Commercial larviculture of Penaeid shrimp

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Thanks to

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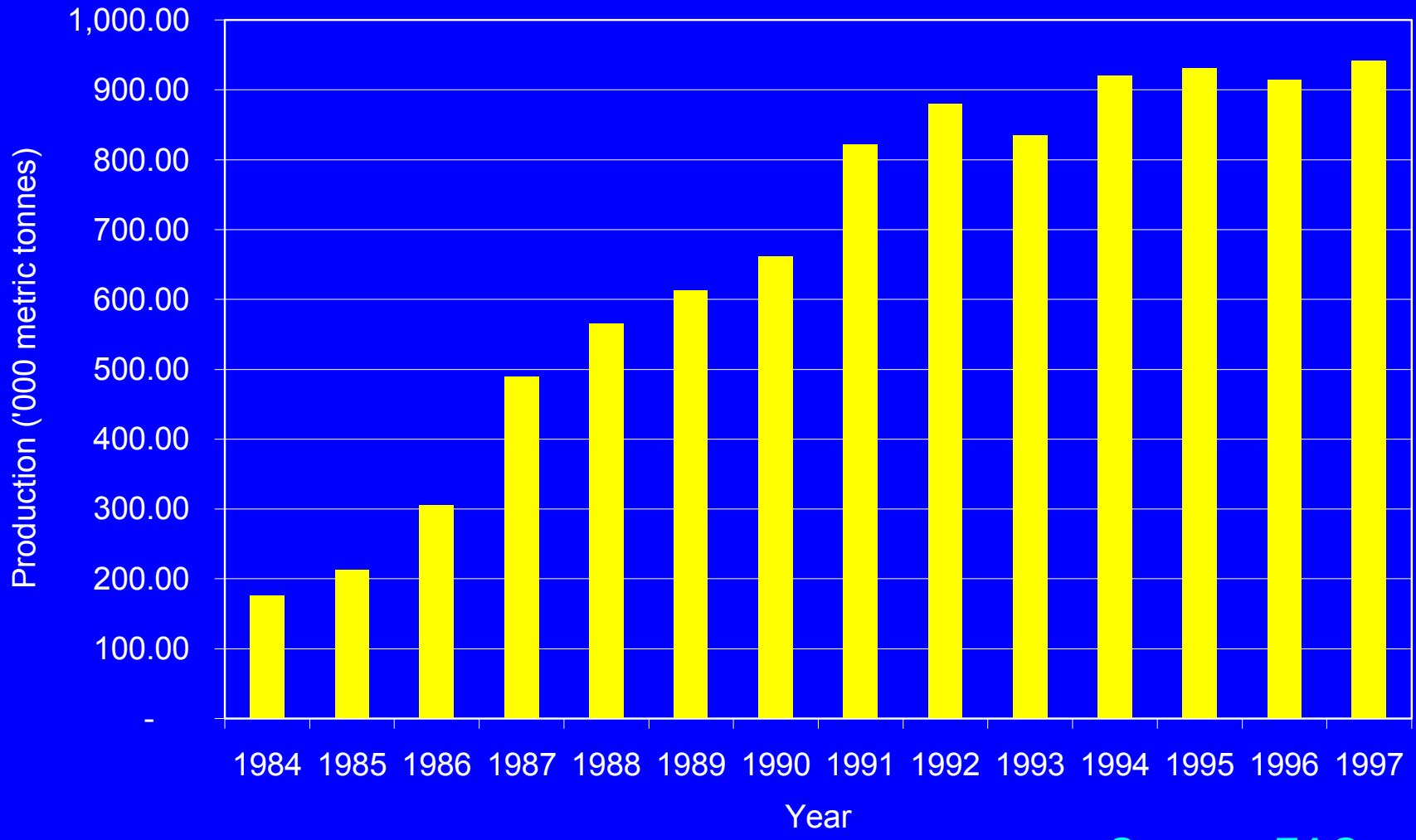
- The many friends and colleagues in the industry from whom I have learned much and have much still to learn
- Last, but not least, my wife Nita and the wives of our friends who have cheerfully suffered through far too many dinner table discussions on shrimp culture

World Farmed Shrimp Production



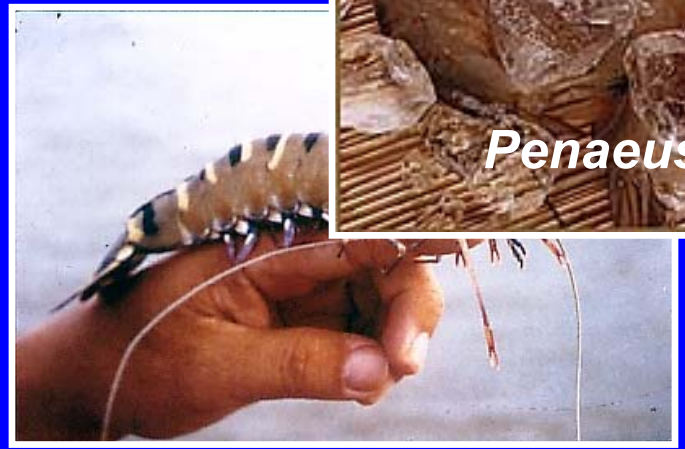
Source: FAO

Major Cultured Species

Penaeus

japonicus

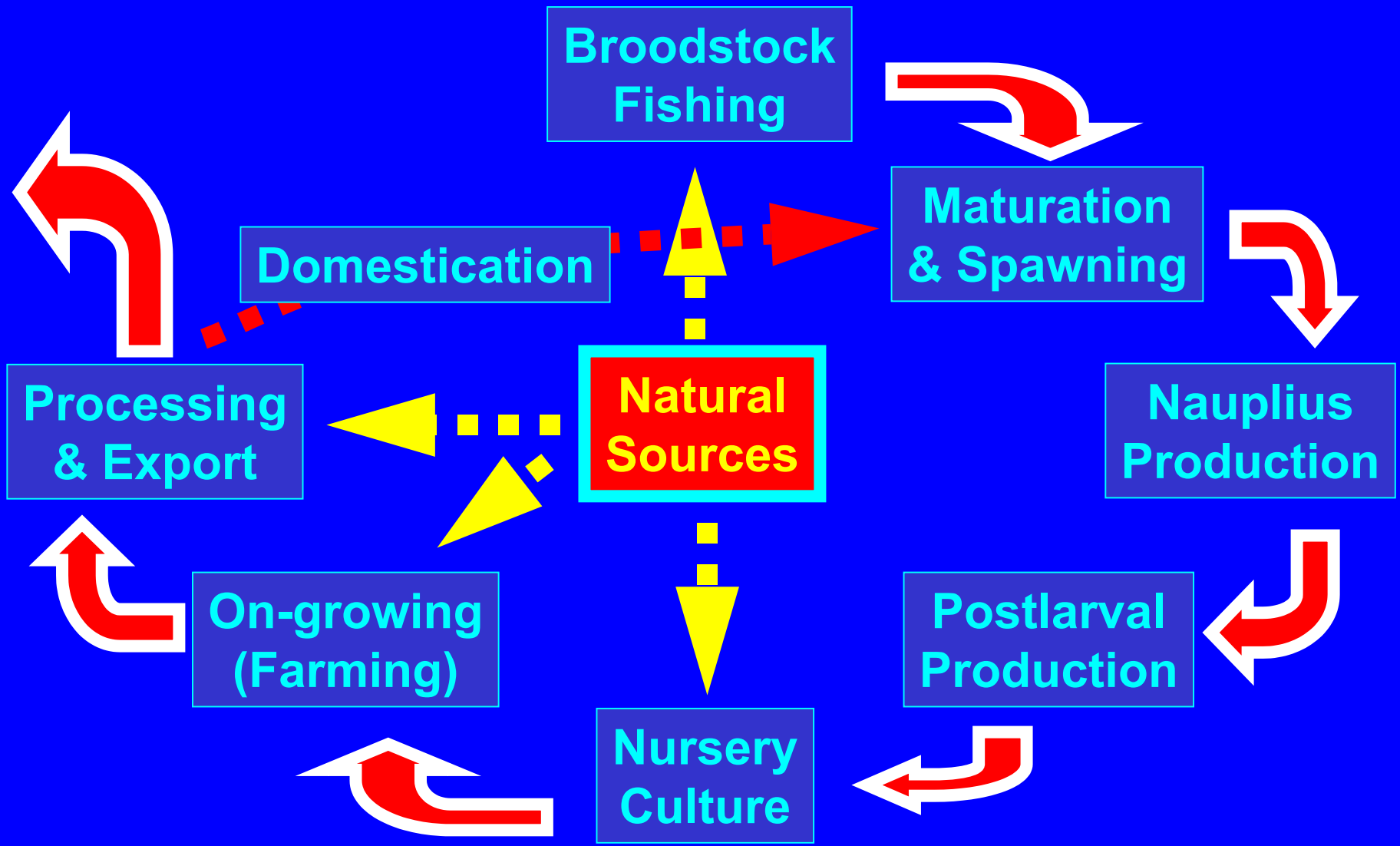
Penaeus chinensis



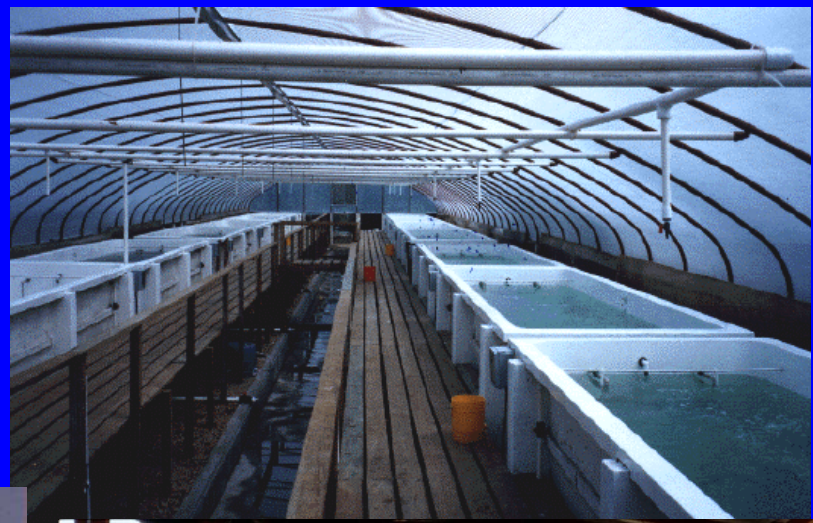
Penaeus monodon

Penaeus stylirostris

Shrimp Production



Postlarvae Sources




ดาวทองฟาร์ม
พันธุ์ลูกกุ้งกุลาดำ

Hatchery Systems

Eastern and Western hatcheries stem from different development sources

Western from “Galveston” style, clear water systems

Eastern from Japanese and Taiwanese style “Community Culture” systems

Asian Hatchery Types

Taiwan-style Indoor

Thailand-style Outdoor

Hatchery Types

The major differences between hatcheries in Asia and the West are:

- Closed vs. open thelycum species
- Age of PL produced
- Survival rates in Asian hatcheries lower
- Asian systems generally less complex
- Asian systems generally smaller size
- Asian industry more diversified

Increasing exposure to western methods is resulting in a convergence of technology

Major Issues in Commercial Culture

Major issues that have been identified by commercial hatchery operators over the past 10 years are:

- Broodstock and Genetics
- Disease and Biosecurity
- Postlarval quality
- Feeds and Nutrition

Broodstock and Genetics

Broodstock and Genetics

Broodstock and genetics developments have been slow but are gaining in importance. Major issues are:

- Availability and Quality
- Health Status
- Nutrition
- Domestication and Improvement
- Specific Pathogen Free (SPF) and Specific Pathogen Resistant (SPR) strains

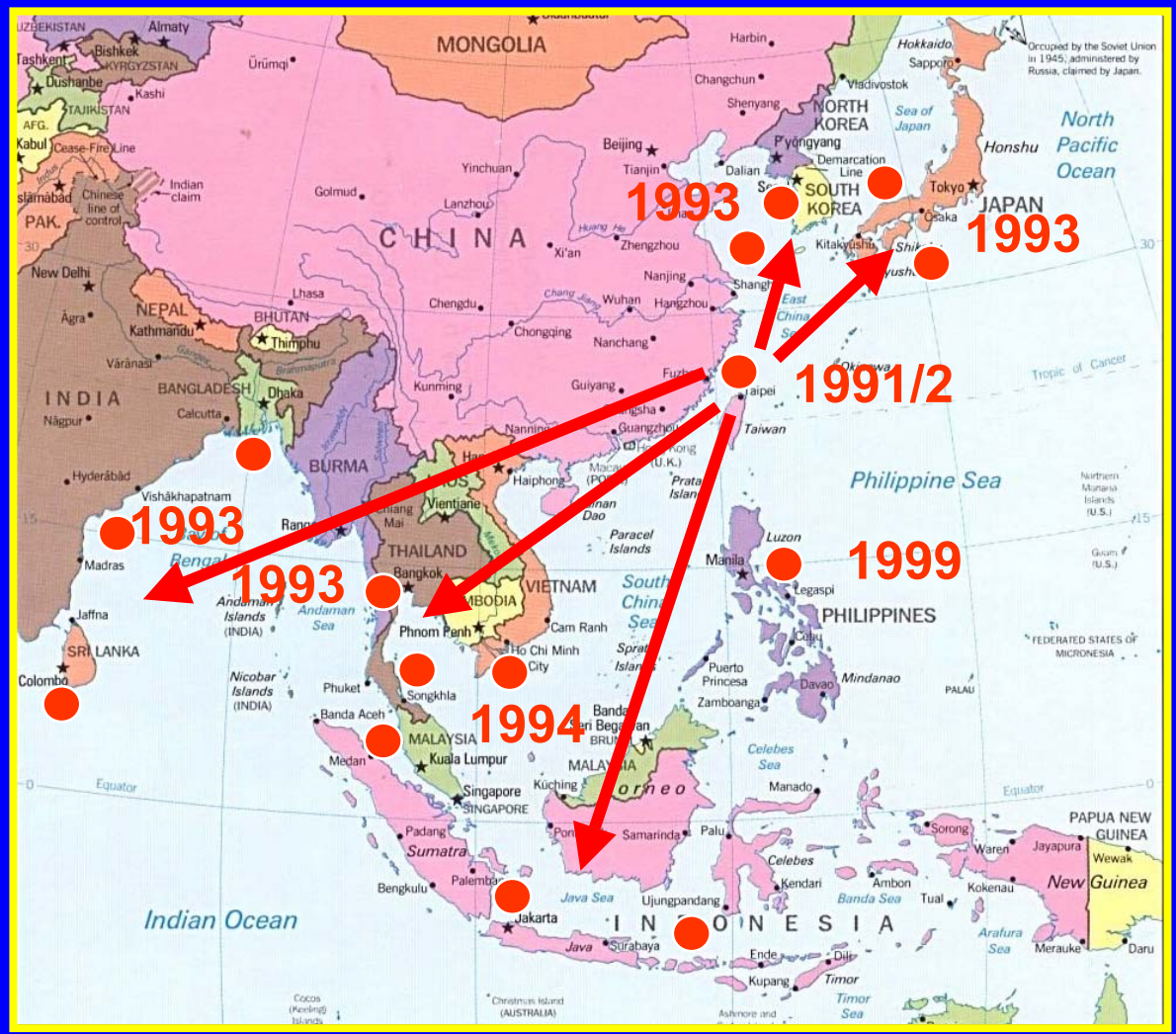
SPF Shrimp

Disease and Biosecurity

- Disease has been the number 1 concern of the shrimp industry since the mid-1990's
- Recently, concerns have increased over the role of transshipment of PL in disease transmission
- Vertical transmission of some virus diseases from broodstock shrimp has also been raised
- Bacterial disease problems continue to plague hatchery systems

Disease

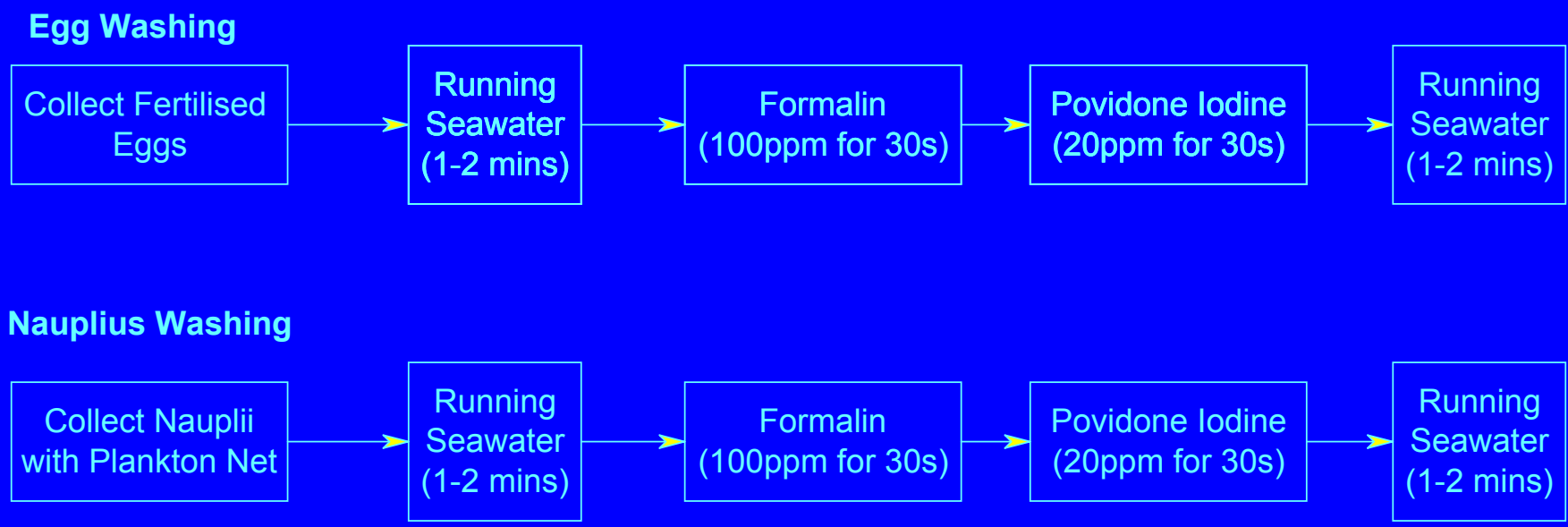
WSSV The Asian Pandemic



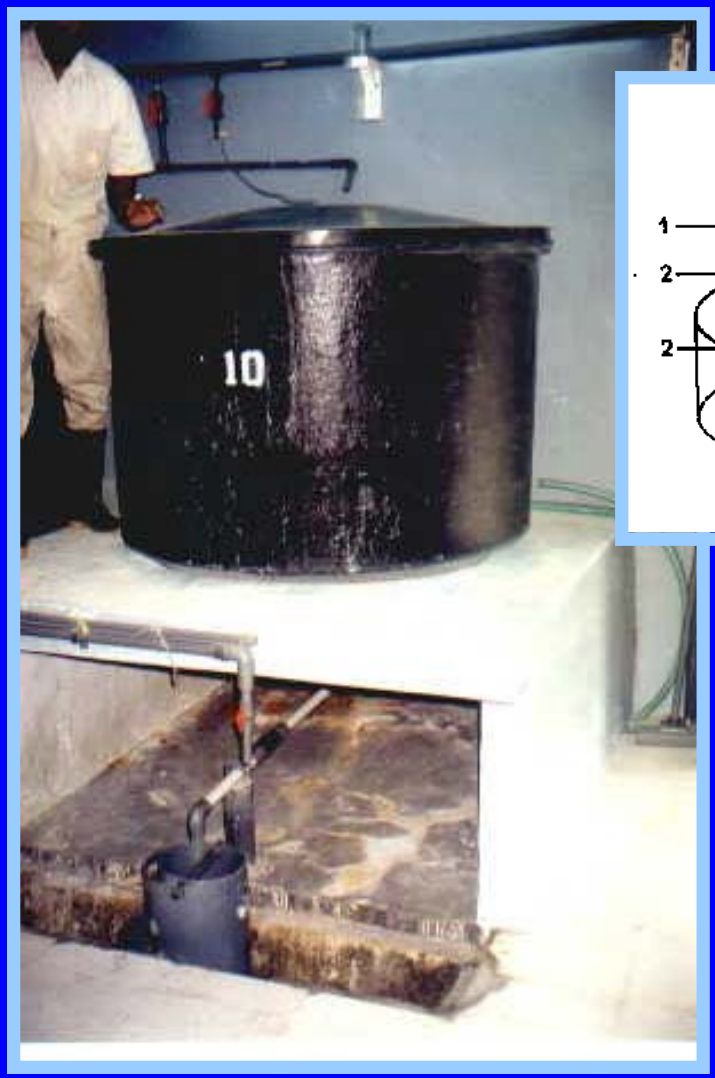
Emergence and spread in the Americas

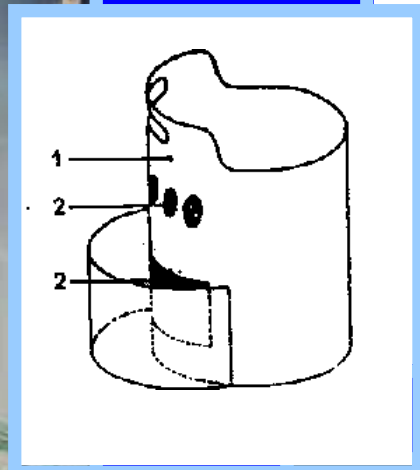
Spawning

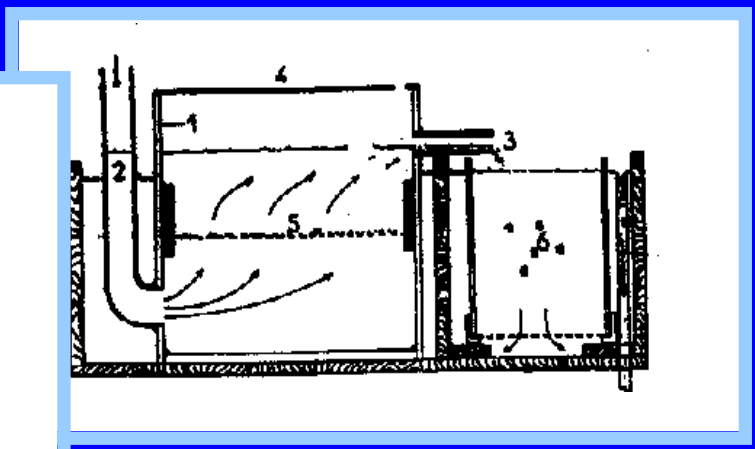
Egg/Nauplius Washing



Nauplius and Egg Washing





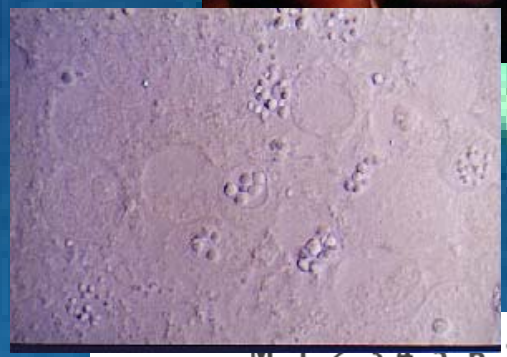


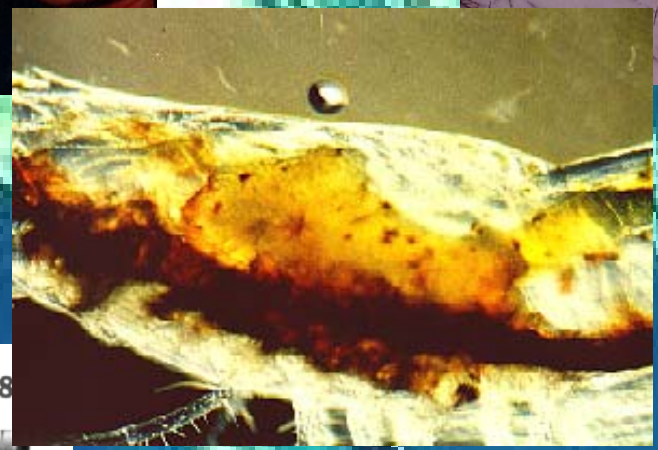
Postlarval Quality

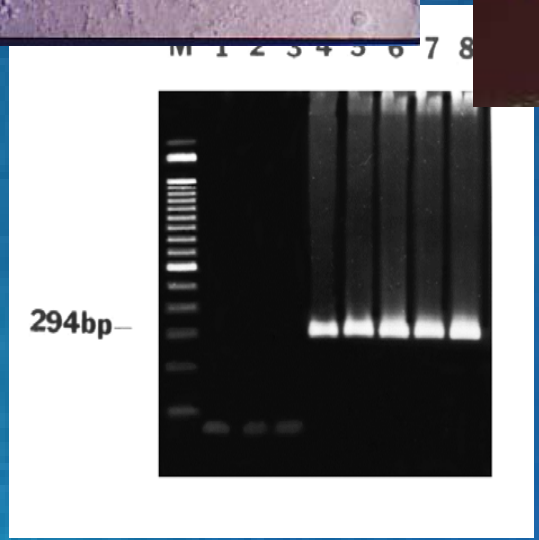
PL quality evaluation is now an accepted procedure in most hatcheries

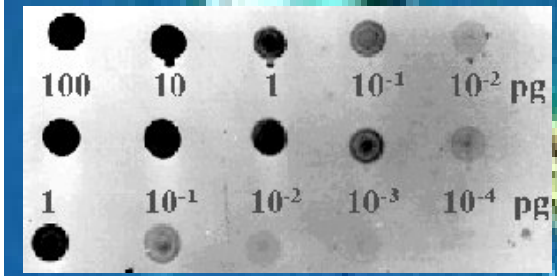
- Stress testing using salinity shock or formalin treatment is most common
- Microscopic evaluation is also increasingly used
- Testing for viruses using molecular diagnostics such as Polymerase Chain Reaction (PCR) is increasingly common

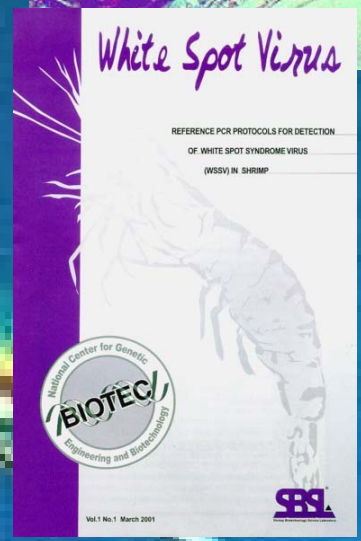
PL Quality Assessment







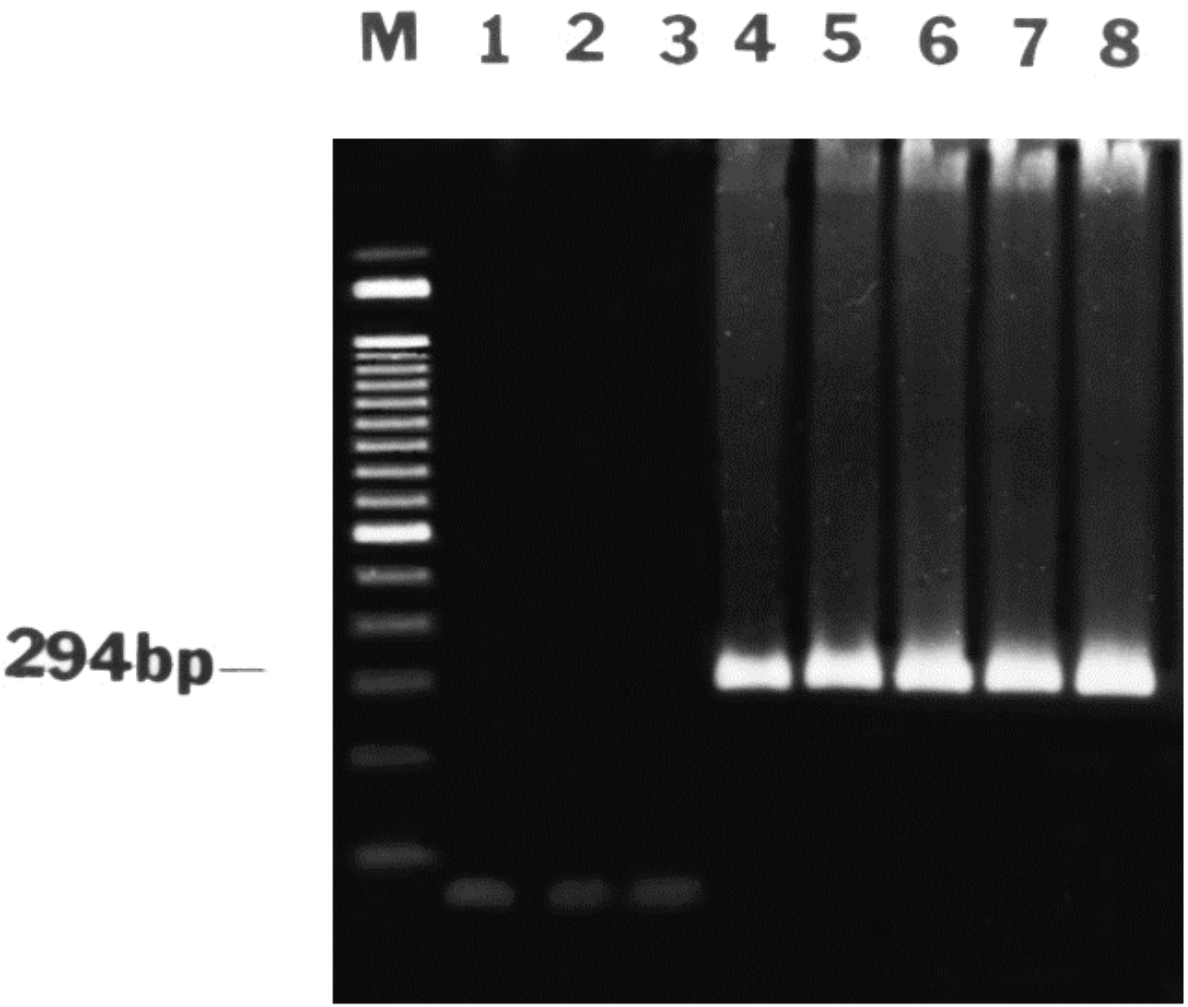




Polymerase Chain Reaction (PCR)

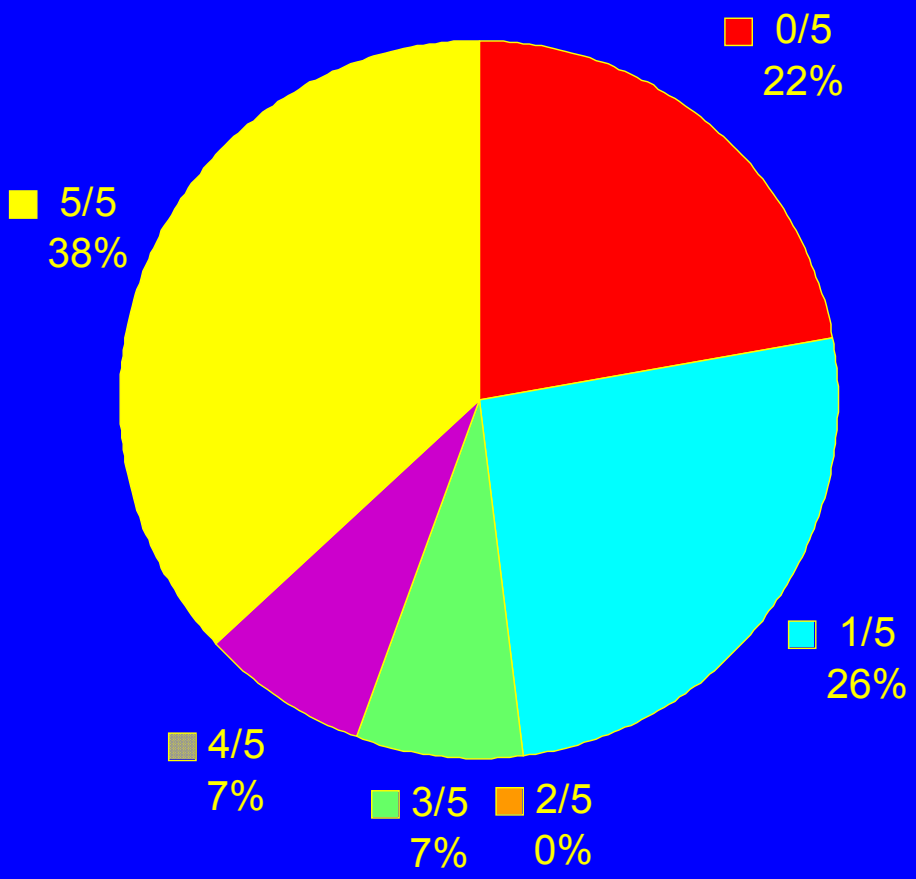
- Basically a method to amplify DNA of the target organism (e.g. WSSV virus)
- A small, complementary, fragment of virus DNA (the primer) is used as a template to amplify the target DNA
- The primer is placed in the PCR vial with reagents and the enzyme *taq* polymerase
- Repeated cycles of heating and cooling cause the DNA to separate and anneal, doubling the quantity of target DNA in the process
- This increases the concentration of DNA enough to be detected by electrophoresis
- If bands corresponding to the primer are found in the gel, the virus is present

PCR for WSSV

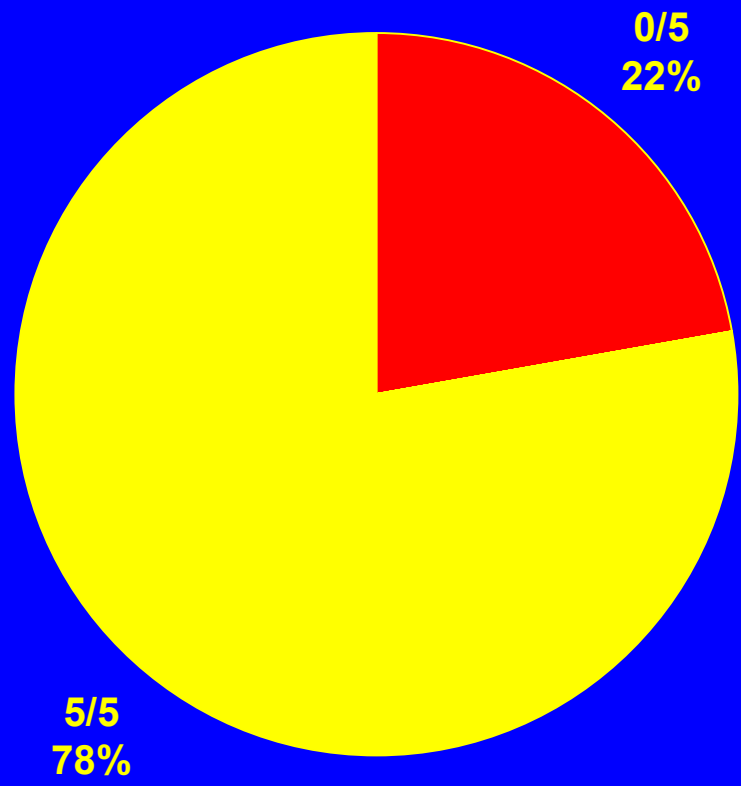


PCR gel of crabs injected with WSSV
M = marker (kb)
1 = 0 hr
2 = 12 hr
3 = 24 hr
4 = 36 hr

Broodstock Screening

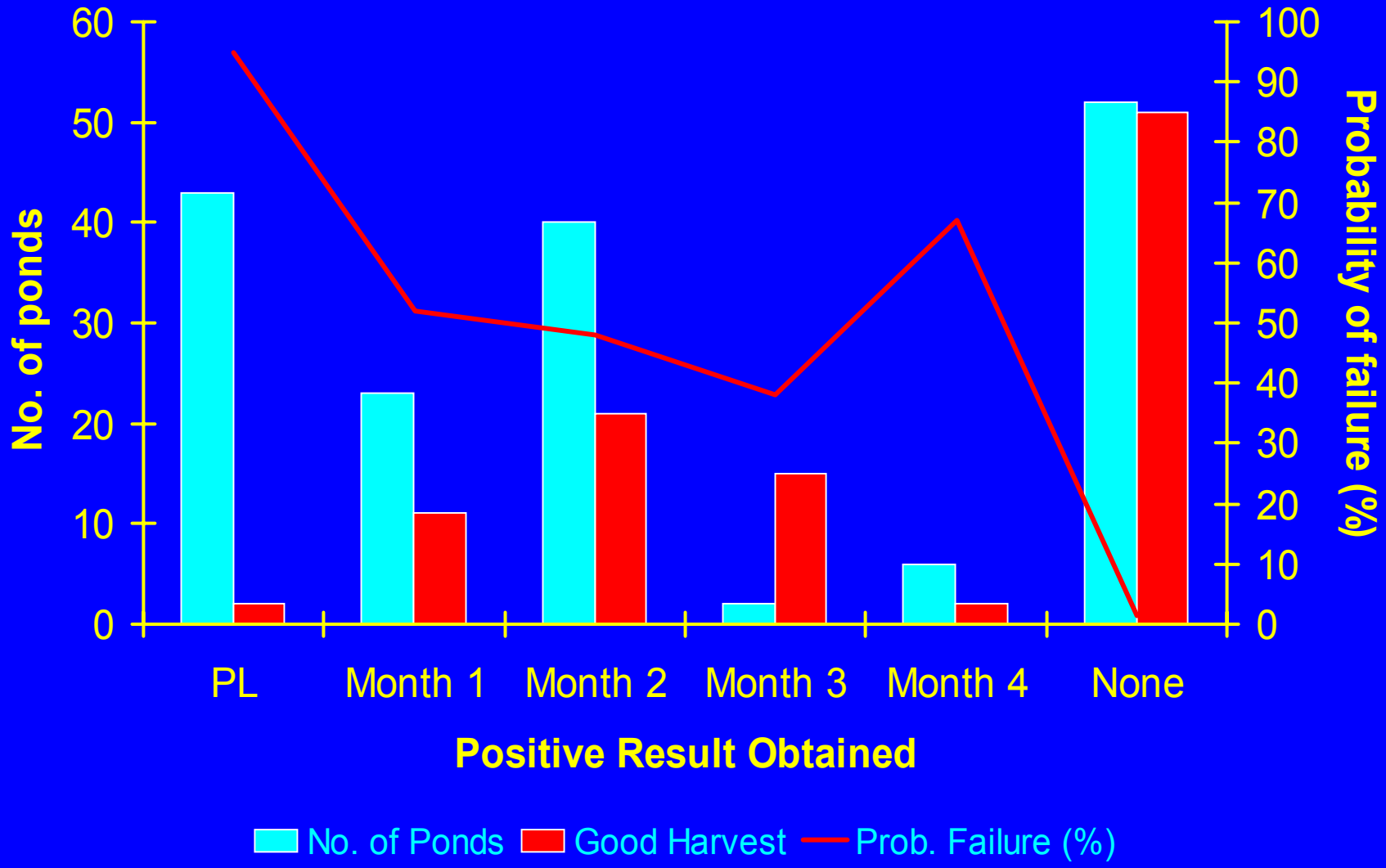


Before Spawning



After Spawning

Postlarval Screening



from data by Boonsirm Withyachumnarnkul

Postlarval Screening

Pond Group	Number Ponds	Number Failed	Proportion Failed	Relative Failure Risk*
Group 0 (PCR^+ PL)	43	41	0.953	49.6
Group 1 (1^{st} Mo. PCR^+)	23	12	0.522	27.1
Group 2 (2^{nd} Mo. PCR^+)	40	19	0.475	24.7
Group 3 (3^{rd} Mo. PCR^+)	24	9	0.375	19.5
Group 4 (4^{th} Mo. PCR^+)	6	4	0.667	34.7
Group 5 (Never PCR^+)	52	1	0.019	NA
Total	188	86	0.457	NA

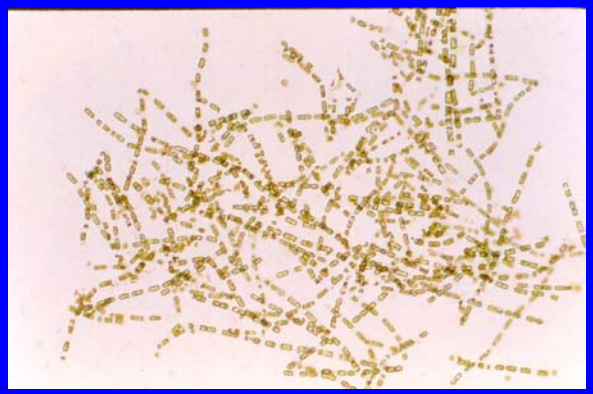
*Compared to Group 5; NA = not applicable; Total # ponds studied = 188; Total # ponds failing = 86 (46%)

from data by Boonsirm Withyachumnarnkul

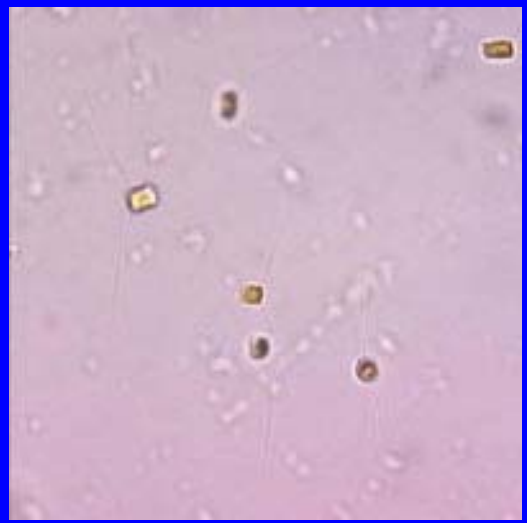
Feeds and Nutrition

- Better understanding of the importance of good nutrition
- More diverse range of feeds and feed products used
- Greater concern about health implications of live feeds and food products
- Impact on PL quality

Skeletonema



Pure Algae Culture

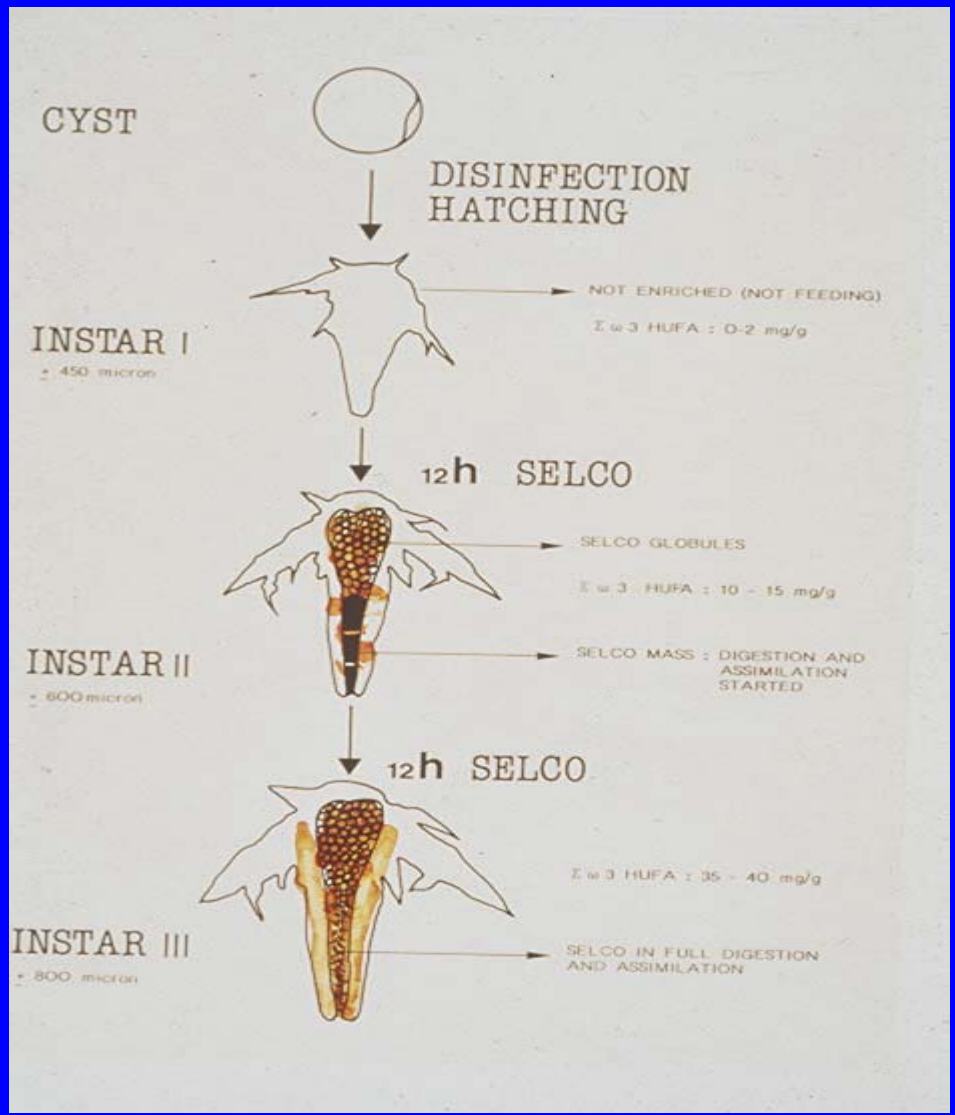


Artemia


BIO MARINE
Brine Shrimp Eggs
LIVING WORLD
SHRIMP EGGS
EGGS • BRINE
Sanders
brine shrimp eggs
BRINE SHRIMP EGGS

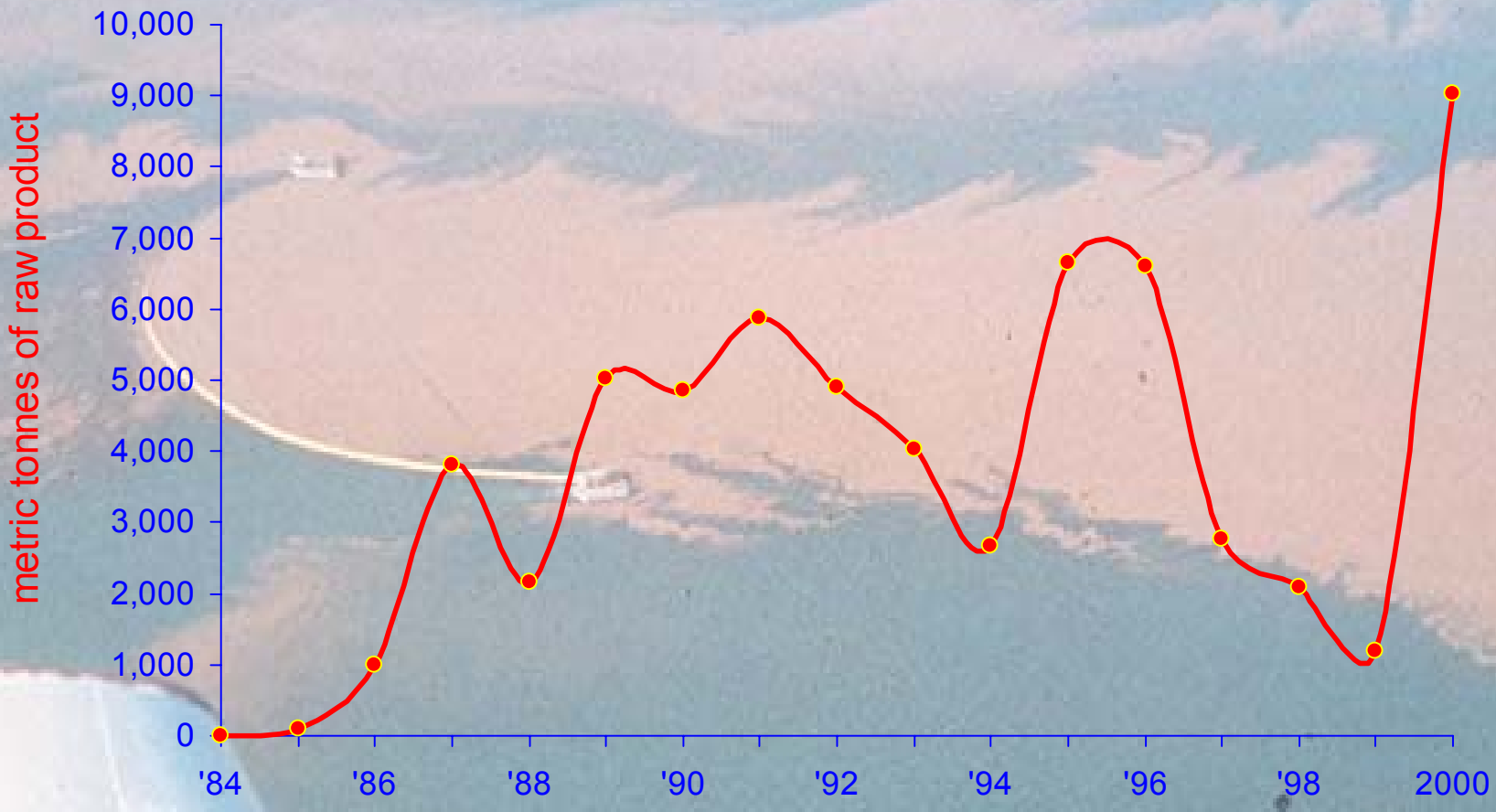
Artemia Culture

Artemia Enrichment



The use of Artemia enrichment is more common in western style hatcheries than in Asian ones. Some of the reasons given are cost, ease of use and the inability of *P. monodon* postlarvae to effectively use larger *Artemia*

Artemia Yields



Artemia Cyst harvest (metric tonnes raw product) from the Great Salt Lake (Utah, USA) (data from USGS, 2001)

Alternative Feeds

Artemia price and availability has prompted the use of alternatives

- Natural Feeds
  - Moina
  - Daphnia
- Formulated Feeds
  - Microencapsulated diets
  - Flakes
  - Spray-dried products

Future Research Priorities

The major research priorities identified by commercial hatchery operators are:

- Genetics and Maturation
- Larval Nutrition
- Probiotics
- Vaccines (Immune enhancers)
- Disinfection Methods

Future Influences

Many factors are likely to provide an influence on hatchery production in future. Some of these are:

- Availability of genetically improved strains
- Increased pressure from farmers and consumers
  - health status of PL
  - HACCP and responsible husbandry practices, Codes of Practice, process documentation
- Increased regulation of broodstock and postlarvae export and import
- Emphasis on efficiency of production and cost control


Thank You