Biosecurity and disease prevention

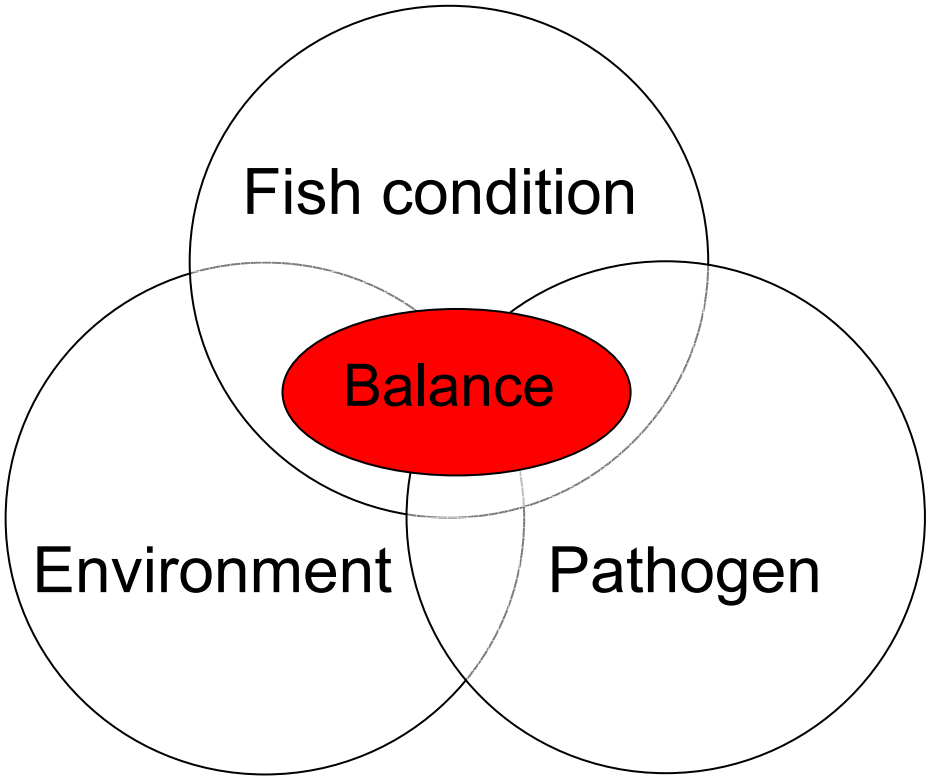
Production goals

– optimal performance, product quality, disease prevention and control

Disease prevention strategies

Probiotics & antioxidant protection help maintain balance

Optimizing growth and performance

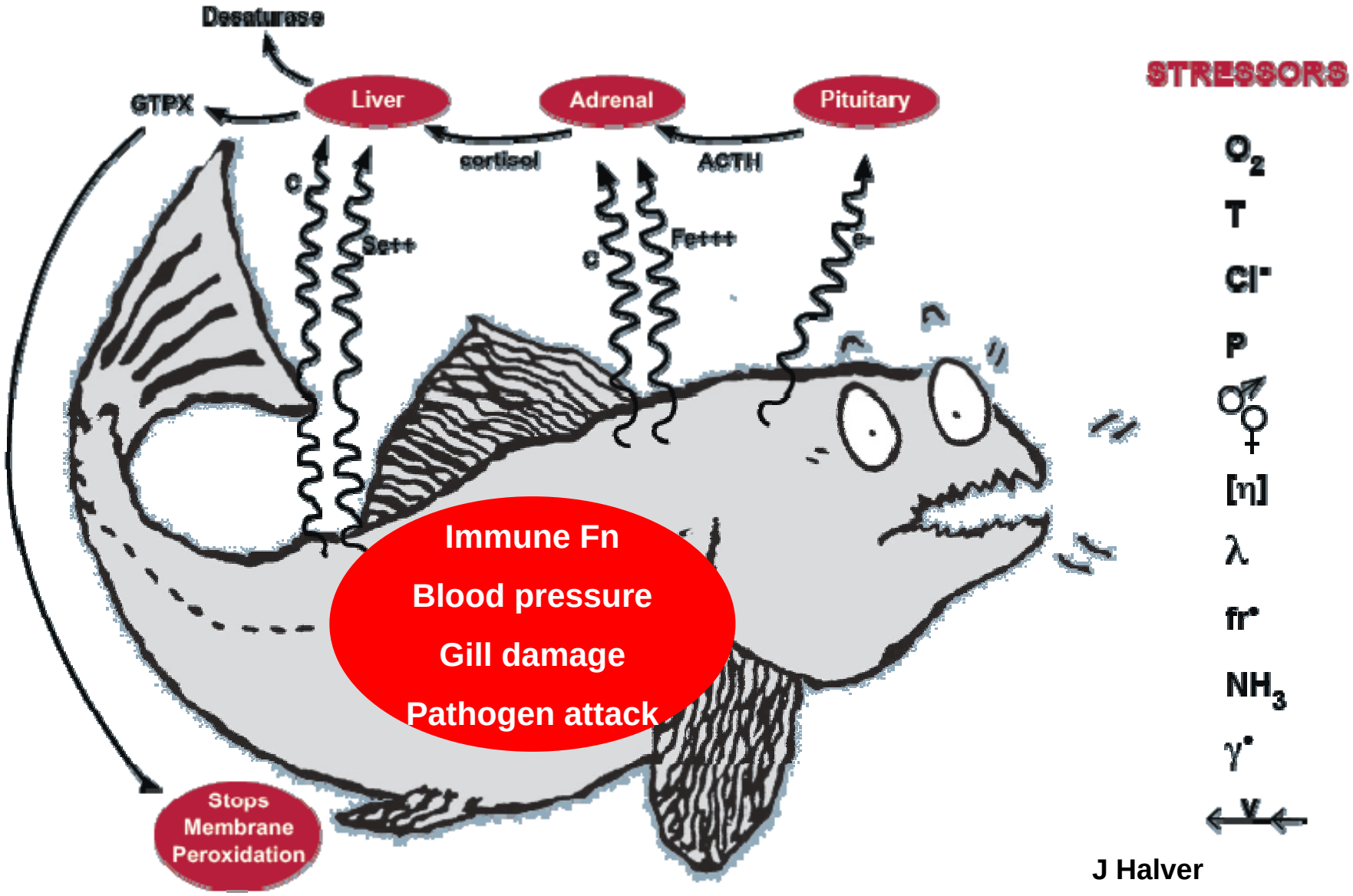


Imbalance leads to the development of disease through opportunistic pathogen attack

Husbandry and system stability affect stress response and health

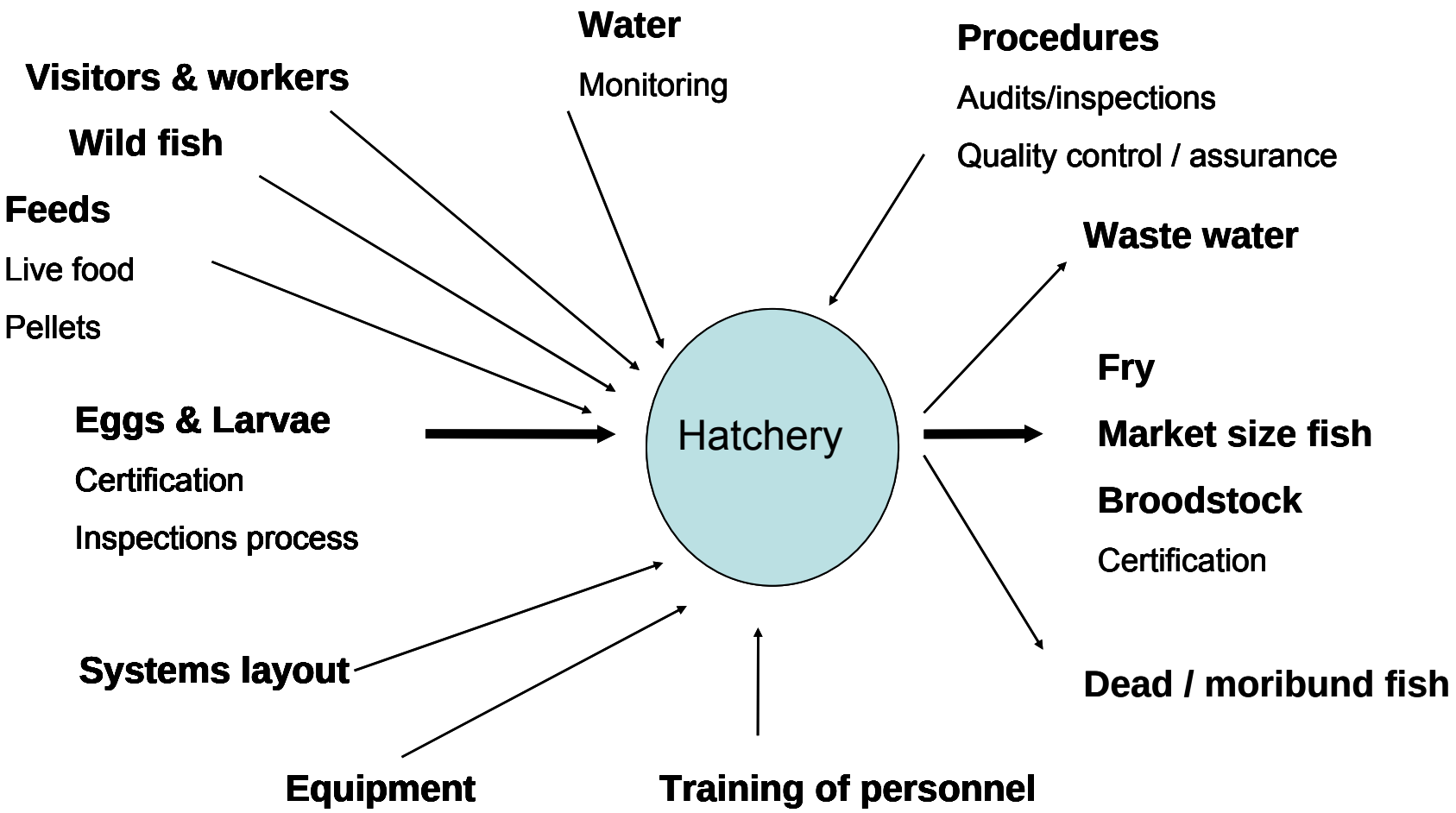
- Direct link between stress parameters and survival and health status *(Varsmos et. al. 2005)*
- Variable water temperature can trigger dramatic changes in immune status and susceptibility to virus.
- Tank cleaning caused short term acute stress and increased plasma osmolality, decreased IgM levels
- Short periods of sub-clinical disease challenge affect life-long productivity
- Early control of sub-clinical disease challenges is therefore extremely important

THE DISTRESSED FISH



J Halver

Critical point identification in a hatchery environment



Identifying Hygiene problems

1. Do you have hygiene plan ?
    a) Hygiene in the farm
    b) Hygiene outside the farm
2. Do you have a specific hygiene manual?
    a) Poster display
    b) Hygiene training
    c) Hygiene information file
    d) Hygiene document
    e) Hygiene team
3. For a new worker do you have specific hygiene training ?
4. Do you limit worker and visitor circulation within the farm ?
5. Have you hand washing facilities?
6. Have you special workers clothes?
7. Do you regularly clean equipment and clothes ?

HACCP Principles

HACCP is systematic approach to the identification, evaluation, and control of good safety hazards based on the following seven principles:

Principle 1: Conduct a hazard analysis

Principle 2: Determine the critical control points (CCPs)

Principle 3: Establish criticals limits

Principle 4: Establish monitoring procedures

Principle 5: Establish corrective actions

Principle 6: Establish verification proceedures

Principle 7: Establish record-keeping and documentation procedures

Departmental organisation

- Reception – Storage – Expedition
- Monitoring of water quality
- Cleaning and disinfection of all the fish farm equipment and tanks
- Aquaculture team
- Visitors
- Farm inlets: Lorry, eggs, broodstock, juveniles....
- External animals (rates, cats, dogs)
- Farm outlets: Juveniles, eggs, dead fish...
- All the departments of the fish farm should be looked at

Development of hygiene and biosecurity plan and protocols

- Water reserve
- Pump station
- Broodstock
- Egg Incubation
- Larvae
- Weaning
- Nursery
- Live food
- Feed storage

Development of hygiene and biosecurity plan and protocols

- Office administration
- Workers facilities
- Global Hygiene management
- Ongrowing
- Growing
- Packaging
- Fish farm Access
- Global environmental analysis:
  - Geographical point
  - Potential pollution
  - Sea water currents
  - River influence
  - Fish farm “auto-pollution”

Biology of immune system development

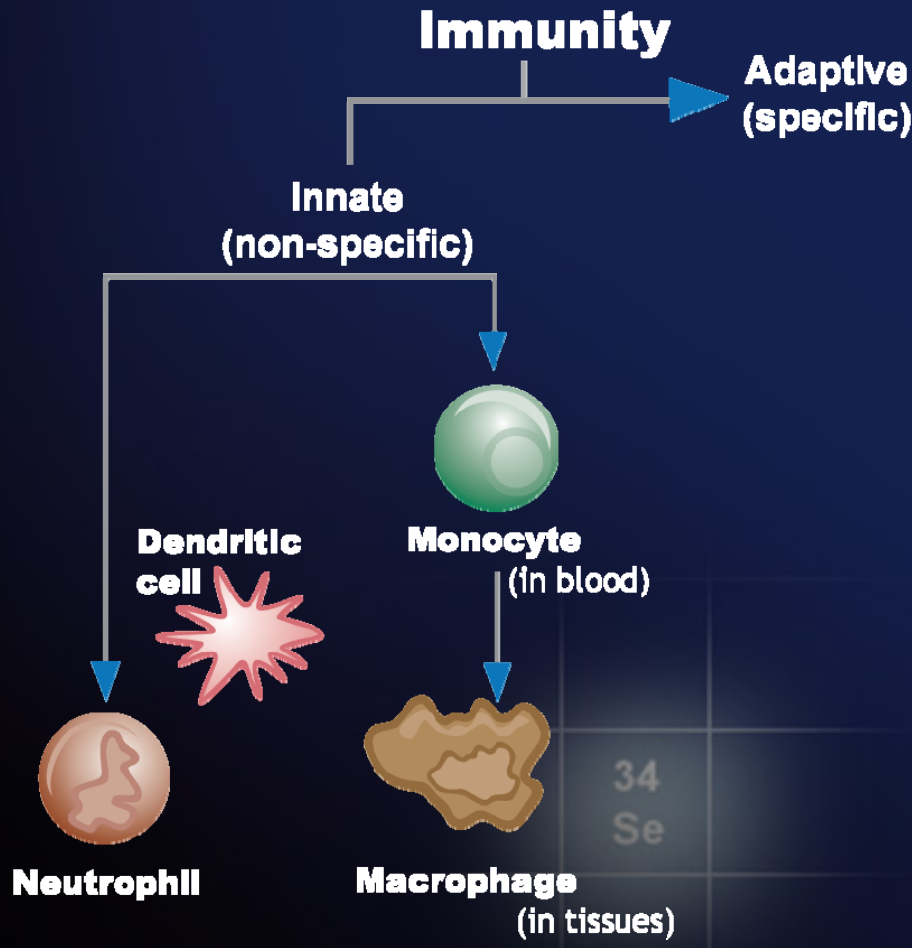
Some viral diseases of aqua & poultry

	Virus family	Poultry	Aqua
DNA viruses	Herpesvirus	Marek's, Duck VE	*O. masou* virus
	Pox virus	Fowl pox	
	Circovirus	CAV, PBFD	
	Nimavirus		WSSV
	Iridovirus		EHNV
	Baculovirus		HB, SEMBV
RNA viruses	Birnavirus	IBD	IPN
	Reovirus	Viral arthritis/malabsorption	Aquareovirus
	Coronavirus	Infectious bronchitis	YHV
	Picornavirus	Duck viral hepatitis	TSV
	Retrovirus	Avian leukosis	
	Orthomyxovirus	Avian influenza	Infectious salmon anemia
	Paramyxovirus	Newcastle	
	Rhabdovirus		IHNV, Spring viremia, VHS

To limit disease impact:

The inflammatory response must be quickly controlled!

- Minimize damage to surrounding tissues
- Faster healing
- Reduced impact of the infection on health and performance



Crustaceans rely on innate immunity

Types of pathogens

Viruses

All RNA and DNA viruses

Bacteria

Salmonella spp.
Campylobacter jejuni
Listeria monocytogenes
Mycobacterium spp.
Brucella abortus
Lawsonia intracellularis
Erysipelothrix rhusiopathiae
Corynebacterium pseudotuberculosis
Pasteurella multocida
Staphylococcus aureus
Pneumocystis carinii
Shigella spp.
Rickettsia typhi
Yersinia pesti (causes plague)

Protozoa

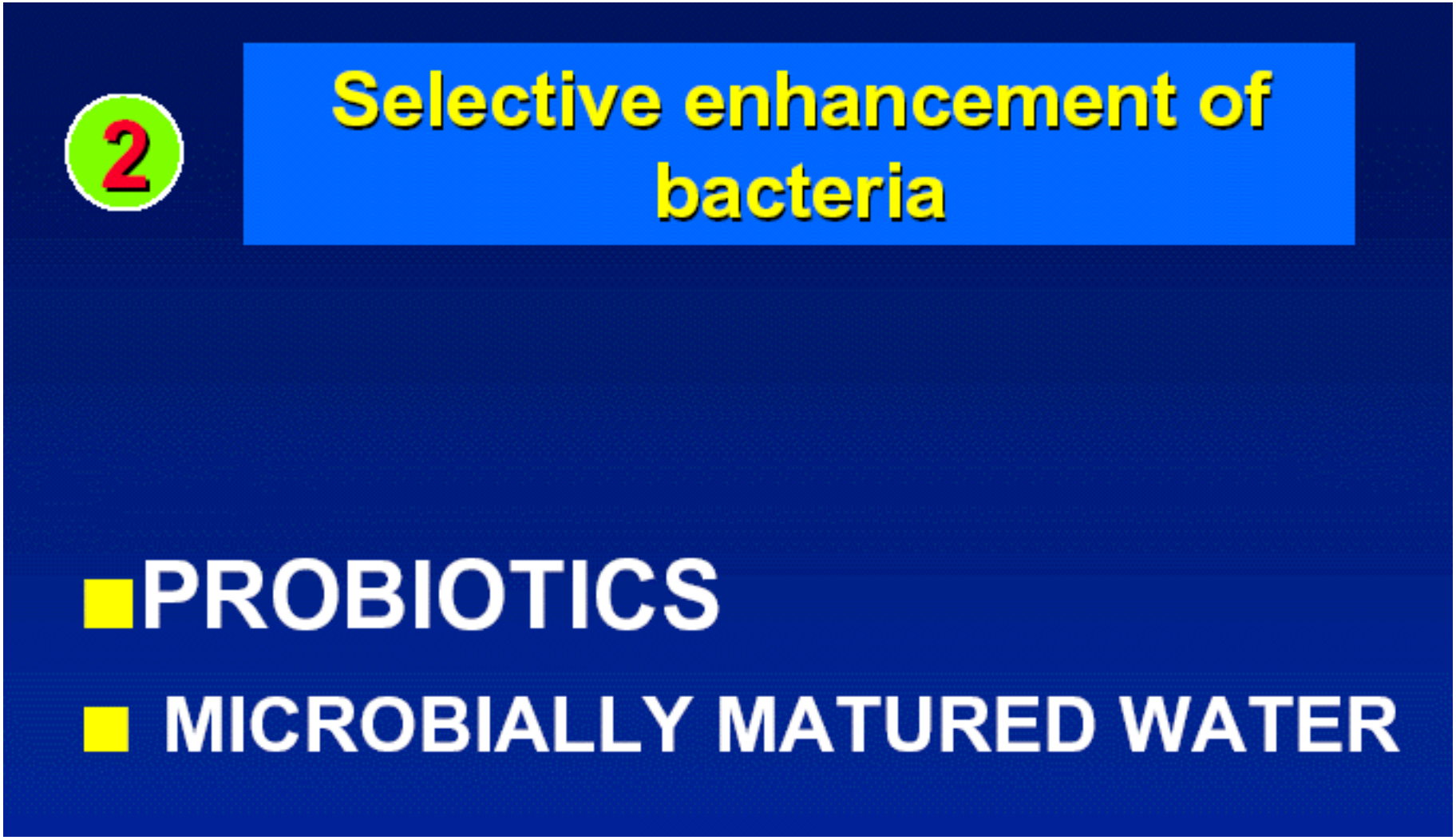
Eimeria spp.
Cryptosporidium spp.
Leukocytozoon spp.
Leishmania spp.
Toxoplasma gondii
Trypanosoma cruzi (Chagas Disease)
Plasmodium spp. *(cause malaria)*

Yeast and fungi

Candida albicans
Cryptococcus neoformans
Aspergillus spp.
Histoplasma capsulatum

**Human pathogens*

Microbiology



Disease resistance enhancement

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Improvement of larval resistance

* Broodstock management *(Nutrition - immunostimalation vaccination)*

  ⇨ *Good egg quality*

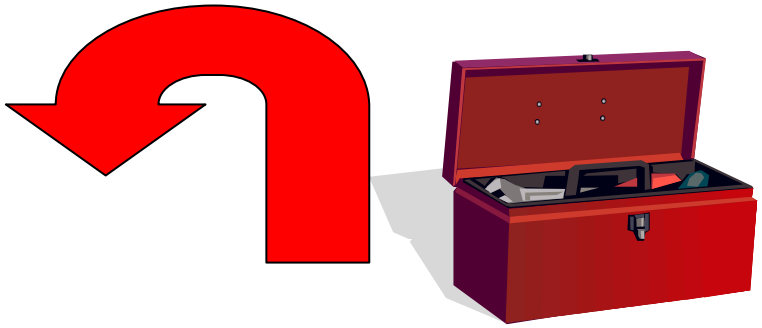
* Immunomodulation

  immunostimulants - vitaminic treatments - antistress factors

⇨ ***Larval Nutrition***

Nutritional strategies for improving health

New tools for improving production



- Stress management
- Microbiological control – water quality, environment and live feed
- Prebiotics & probiotics in live feed and dry diets
- Nutrition - mineral dependant enzyme pathways, ARA etc

An **immunomodulator** is a substance which has an effect on the immune system.Immunostimulants or immunosuppressants)

Immunostimulants

- Increase disease resistance by improving host defensive mechanisms against opportunistic pathogens

There are two main categories of immunostimulants:

- **Specific immunostimulants** are those which improve specific immune response, such as vaccines or any antigen.
- **Non-specific immunostimulants** are those which help general immune response such as adjuvants and non-specific immunostimulators.
- Enhance specific immune responses and non-specific mechanisms

immunostimulants or immunosuppressants

- Stimulate macrophages and dendritic cells located in gut tissue
- No memory component
- Short duration effect
- B glucans, peptidoglycans, lipopolysaccharides, nucleotides – type of polysaccaride
- Should not be fed continuously

Probiotics

- Live microbial feed supplements which help the fish by improving its intestinal microbial balance
- Can compete with pathogenic bacteria in the gut for space and nutrient, can produce antimicrobial substances and change intestinal environmental conditions
- Probiotic bacterial cultures are intended to assist the body's naturally occurring gut flora, an ecology of microbes, to re-establish themselves.

Vaccination – dip and injection

Vaccination response - fish

- Fish have a range of adaptive immune responses and immune memory, involving B cells and T cells, antibody and phagocytic cells.
- This adaptive immune response enables them to specifically “remember” exposure to pathogens and respond with increased efficiency on subsequent exposure, forming the basis of vaccination
- Understanding of these immune mechanisms and how the pathogens interact has allowed aquatic animal health scientists to develop successful vaccines.

Vaccination response - shrimp

- Widely thought that invertebrates do not have an adaptive immune response.
- Thus vaccines have not been routinely developed and used in shrimp aquaculture
- Invertebrates have generalized immune responses to invading pathogens such as bacteria and fungi.
- There is increasing evidence for a specific immune memory in crustaceans, including shrimp and that the diversity and sophistication of responses in invertebrates is far greater than previously assumed

Vaccination of fish

Developed in 1990's for salmon farming

Vaccines for farmed fish are

- Injectable and oil adjuvanted
- Aqueous immersion vaccines
  - Used for juvenile stages to offer protection prior to injection
- Oral vaccines
  - available commercially
  - variable success as primary immunogens

Dip vaccination of fry in the hatchery

Dip vaccination of fingerlings

Anaethetic

Dip vaccination of fish

Injection vaccines

- Appears impractical for thousands of fish
- Adopted by salmon farmers
- Extremely effective
- Stress can be managed with use of anaesthetics
- Skilled vaccinators can inject high numbers of fish per day

Injection vaccination of fish

- When the fish are large enough to be individually handled (>50g average weight) they can be vaccininated by injection
- Fish are crowded into a small area and are anaesthetised since the larger the fish the greater the risk of self-injury due to stress reactions..
- A measued dose of vaccine (usually 0.1ml to 0.2ml) is injected in the abdominal area of each fish held with the ventral side up and the head away from the operator´s body. The needle is inserted into the peritoneal cavity at a 45^{o} angle to a depth of approximately 0.5 cm. Automatic injection guns or syringes are used.

Injection vaccination of fish

Pond and tank biosecurity - equipment

Tank hygiene and daily cleaning for maintaining optimal tank conditions

Hatchery biosecurity

Health and hygiene

- Autoclave
- Drying oven
- Microwave

Biosecurity - Biological materials

Biosecurity - Visitors

When visitors to the farm are expected, consideration of relative risks allows you to develop and use practical biosecurity measures.

Low-risk visitors - Visitors from villages or towns who have no contact with fish farms present very little risk of carrying diseases.

Moderate-risk visitors - People who routinely visit fish farms but have little or no contact with the fish or culture water such as salesmen and delivery people present only a moderate risk of introducing disease.

High-risk visitors - High-risk visitors include veterinarians, shrimp suppliers or shrimp buyers, neighbouring farmers, and anyone else who has close contact with fish or fish farms.

Visitors should wash their hands and feet.

Equipment and instruments that have direct contact with fish should be cleaned and disinfected before and after use.

Biosecurity - Vehicles

There is a risk of transferring disease between safe zones by vehicles especially vehicles transferring stock or equipment between farms or other facilities. Vehicle tyres and undercarriages should be cleaned with freshwater.

Cleaning of small equipment

Disinfection baths

Equipment in daily use can be stored in disinfection baths but should be rinse well before use. All baths should be changed weekly or when dirty (which ever is sooner).

1. Live food production equipment (airtubes /pipettes etc.) should be left in hydrochloric acid baths (pH 2) which should be changed weekly.
2. Fish handling equipment e.g. hand nets/ tank cleaning equipment etc. can be stored in iodophor baths or hypochlorite (Chlorine can degrade hand nets).
3. Footbaths or foot-mats should be set-up at hatchery entrances.

Cleaning of large equipment

1. Hose down with fresh water to remove major fouling.
2. Add detergent to warm water and remove encrusted fouling with a brush or abrasive pad (e.g. Scotch brite). Rinse with fresh water.
3. Disinfect equipment with iodophor or similar if equipment was in previous contact with diseased fish. Rinse and store dry if not being used immediately.
4. Work bench surfaces etc. should be wiped with hypochlorite periodically and floors should be sprayed with hypochlorite at least once a week.

Vehicles

Vehicles

1. Vehicles from other farms should not be allowed into the fish holding areas. The tyres and body work should be disinfected using a high pressure hose with disinfectant added.
2. The tanks of all fish transport vehicles should be thoroughly cleaned and disinfected as in equipment cleaning before being stocked.

Mortality disposal

All mortalities should not flushed away through the farm effluent system.

They need to be properly disposed of

For small quantities of mortalities fish can be

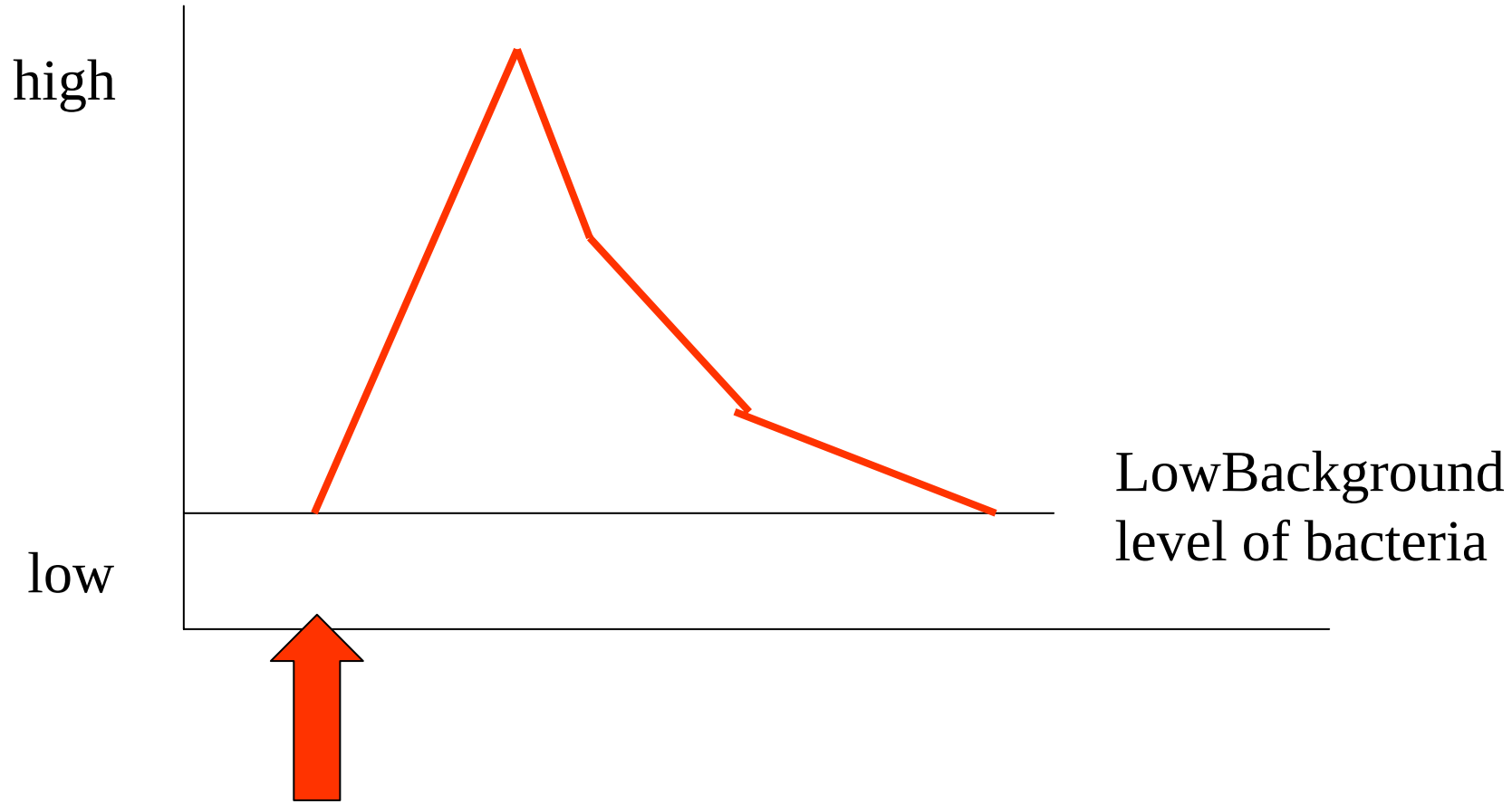
- buried in pits with lime,
- composted,
- incinerated
- bagged up and removed from the site as for normal household domestic waste.

If the fish is rotten, some hypochlorite can be added.

Harvesting and Transporting Fingerlings

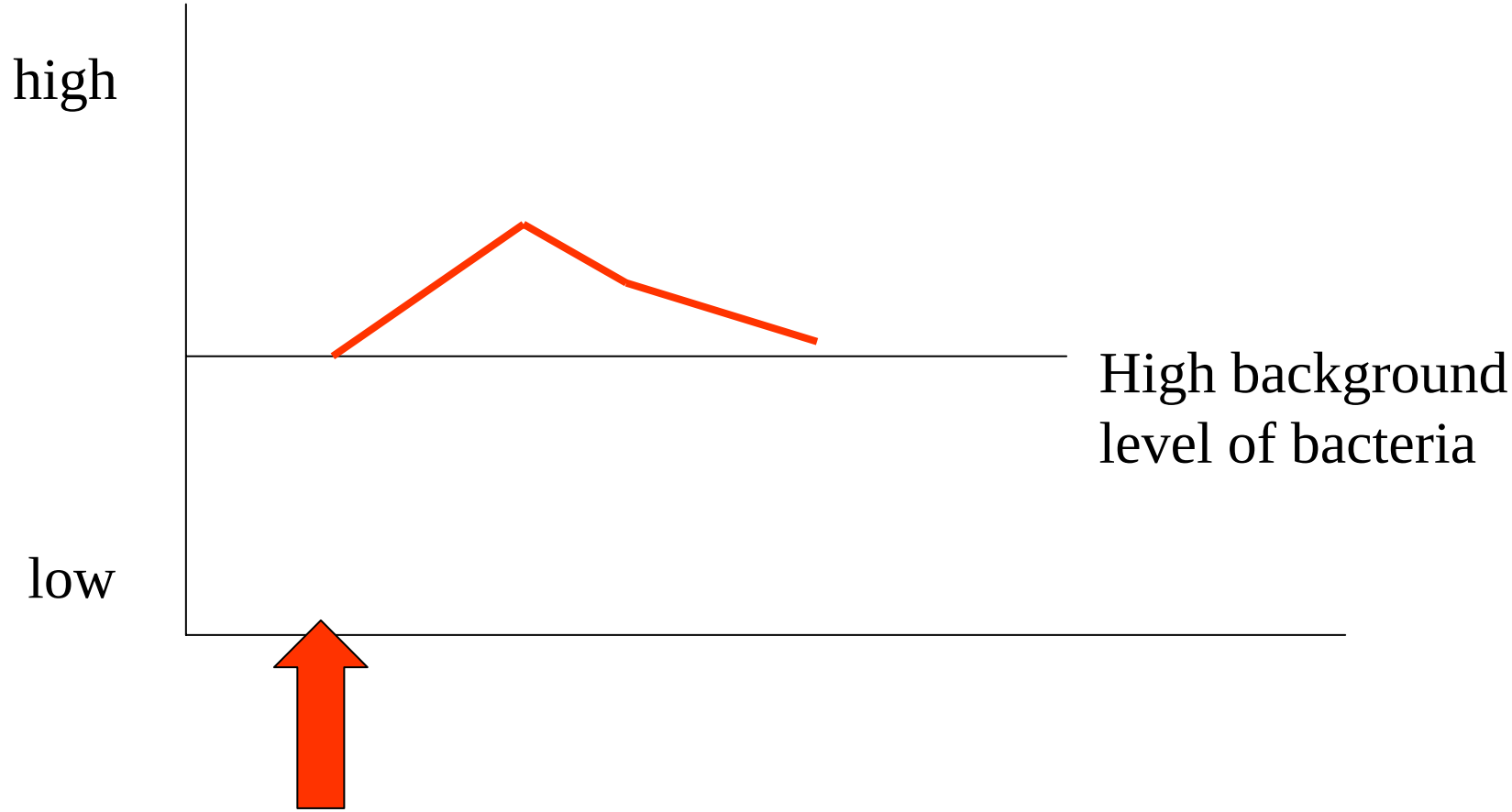
Recirculation, water maturation

Bacteria dynamics



Stabilising effect

- Probiotic bacteria give water stability



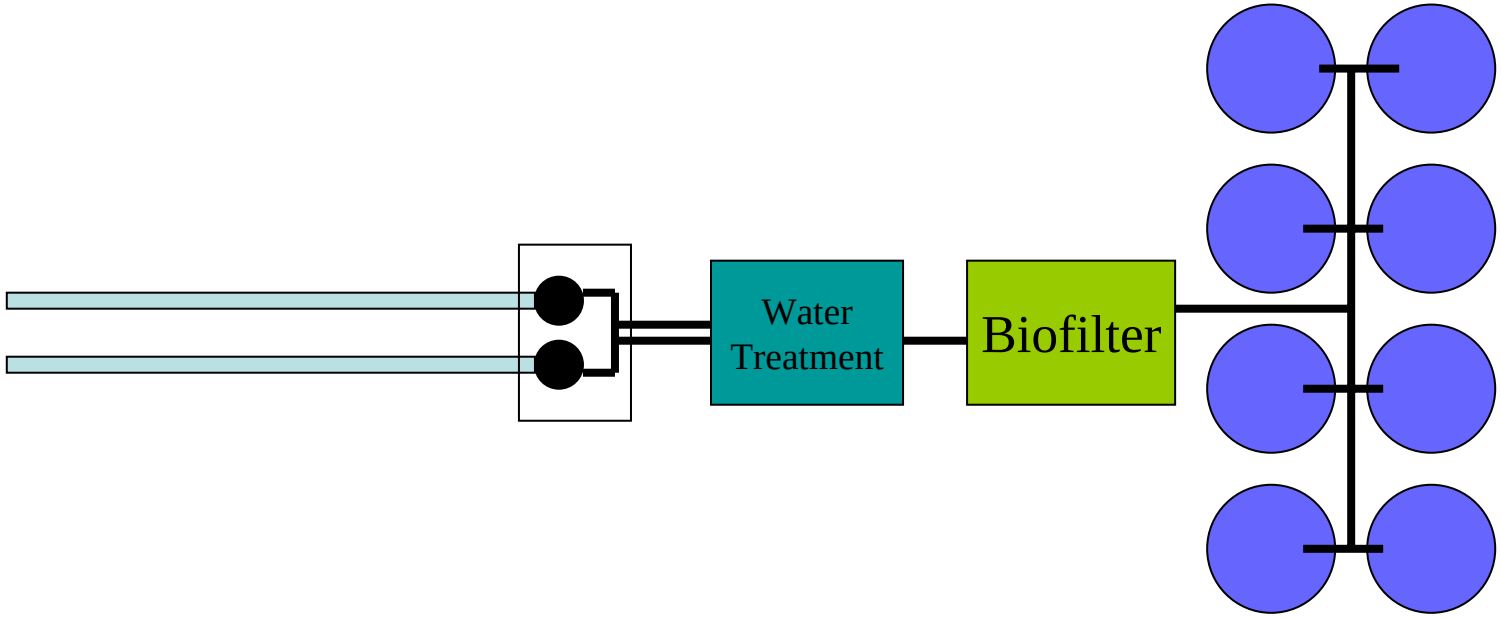
Bacterial control in larvae tanks

Possibilities

- Maturation of incoming water
- Recirculation of water in larval tanks
- Bacteria replacements/substitutes

Water Maturation

- Larvae system



Water recirculation

- Larvae tanks