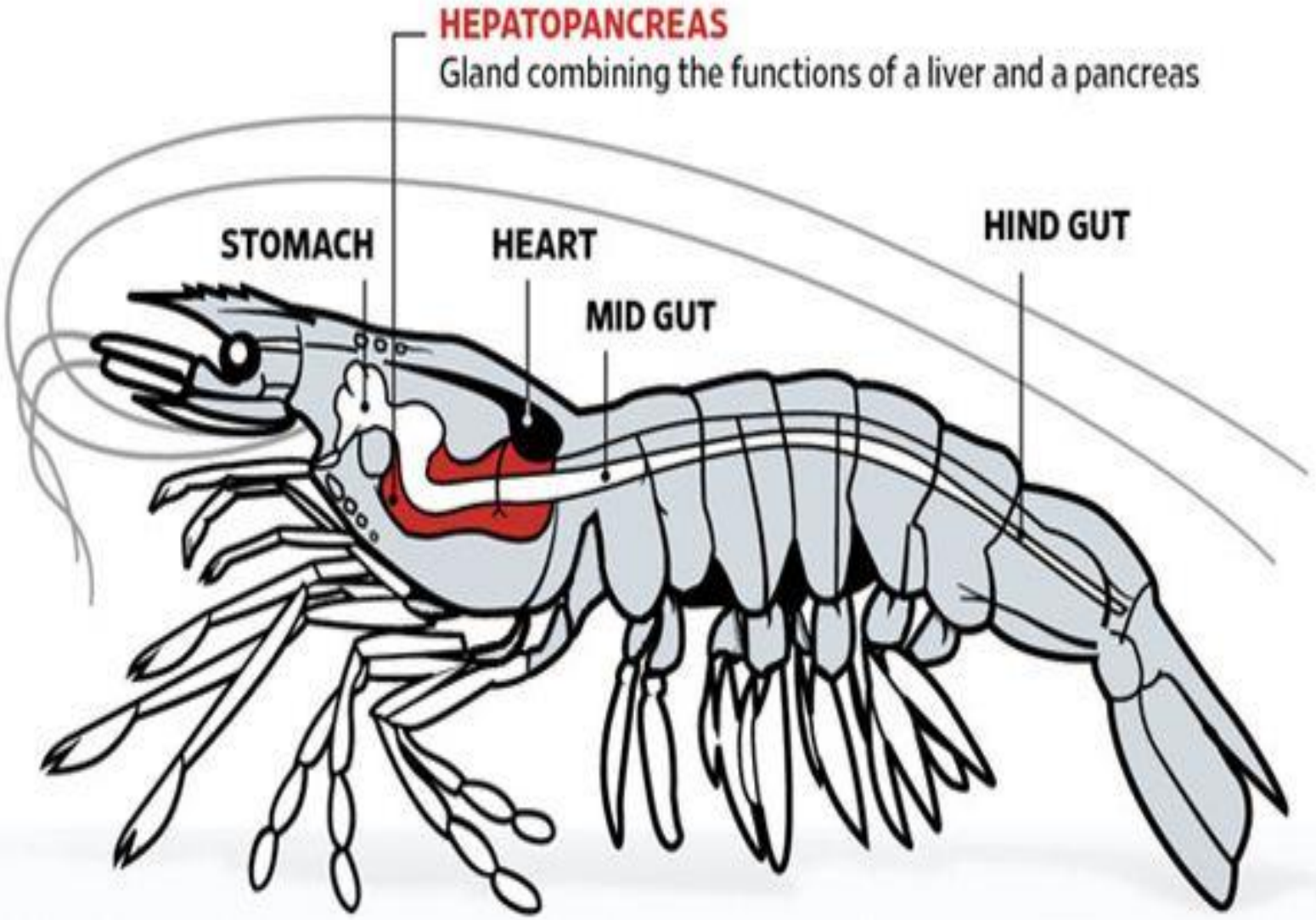


Sources: FAO (2013) for 1991-2011; GOAL (2013) for 2012-2015.

Early Mortality Syndrome

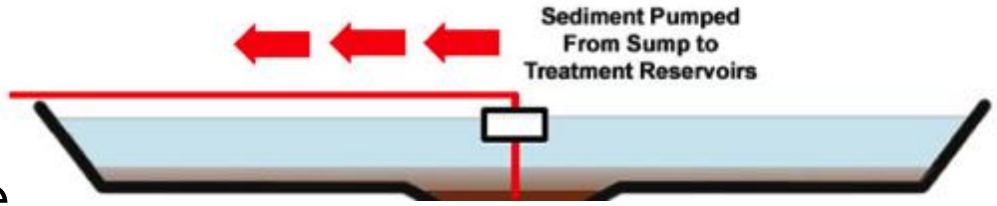
A bacterial disease caused by a strain of *Vibrio parahaemolyticus.* It does not affect humans.

EMS produces a toxin that damages the hepatopancreas

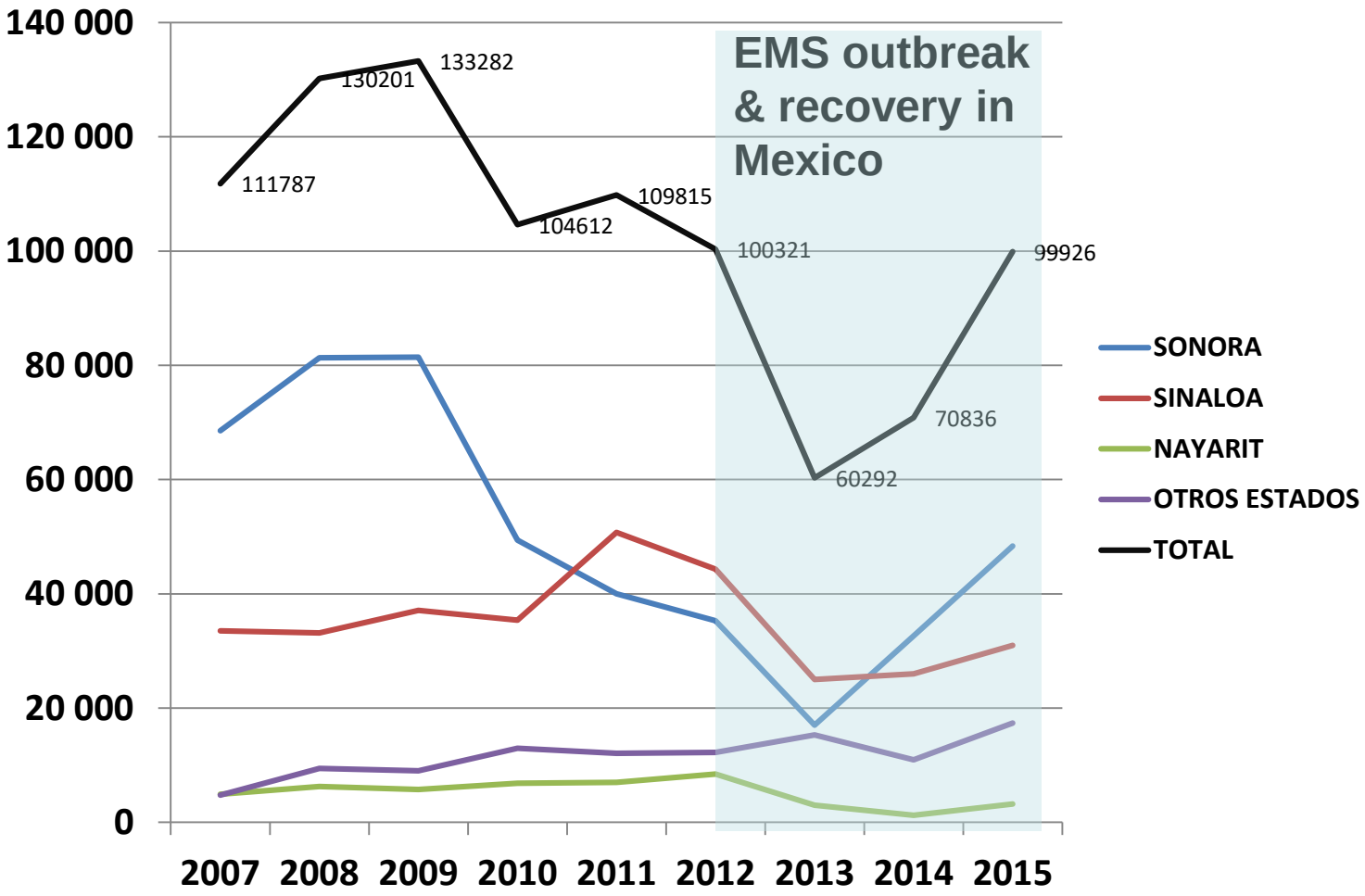


EMS Management: "Shrimp Toilet"

- Avoid Toxicity
  - *Vibrio parahaemolyticus* does not produce toxin at a density below 10^4 colony-forming units per milliliter.
- Minimize Organic Load
  - Avoiding overfeeding
  - Digest excess organic matter with probiotics
  - Remove organic sludge and uneaten feed at the bottoms of ponds



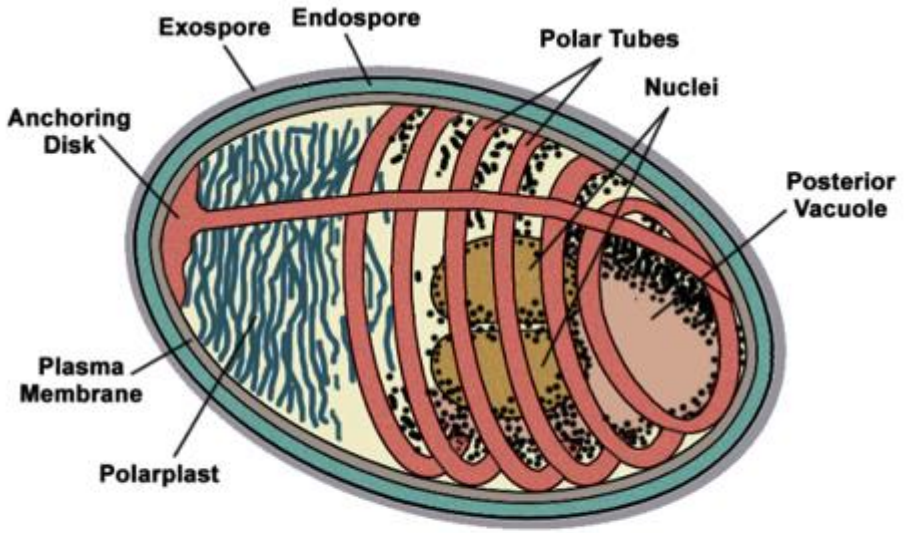
EMS Management:
3. Resistant Broodstock



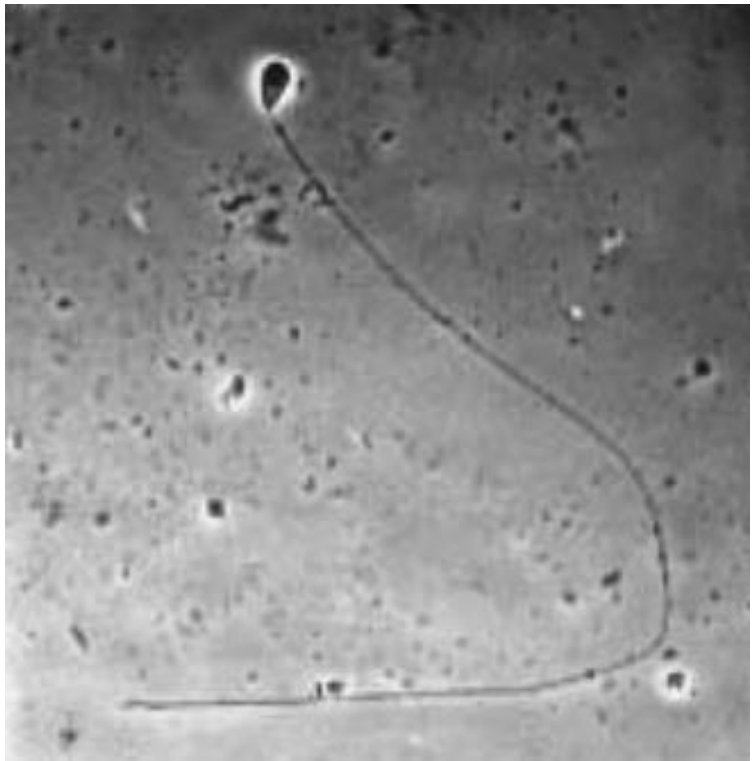
Emergence of EHP

EHP: (*Enterocytozoon hepatopenaei)*

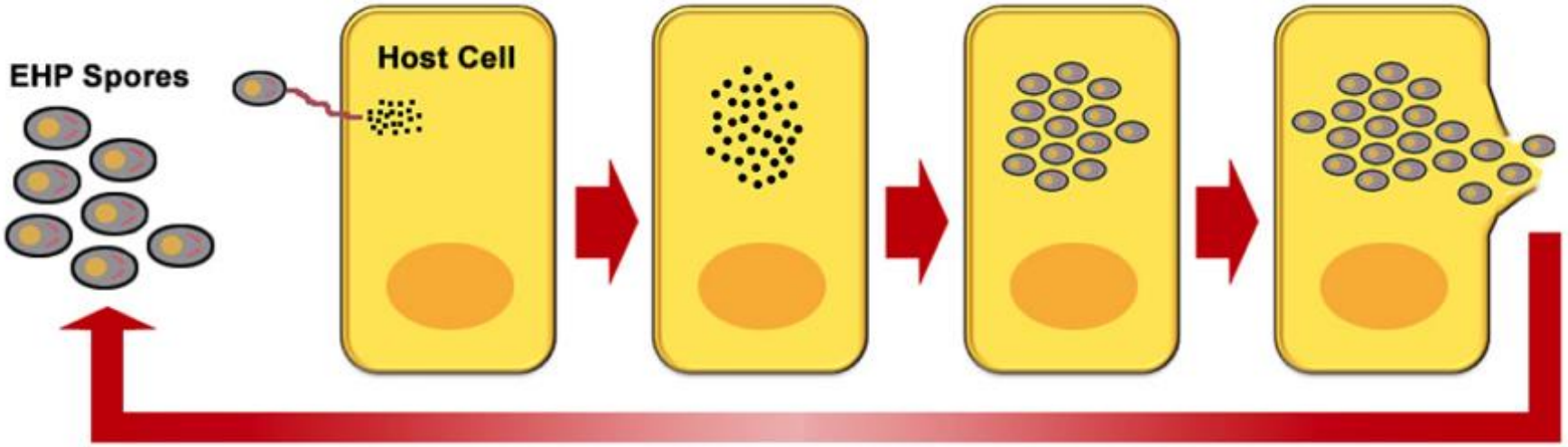
- Small (1 micron) intracellular spore-forming parasite.
- Spore has thick wall of protein and chitin.
- Coiled tubule everts like a harpoon which injects hepatopancreas cells.
- Disrupts digestion, causing slow growth and wide size variation
- Widespread throughout China, Vietnam, Thailand, Malaysia, Indonesia, and India



The spores of *E. hepatopenaei* have thick outer walls that allow the spores to survive harsh conditions.



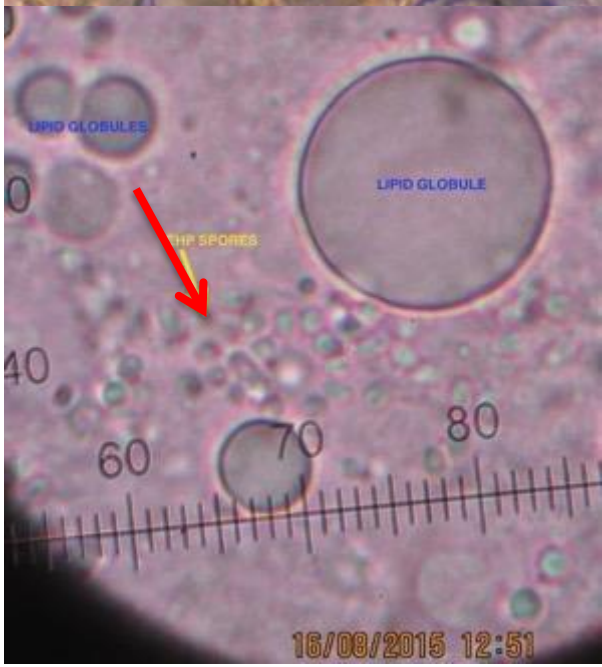
The EHP Pathogen: Spore infection and progagation



- Genetic material is injected into cell.
- Spores replicate within tubule cells of the hepatopancreas.

EHP Transmission

- Vertically
  - Eggs and nauplii contaminated by spawner feces.
  - Live polychaete worms are a major concern
- Horizontally
  - Cannibalism, fecal/oral
- Survival in Environment
  - Spores resistant to adverse environments – including chlorine



Essential Disciplines

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2. **Breeding**
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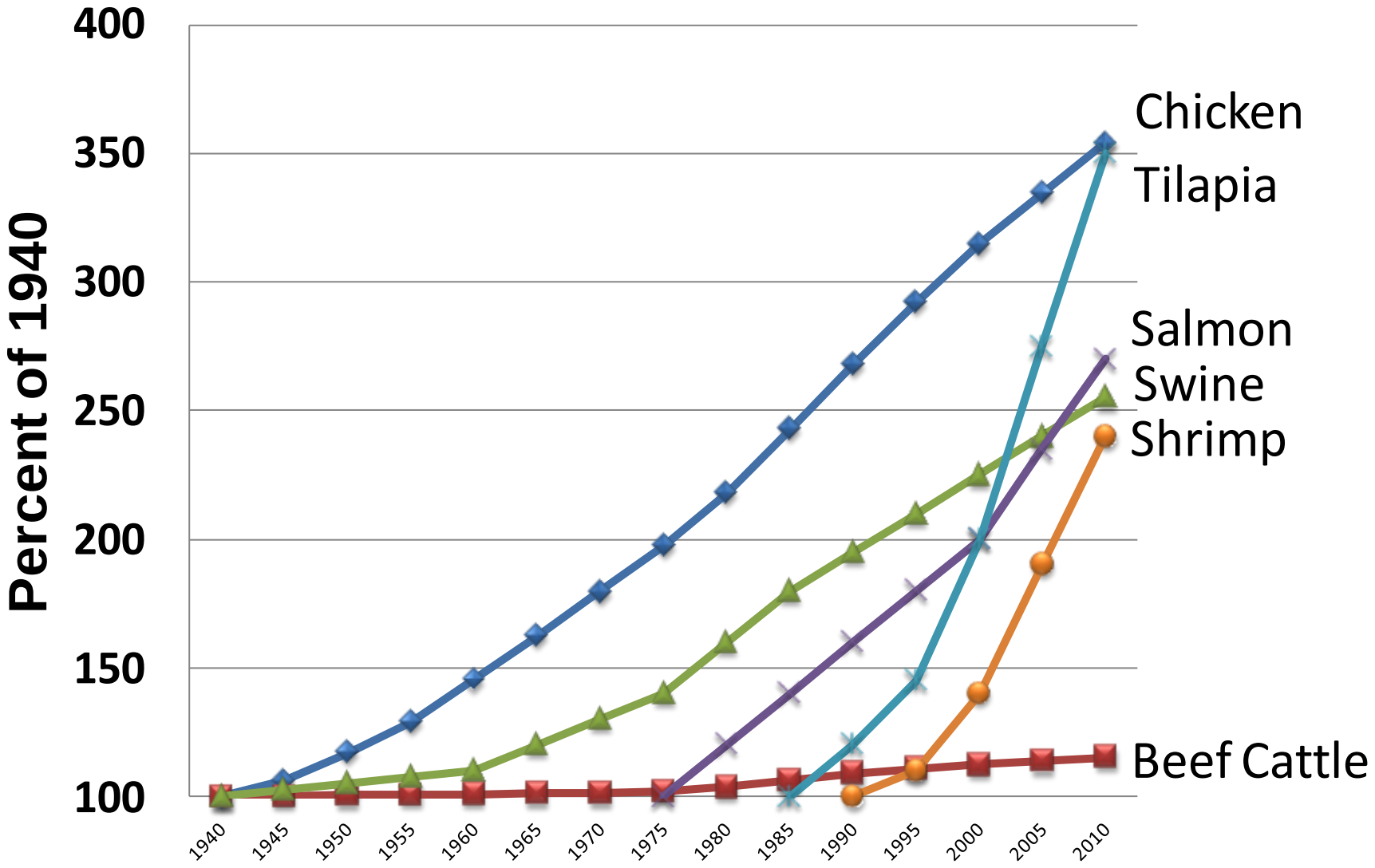
Relative Genetic Gain in Growth Rate



Selection Traits

- Growth
- Disease resistance
  - TSV
  - WSSV
  - EMS
  - IMNV
- Reproduction
- Dietary soy tolerance

KONA BAY
MARINE RESOURCES

Essential Disciplines

1. Health
2. Breeding
3. **Nutrition**
4. Management
5. Market Acceptance

The Challenge: Sparing the Use of Fishmeal in Shrimp Feeds

- Fishmeal supply is flat or declining, while aquafeed demand is surging.
- Aquaculture is consuming a greater share of the global fishmeal supply. ("Fishmeal Trap")
- Alternative proteins lack key essential nutrients and may contain anti-nutritional compounds.

Fishmeal Issues

- **Environmental Concerns**
  - Many of the small feed fisheries are poorly managed
- **Social Concerns**
  - Forced labor on fishing vessels
- **Cost**
  - Fishmeal prices have tripled in the last decade

AP Investigation: Slaves may have caught the fish you bought

March 24, 2015

INCLUDES VIDEO

The Burmese slaves sat on the floor and stared through the rusty bars of

More than 2,000 enslaved fishermen rescued in 6 months

Sept. 17, 2015

More than 2,000 fishermen have been rescued this year from brutal conditions at sea, liberated as a result of an Associated Press

Over 300 slaves rescued from Indonesia island after AP investigation into forced labor

April 4, 2015

At first the men filtered in by twos and threes, hearing whispers of a

Nutrition Strategy

- Shift to soy-based feeds with encapsulated amino acids, synthetic attractants, algal fatty acids, etc.
- Improving feed delivery systems
- Developing dry feeds for maturation and artemia replacement

Essential Disciplines

1. Health
2. Breeding
3. Nutrition
4. **Management**
5. Market Acceptance

Management of Overseas Farms

Blue Archipelago, Malaysia

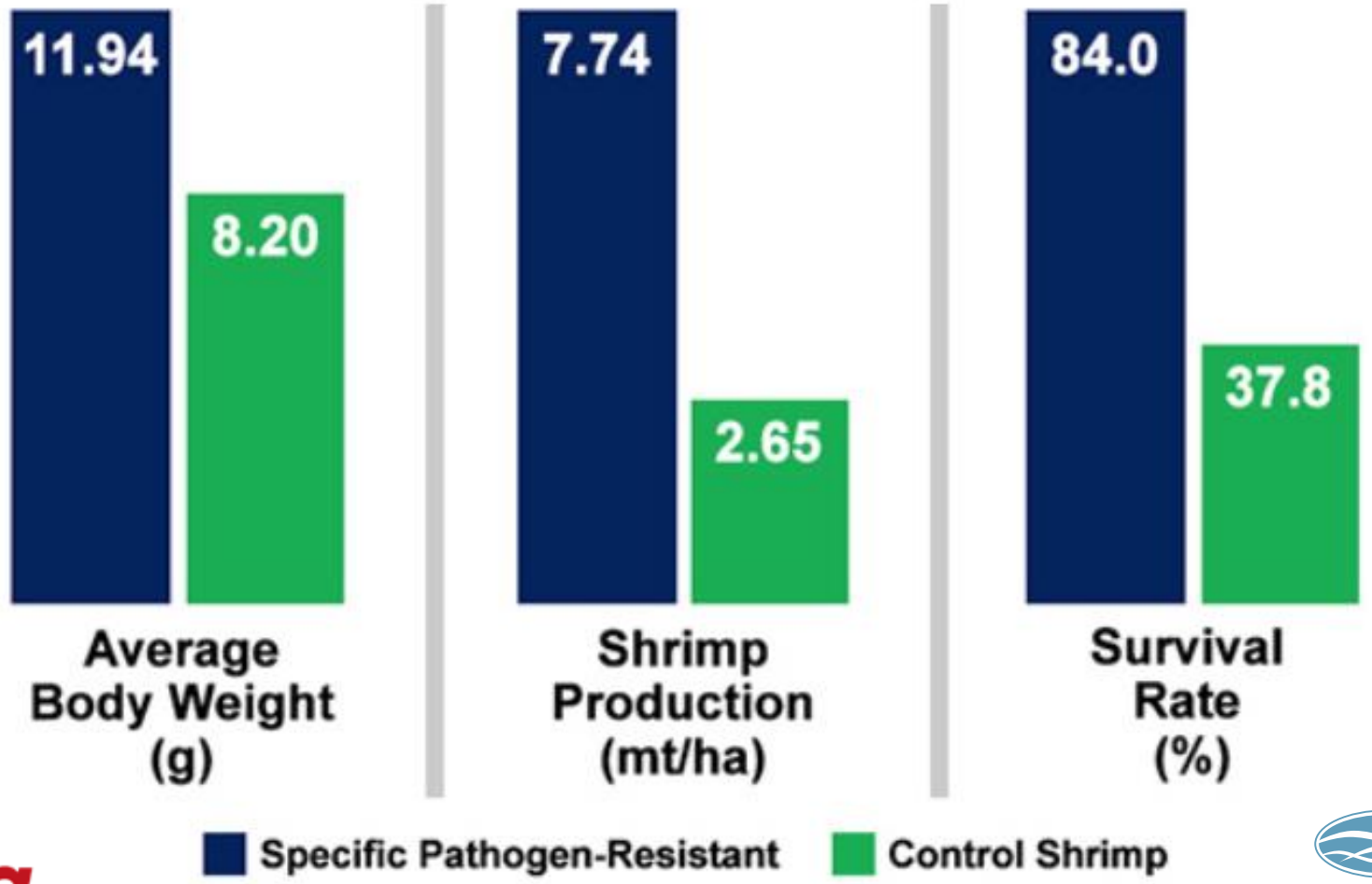
iKERPAN Farm

- Location : Kedah
- 152 ha of ponds

iSHARP Farm

- Location : Terengganu
- 132 ha of ponds

Initial Trial: 12 ponds stocked with EMS/WSSV-Resistant Broodstock



iAqua
IMPROVING AQUACULTURE

KONA BAY
MARINE RESOURCES

Productive, Sustainable Systems

- GAA Innovation Award to Werner Jost, AquaScience, Brazil
  - 21 g in 116 days at 200/m2
  - Yield: 43 MT/ha
  - No discharge. Water reused for 5 production cycles using nitrification and denitrification

Integrated Multitrophic Systems

- Improved disease control
- Increased productivity
- Multitrophic culture of clams and oysters with shrimp
- Improved sustainability by reducing water, energy and feed use

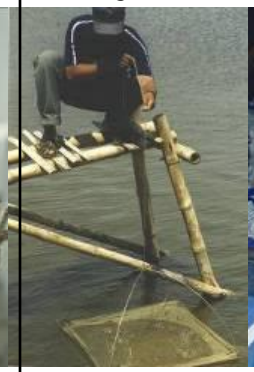
Essential Disciplines

1. Health
2. Breeding
3. Nutrition
4. Management
5. **Market Acceptance**

Market Acceptance

- During the last 20 years, challenges have emerged as aquaculture has grown rapidly around the world
- Can aquaculture avoid the pitfalls facing a young industry?
- Challenges
  - Environmental
  - Social
  - Food Safety
  - Animal Welfare
  - Traceability

BAP standards address entire production chain

	Production Chain			
	Hatchery	Farm	Feed	Processing
				
Environmental	✓	✓	✓	✓
Social	✓	✓	✓	✓
Food Safety	✓	✓	✓	✓
Traceability	✓	✓	✓	✓

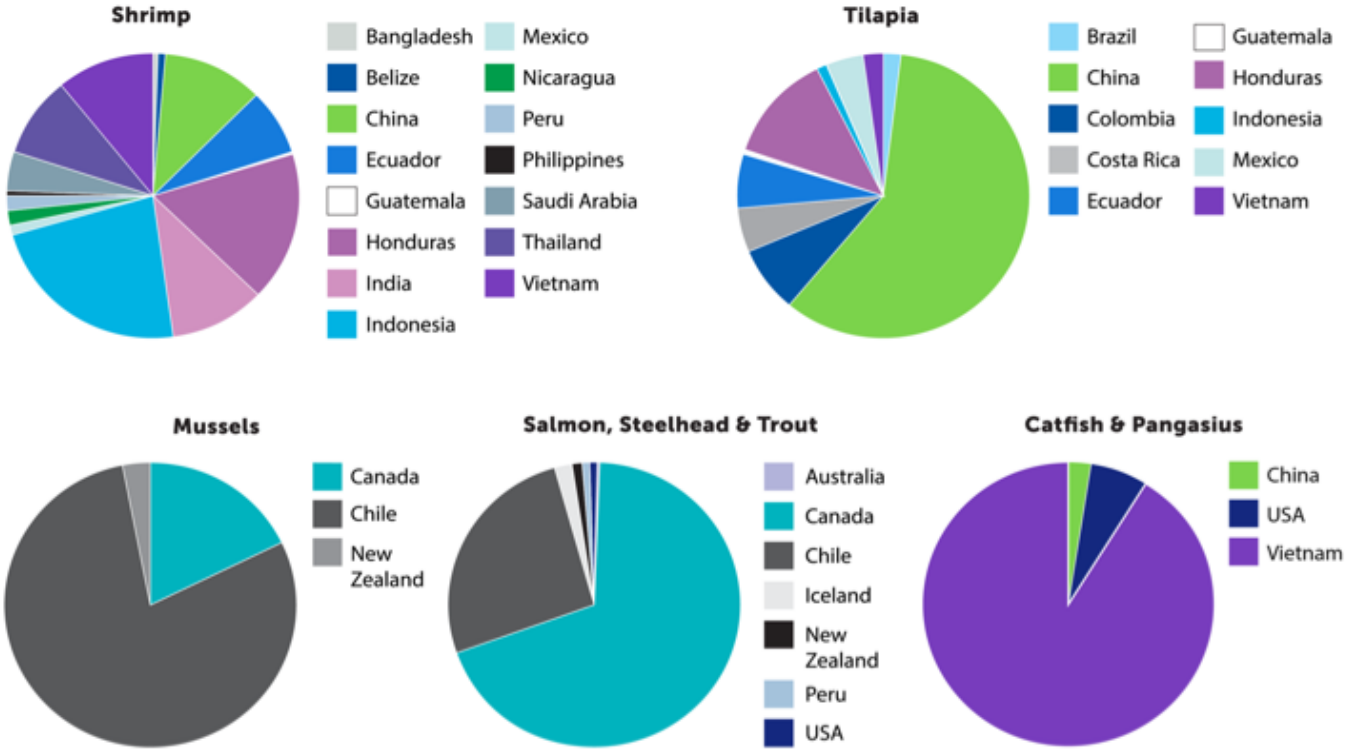
Volume of Seafood from BAP-Certified Processing Plants

Millions of Metric Tons of Product (through October 2016)

Global Aquaculture Alliance

BAP Geographic Diversity

Volume of Seafood from BAP Certified Farms (through November 2016)



Global Aquaculture Alliance

BAP Market Endorsers: Meeting Sustainability Goals

BEST AQUACULTURE PRACTICES CERTIFIED

Global Aquaculture Alliance™

GAA's EU Market Development Team

Marcos Moya
Manager of BAP Supply Development

Melanie Siggs
GAA Director of Strategic Engagements

Iain Shone
GAA Development Director

Mike Berthet
Market Development UK

Conclusions

- Shrimp farming is the most value sector of aquaculture, but the production chain is in distress due to disease
- The solutions are multidisciplinary: health, breeding, nutrition, management, and market acceptance.
- Opportunity to overcome production bottlenecks with disease resistant and soy tolerant broodstock, fishmeal replacement technology, and management systems