XIX CONGRESO ECUATORIANO DE ACUICULTURA

Tecnologías para una producción sustentable

Aquaculture Biosecure Systems

BIOSECURITY IN SHRIMP FARMING

Practical Biosecurity Risk Management Measures

by Francois Brenta

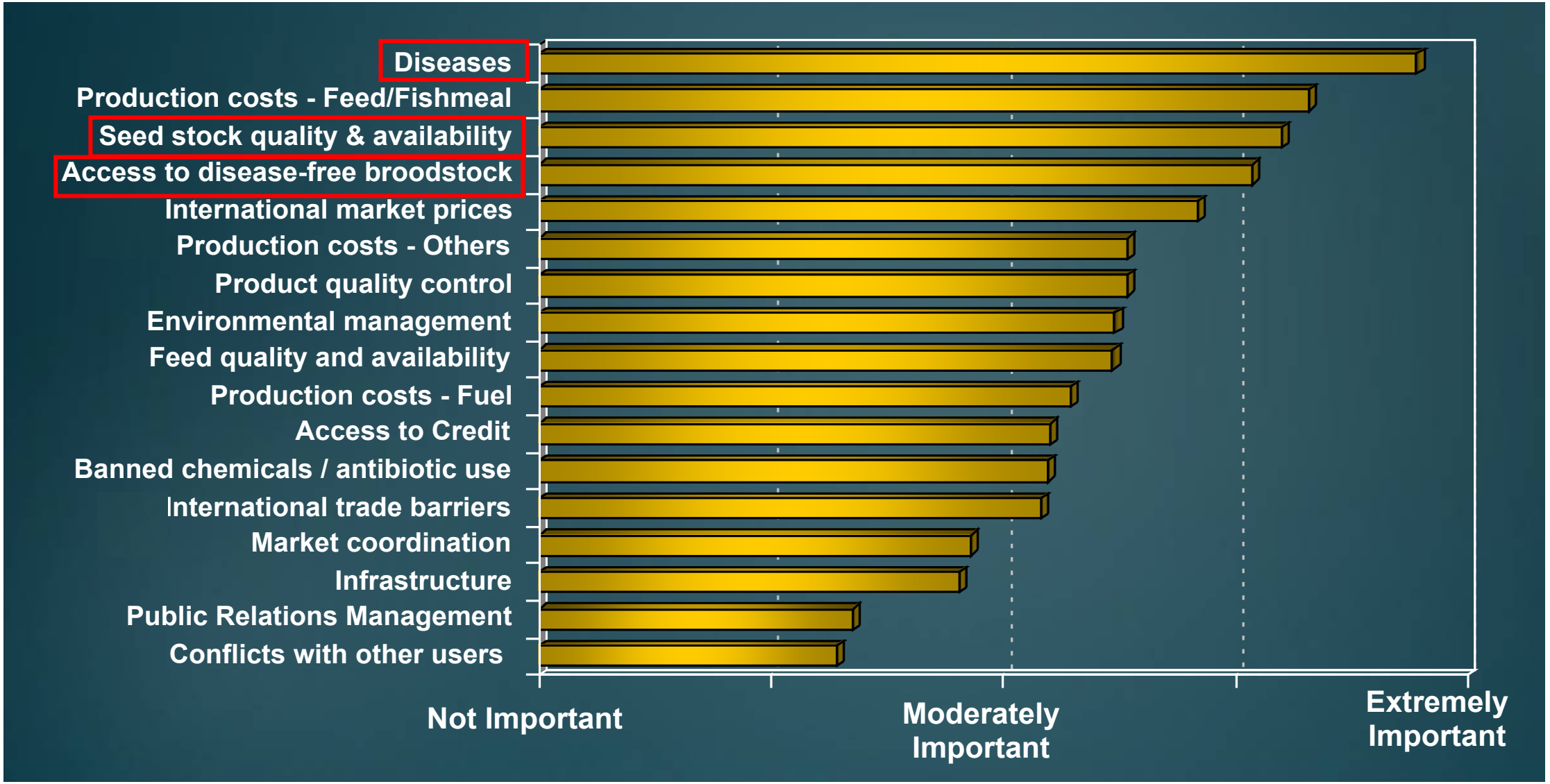
BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Most of world shrimp farming companies have adopted the "casino" risk management strategy:

As a result, billions have been lost due to diseases…causing disruption of the supply chain, devastating social impacts, loss of confidence in the industry and loss of investment.

BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

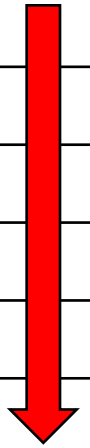
Source: 2016 Survey from the Global Aquaculture Alliance



BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

- ❑ A disease is a business risk.
- ❑ No profitable zero risk approach.
- ❑ **Biosecurity** is a practical risk management tool to **reduce the economic impact of diseases**.

Areas of production	**Level of impact of a disease outbreak on long term business sustainability**
Broodstock production (nucleus breeding)	Extremely high
Broodstock maturation & nauplii production	High
PL production	High
Nursery production	Moderate
Farm production	Moderate
Quarantine	Low



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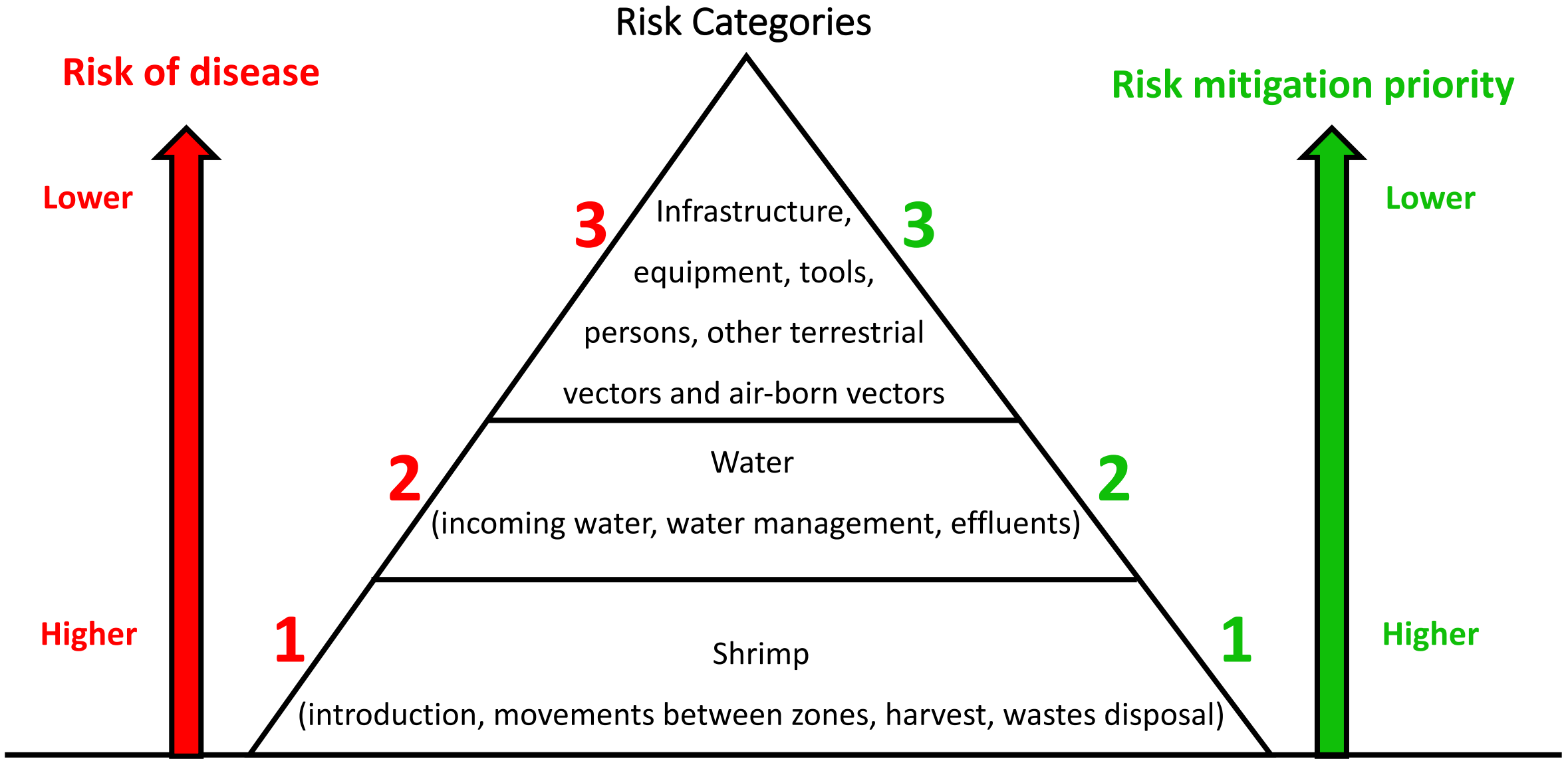

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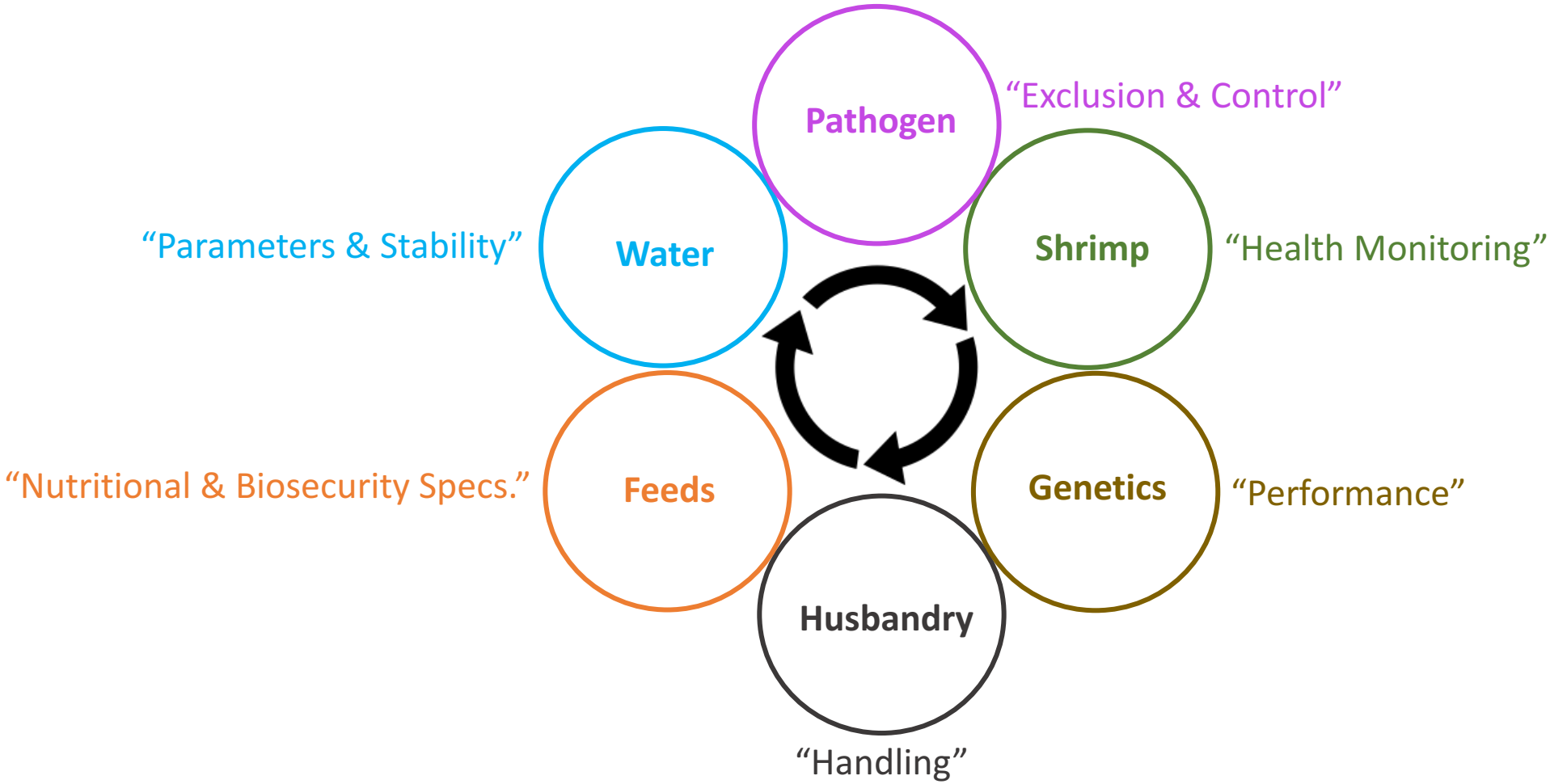
Biosecurity Management Approach



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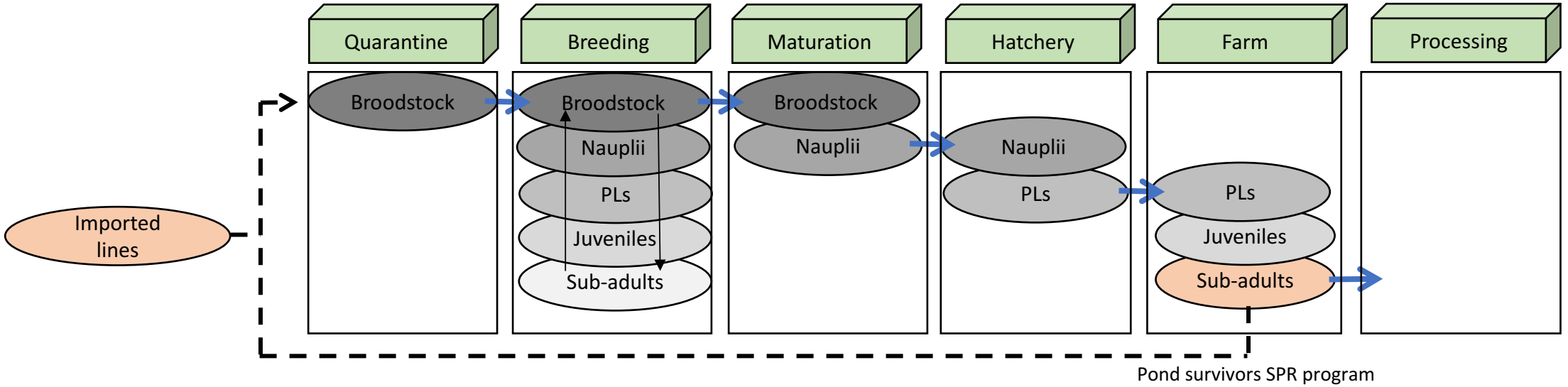
The Shrimp Farming Process

- Shrimp production process → series of interdependent activities.
- Common risks of pathogen transmission → disease outbreak.



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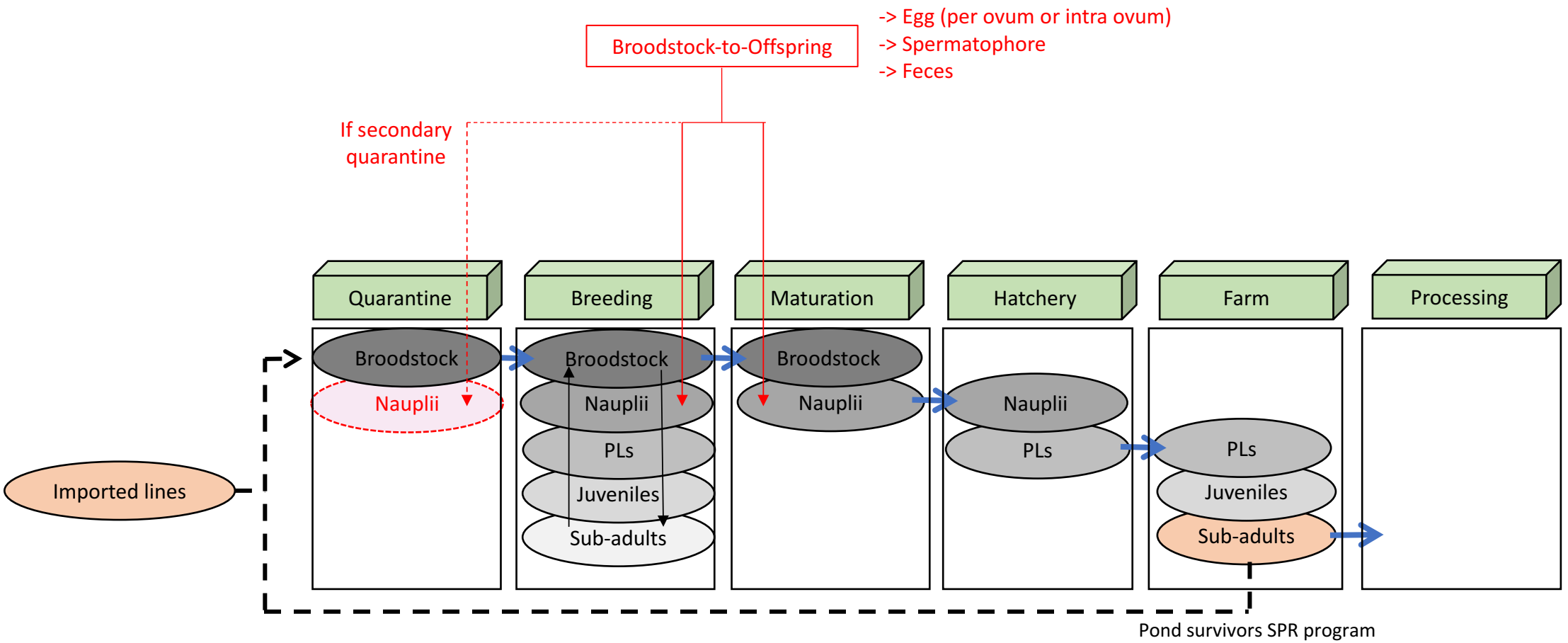
Vertical Pathogen Transmission



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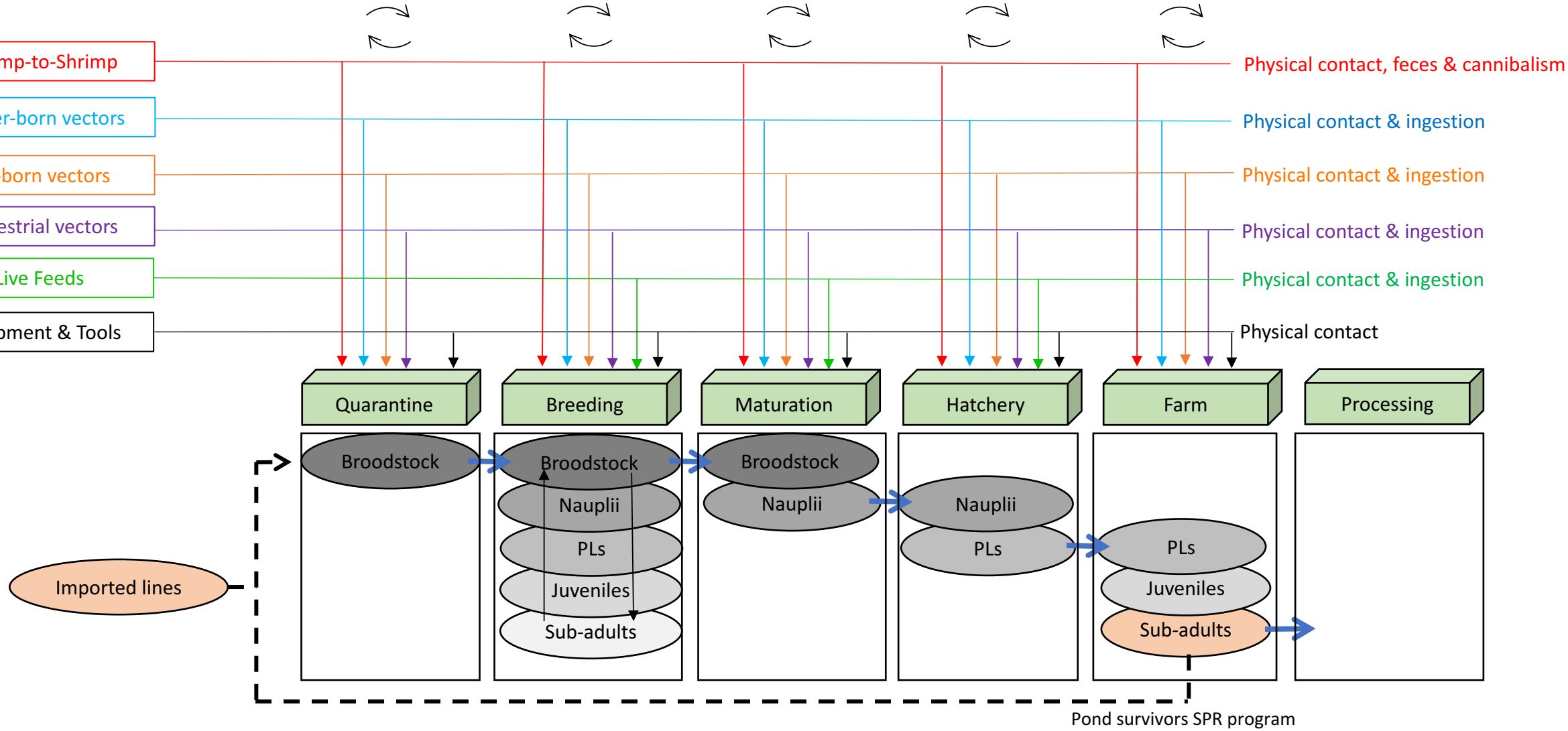
Horizontal Pathogen Transmission



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The Importance of Sampling

- Monitoring pathogen status in shrimp throughout the production process.
- Pathogen prevalence is the percentage of a population that is affected with a particular pathogen at a given time.
- If a batch sample is positive it means that the batch is positive.
- If a batch sample is negative it only means that the sample is negative.
- Random and directed samples (symptomatic).
- Sample for wet mount (microscopic health assessment).
- Sample for histology only on live symptomatic.
- Sample for PCR (non-destructive or destructive, preferably from symptomatic); importance of the back-up sample and the choice of tissues.

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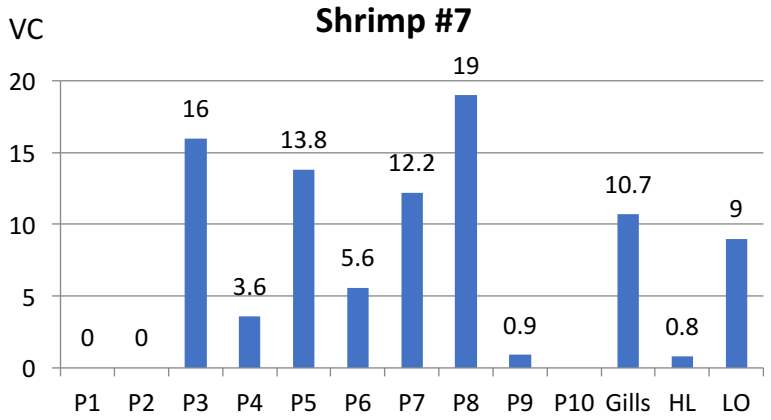
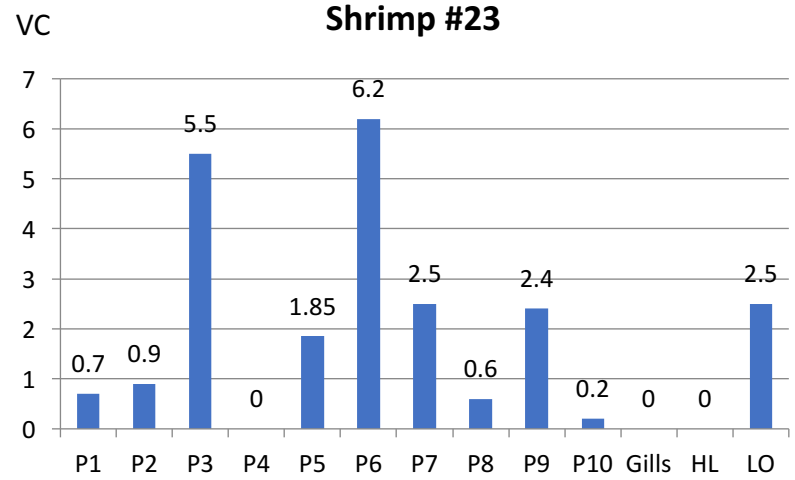
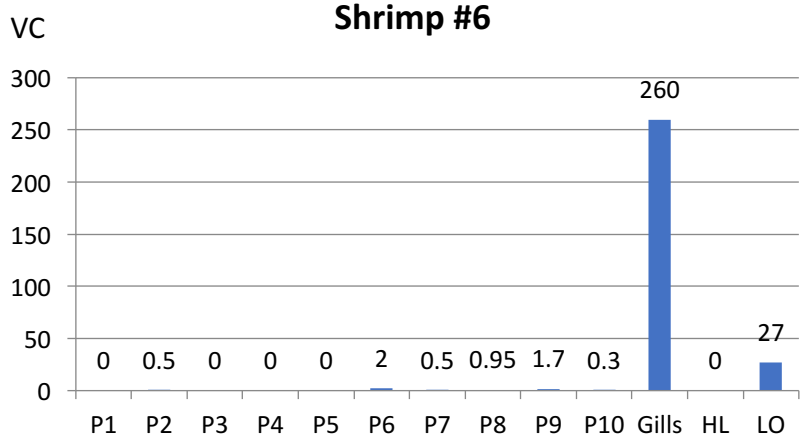
Practical Example: The Importance of the Choice of Tissue for WSSV detection

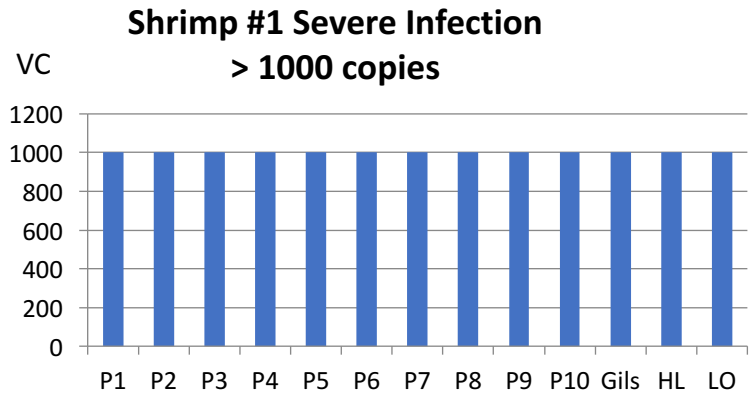
- ❑ Infection trial by ingestion resulted in 100% of WSSV positive shrimp.
- ❑ For each shrimp, tissues individually tested by quantitative PCR: pleopods, gills, lymphoid organ (LO) and hemolymph (HL).
- ❑ Results indicate an average of 10.5 viral copies (detection limit is 10), with different infection levels among tissues from the same shrimp.





- Pleopods: P1-P10
- Gills
- Hepatopancreas: HP
- Lymphoid organ: LO
- Viral copies: VC





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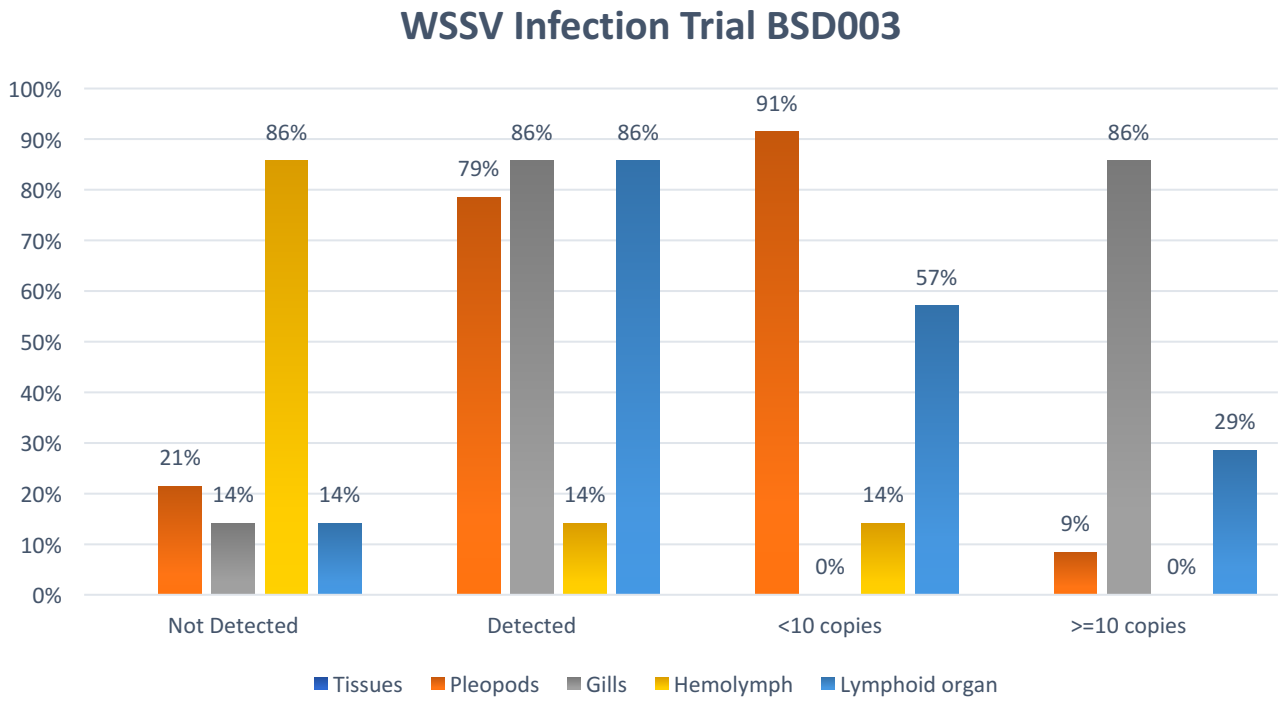
Practical Example: The Importance of the Choice of Tissue for WSSV detection

Conclusions from the infection trial:

- For non-destructive samples, clipping one pleopod is easy enough and non-lethal, however there is ~20% probability not to detect WSSV in an infected shrimp.
- For destructive samples, a combination a tissues allows for detection of 100% of WSSV infected shrimp even for levels < 10 viral copies.



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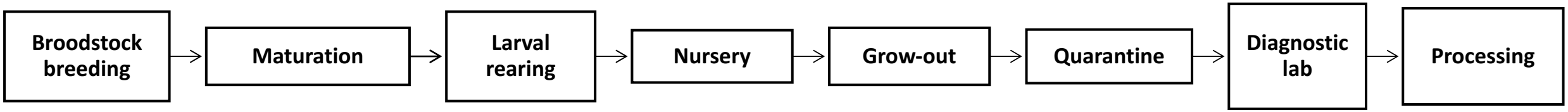
Minimizing the Risks from the Movement of Persons, Equipment and Tools



- ❑ All facilities:
  - Youngest batch → Oldest batch
  - Non infected or asymptomatic batch → Infected or symptomatic batch
- ❑ Farm:
  - Nusery → Grow-out
- ❑ Hatchery:
  - Algae → Larval → Artemia
- ❑ Maturation:
  - Hatching → Spawning → Broodstock

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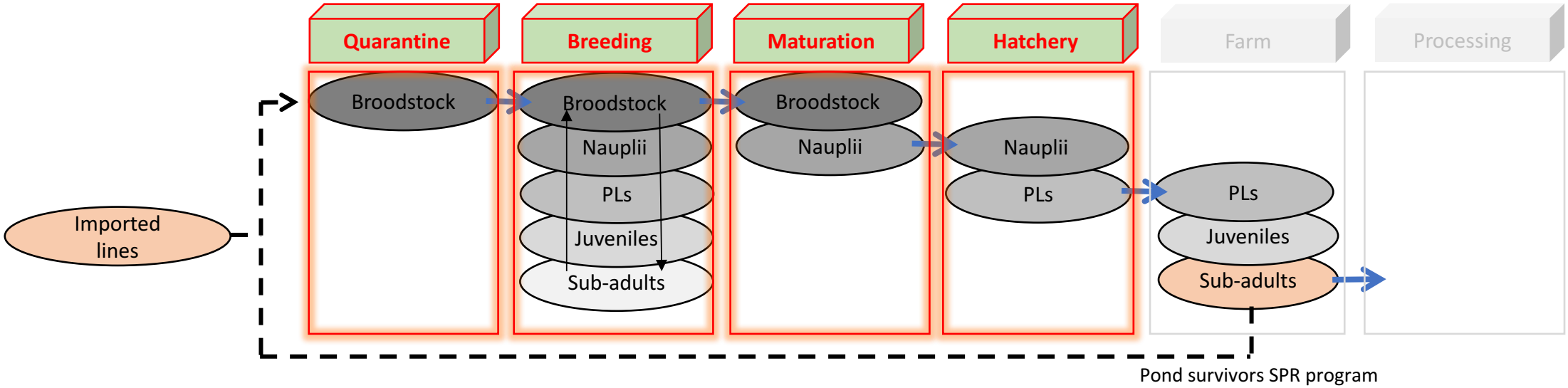
BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Indoor Facilities



❑ INFRASTRUCTURE:

- ✓ Fenced, concrete buildings or greenhouses, zone segregated (access, inlet, effluent and air), able to drain and dry.
- ✓ Algae mass culture tanks indoor with insect nets.
- ✓ Single site entry for persons, controlled service gate and drop-off point for deliveries without entry.

❑ ACCESS:

- ✓ Entry restricted to authorized persons only and with change to uniform. If disease outbreak access restriction increases.
- ✓ Shower for quarantine mandatory on exit if imported batch, recommended on entry for all indoor facilities.
- ✓ Hand-wash and foot dip with disinfectant (>680mV ~ 350ppm quaternary ammonia, 600ppm iodine or 30ppm chlorine).
- ✓ Entry of raw seafood products forbidden.

BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

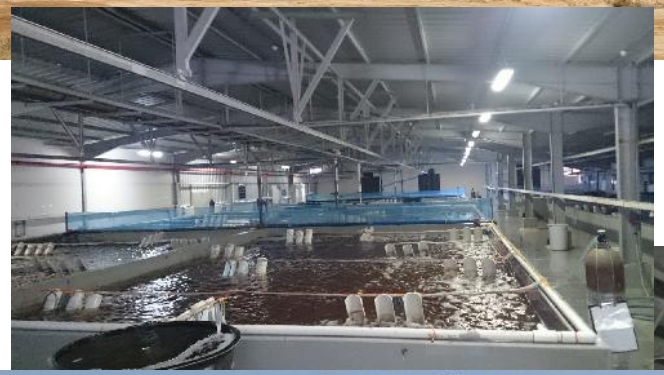
Common Risk Mitigation Measures for Indoor Facilities

❑ EXAMPLES OF BIOSECURE INDOOR INFRASTRUCTURE:

Fenced breeding facility

Larval rearing

Family program



Grow-out

Staff entrance

Grow-out

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Quarantine

BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Indoor Facilities

❑ EXAMPLES OF INFRASTRUCTURE AND ACCESS RISK MITIGATION MEASURES:

Nursery

Nursery phase II

Nursery phase I

Nursery

Indoor algae mass culture

Individual spawning

Individual hatching

BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Indoor Facilities

❑ WATER TREATMENT:

✓ Inlet water filtered to the lowest possible level and disinfected (680mV for 10 minutes).
✓ Mature water (biofloc inoculum or probiotics). For broodstock production, post-larval and nursery production, avoid photo-autotrophic systems and promote the use of heterotrophic dominant biofloc systems.
✓ Effluent from quarantine filtered to the lowest possible level and disinfected (680mV for 10 minutes).

❑ GENERAL PROFILAXIS:

✓ Equipment and tools routinely cleaned, disinfected, rinsed with disinfected water and left to dry.
✓ Tank scrubbing to remove biofilm, rinsed and filled-up with water and acid to reach pH of 4, followed by base to reach pH of 12, followed by rinsing and drying.
✓ Organic wastes incineration or disposal by equivalent means.

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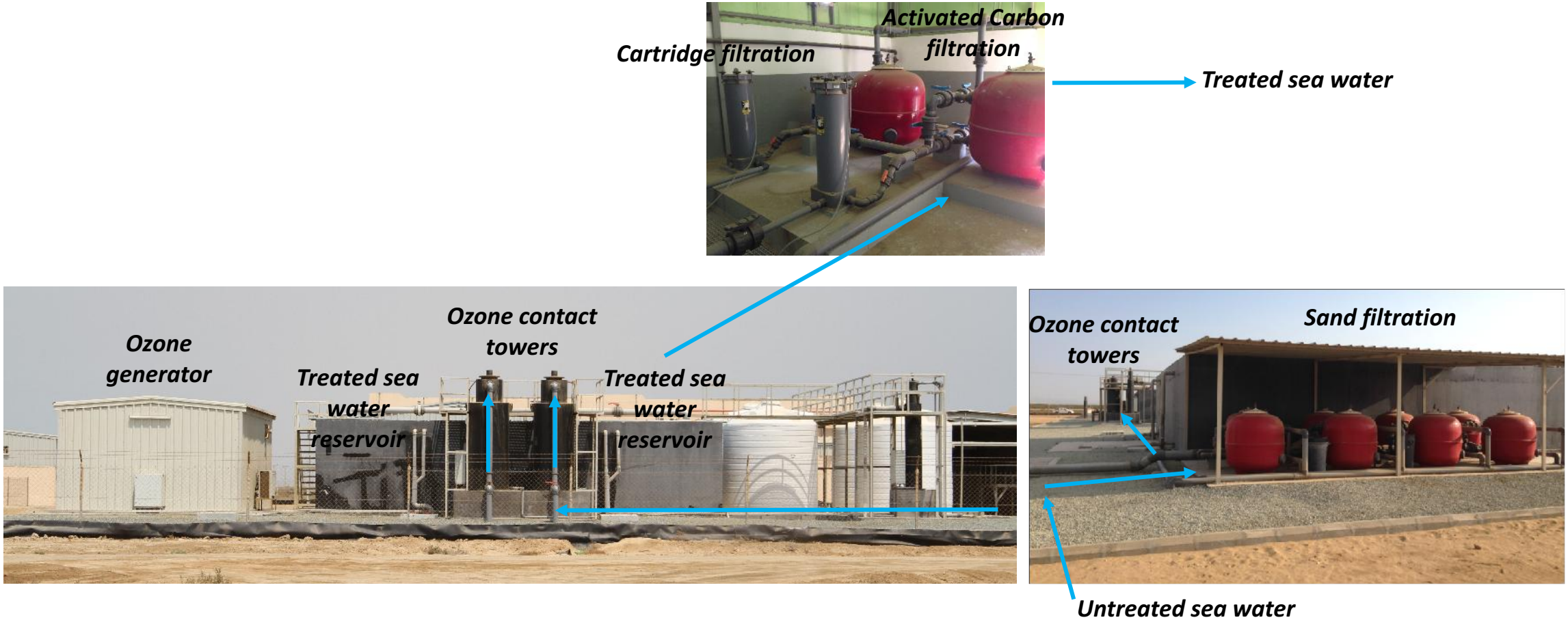
Common Risk Mitigation Measures for Indoor Facilities

- EXAMPLES OF WATER TREATMENT SYSTEMS:



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Common Risk Mitigation Measures for Indoor Facilities

- EXAMPLES OF GENERAL PROFILAXIS:

Biosecure entry with shower, changing room and laundry

Footbath

Hands-dip

Individual tank equipment

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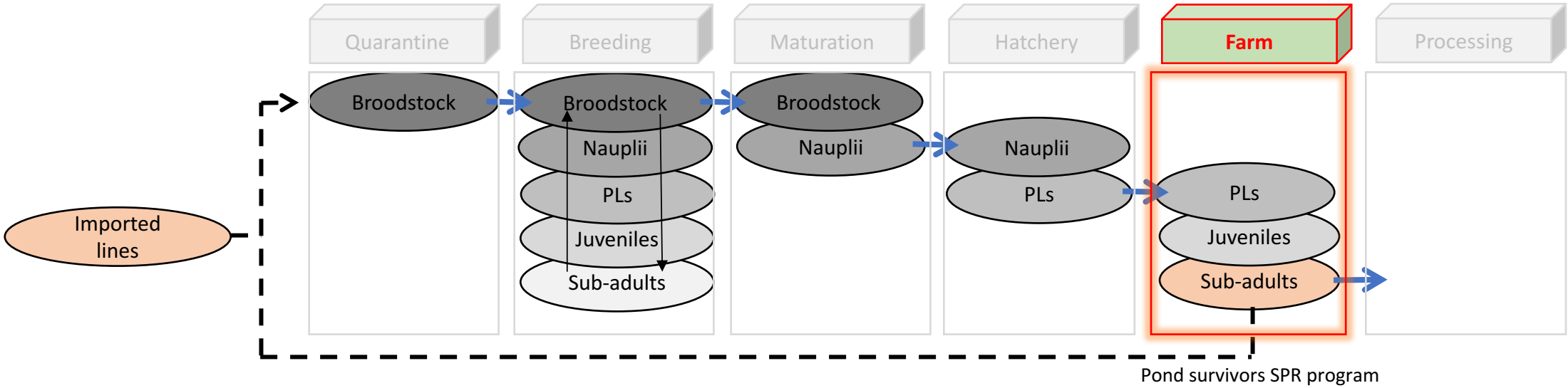
Common Risk Mitigation Measures for Outdoor Facilities



❑ INFRASTRUCTURE:

- ✓ Nursery and intensive grow-out with crab fence and bird net, risk zone segregation (access, inlet and effluent), able to drain and dry.
- ✓ Semi-intensive farms with zone segregation (access, inlet and effluent), without seepage, able to drain and dry.
- ✓ Controlled farm gate.

❑ ACCESS:

- ✓ Entry restricted to authorized persons only. If disease outbreak access restriction increases.
- ✓ Entry of raw seafood products forbidden.

BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Outdoor Facilities

❑ EXAMPLES OF BIOSECURE OUTDOOR INFRASTRUCTURE:

Grow-out with bird net and crab fence

Grow-out

Central drain (shrimp toilet)

Nursery

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BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Outdoor Facilities

❑ WATER TREATMENT:

- ✓ For all farm production systems, inlet water filtered to the lowest possible level and for intensive nursery and intensive grow-out (ideally drum filtration), disinfected with 0.5ppm Trichlorfon + 0.5ppm Copper Sulfate and 10 days retention time or with ozone at 680mV for 10 minutes contact time and 2 hour retention time.
- ✓ Matured water (biofloc inoculum or probiotics). For intensive nursery and intensive grow-out , avoid photo-autotrophic systems and promote the use of heterotrophic dominant biofloc systems.

❑ GENERAL PROFILAXIS:

- ✓ For ponds and canals, removal of fouling organisms and dry-out; if dry-out is not feasible or if presence of crustaceans, proceed with filling-up to cover target areas and disinfect with 2ppm Trichlorfon. Validate absence of crustaceans, if necessary repeat disinfection until termination is achieved and drain.
- ✓ Equipment and tools routinely cleaned, disinfected and left to dry.
- ✓ Organic wastes buried or disposal by equivalent means.

BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Outdoor Facilities

❑ EXAMPLES OF FARM PREPARATION:

Disinfection of wet areas

Complete dry-out

Sampling-search for crustaceans in soil

BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Outdoor Facilities

- EXAMPLES OF FARM PREPARATION:

Application of chemicals for disinfection

Inoculum for water maturation

Survival cages for (PL) stocking

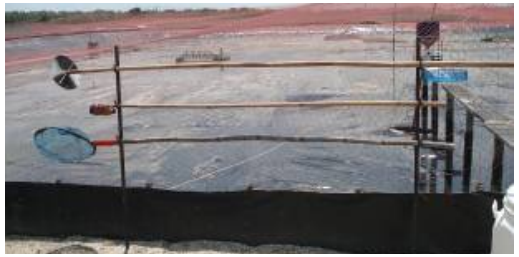
BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Common Risk Mitigation Measures for Outdoor Facilities

❑ EXAMPLES OF GENERAL FARM PROFILAXIS:

Clean screens

Pond-wise clean tool



Clean bag-net

Clean cast-net

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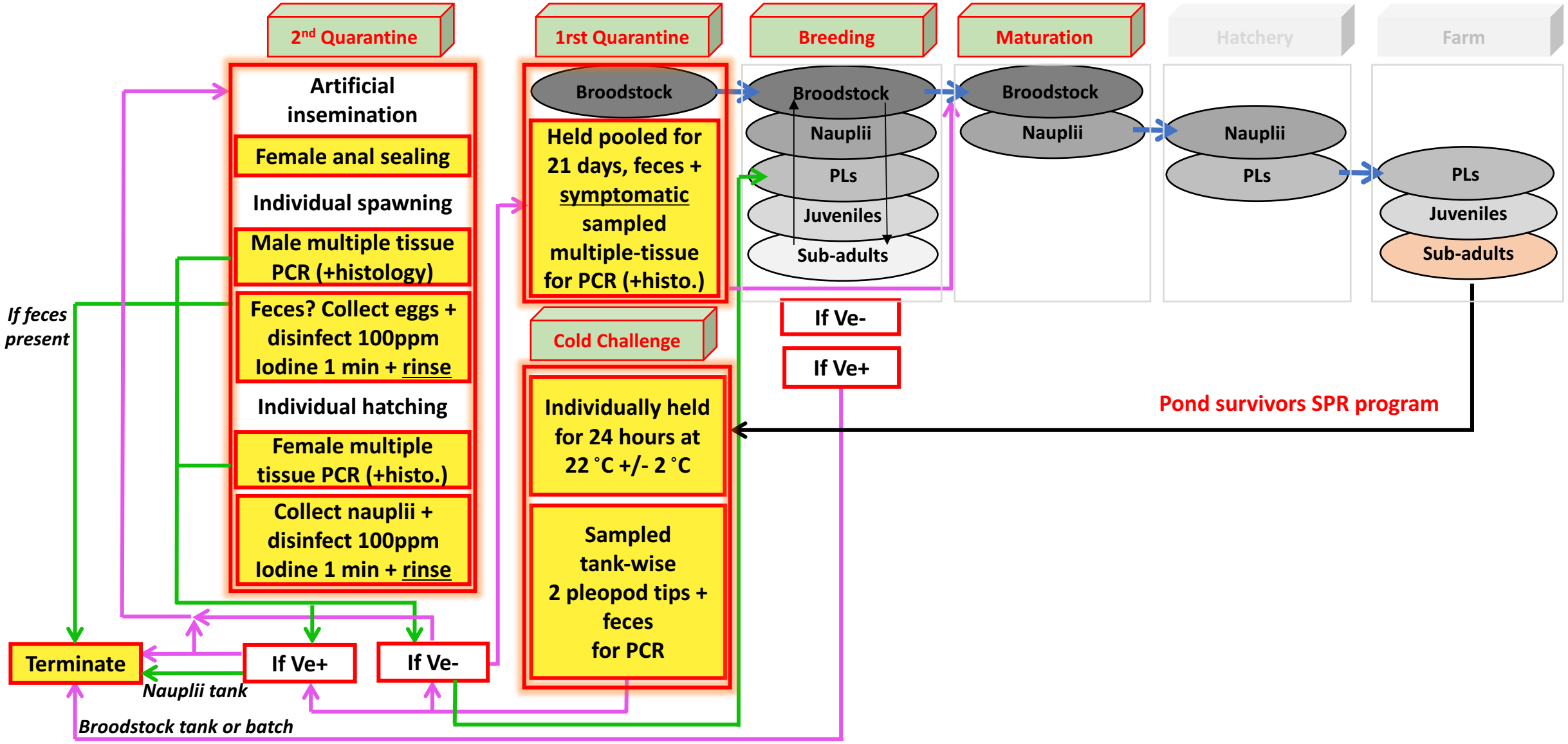
Specific Risk Mitigation Measures for Quarantine



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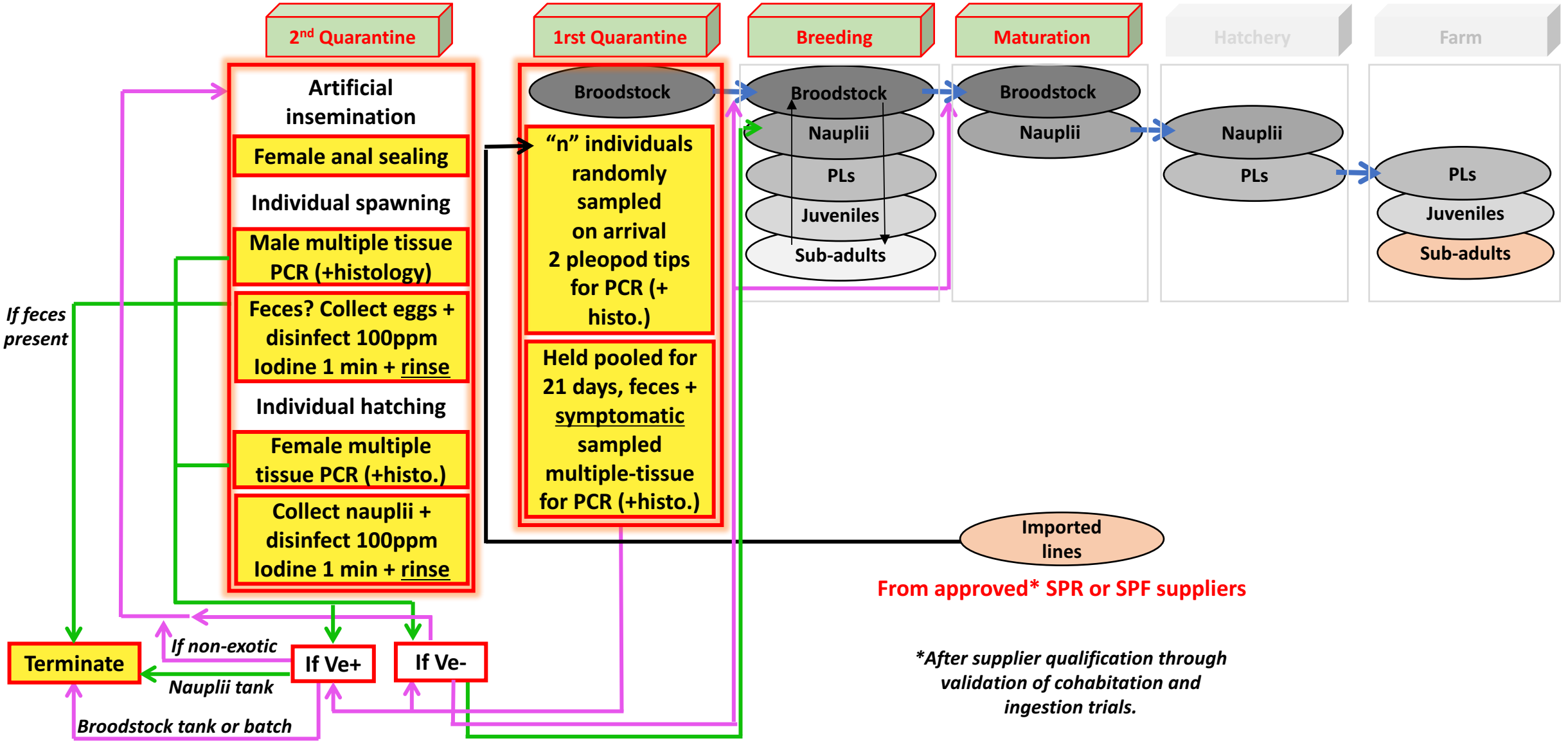
Specific Risk Mitigation Measures for Quarantine



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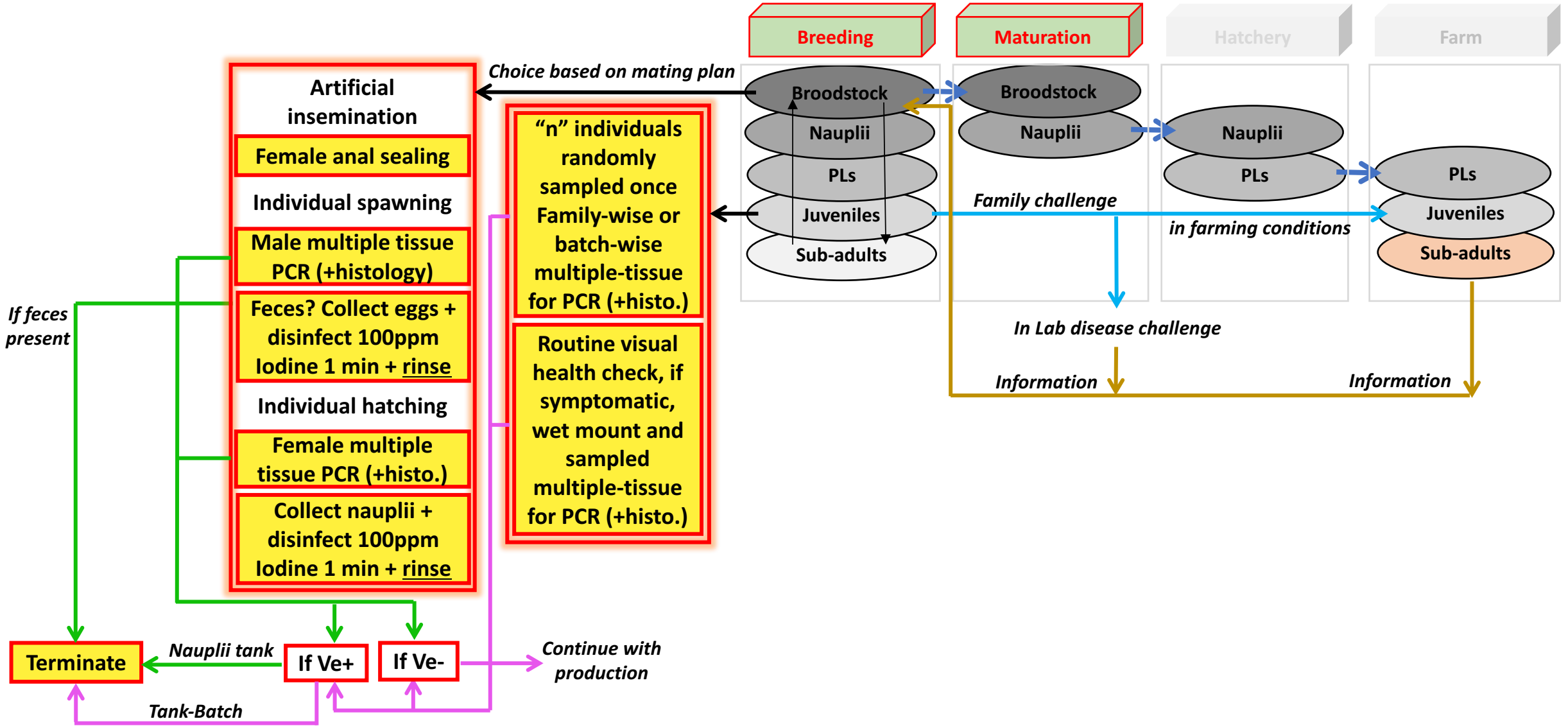
Specific Risk Mitigation Measures for Broodstock Breeding Program



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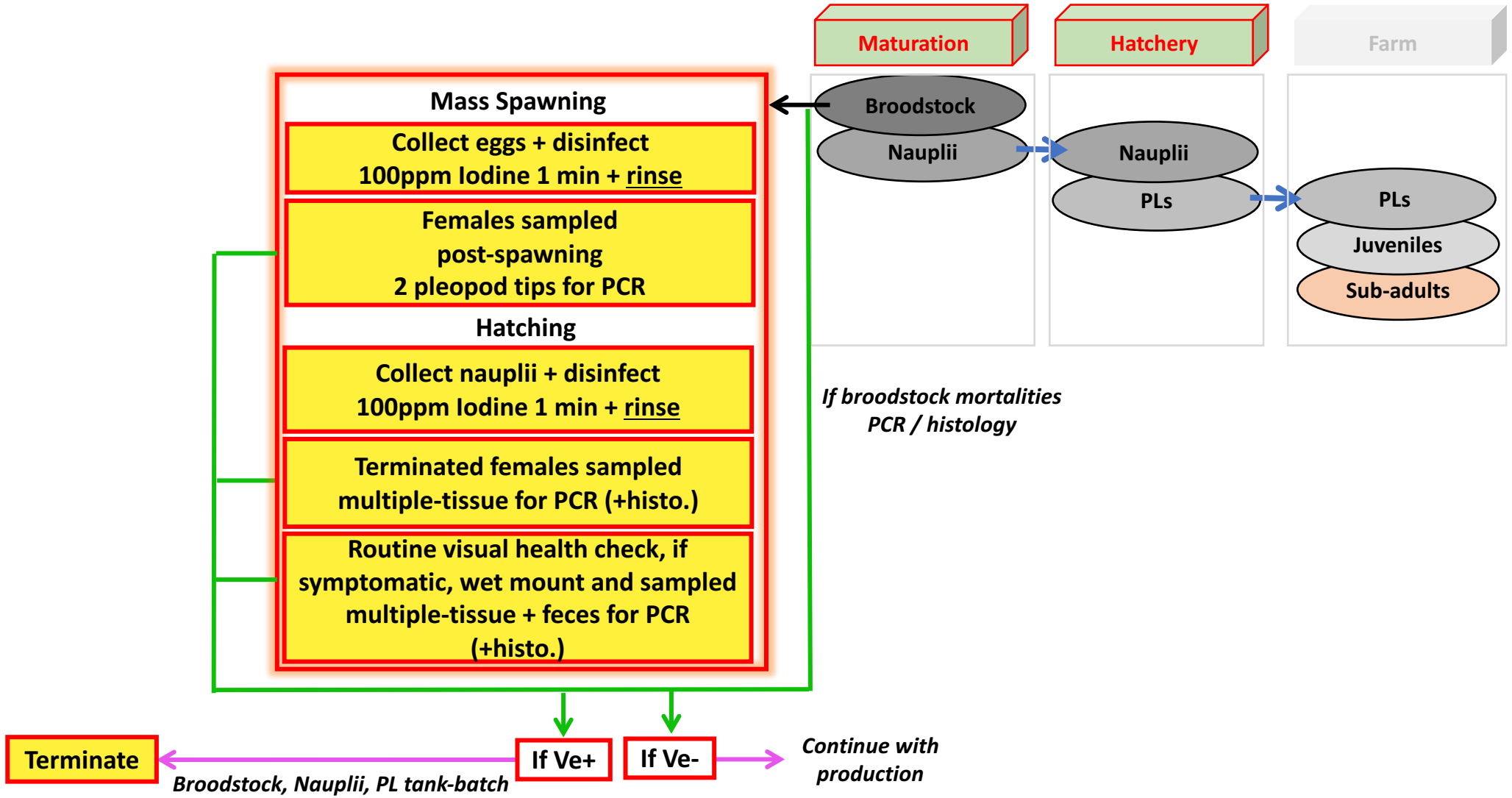
Specific Risk Mitigation Measures for Maturation



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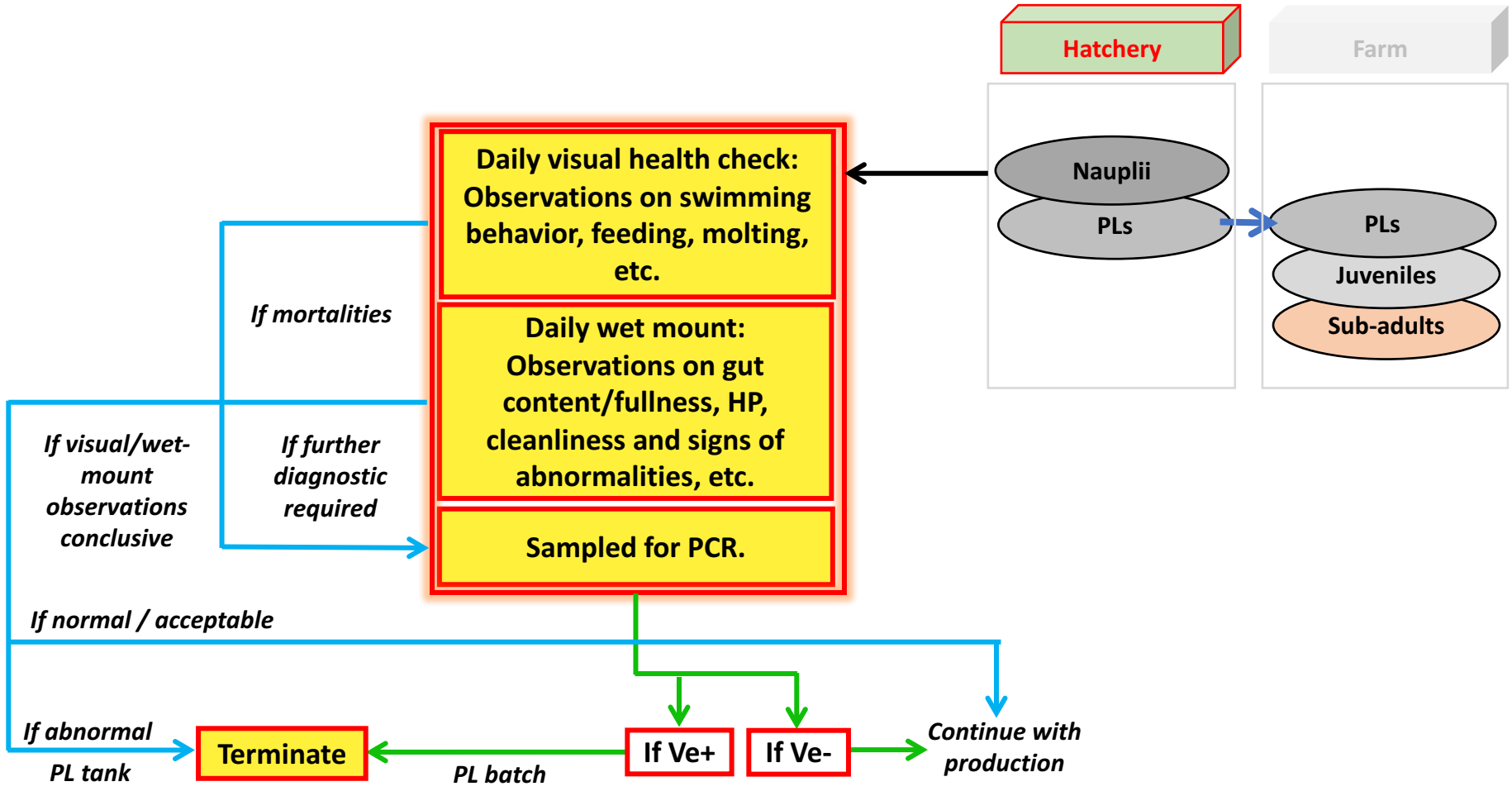
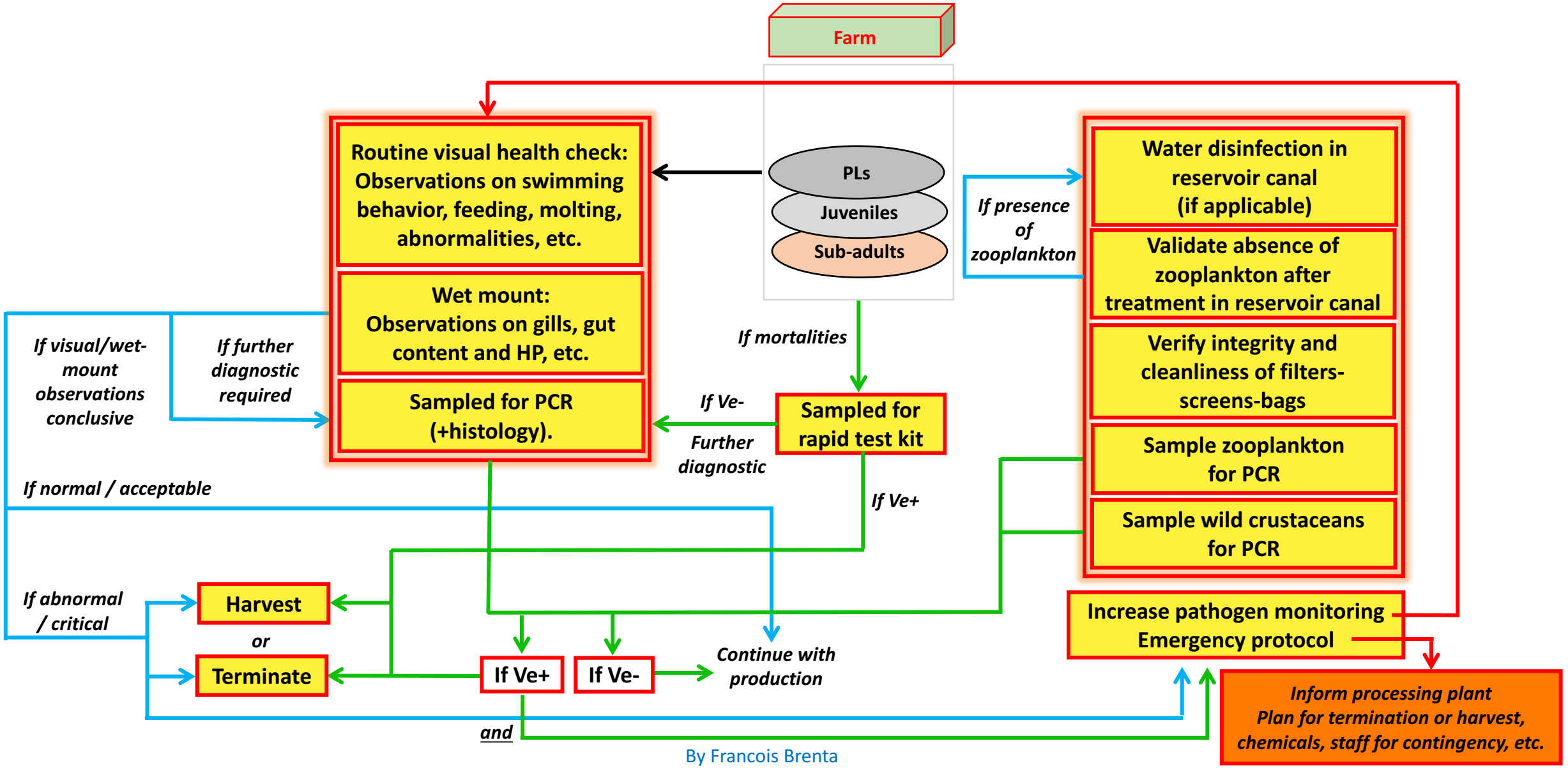
Specific Risk Mitigation Measures for Hatchery



BIOSECURITY IN SHRIMP FARMING – Practical Biosecurity Risk Management Measures

Specific Risk Mitigation Measures for Outdoor Nurseries and Farms



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Future Challenges of the Shrimp Farming Industry

- Diseases.
- Increasing competition for land and energy.
- Increasing demand of protein for human consumption.
- Wastes.
- Climate change.
- Stricter regulations.

Impact of Biosecurity in the Future of Shrimp Farming

Increasing development of intensive biosecure projects (high yield-low footprint)

- ❑ Genetics: growth, disease resistance and reproductive development.
- ❑ Super-intensification.
- ❑ Inland.
- ❑ Ground water or water treatment (ozone).
- ❑ Zero water discharge and water remediation (biofloc, RAS).
- ❑ Highly energy-efficient aeration-mixing systems.
- ❑ Automation (electro-valves, feeders, etc).
- ❑ Organic waste recycling (sludge, animal tissue, etc).
- ❑ Zoning.

Evolution of existing semi-intensive farms (low yield-high footprint)

- ❑ Genetics: strong focus on disease resistance.
- ❑ Intensive nursery and pre-grow multiphase systems, resulting in risk reduction, increased crop rotation and profitability.
- ❑ Zoning.

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Questions ?

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