Growth and husbandry effects in perch *Perca fluviatilis*

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PERCID FISH CULTURE - From research to production
Namur (Belgium) - January 2008

Introduction

- *In the past, Eurasian perch was mainly produced under natural water temperature (2-23 °C) in ponds or cages*

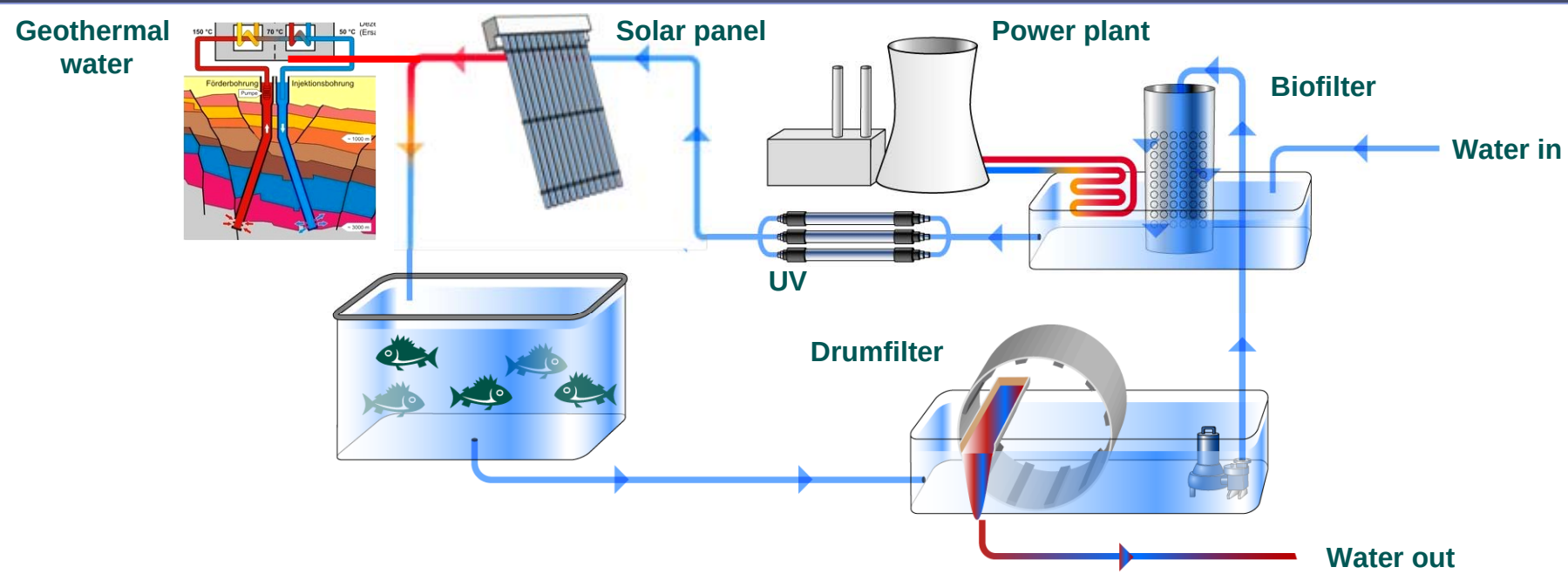
- *Due to huge temperature fluctuation and spontaneous spawning of perch in the beginning of the spring , growth, survival and productivity were poor in these rearing systems*

Introduction

- Researches conducted during the last 10 years →
  - *Control of reproduction*
  - *Optimisation of larval rearing*
  - *Growth and husbandry improvement*
  - *Genetic improvement (mono-sex female population, domestication)*
- → Development of intensive rearing of perch both at experimental, pilot and at commercial scale

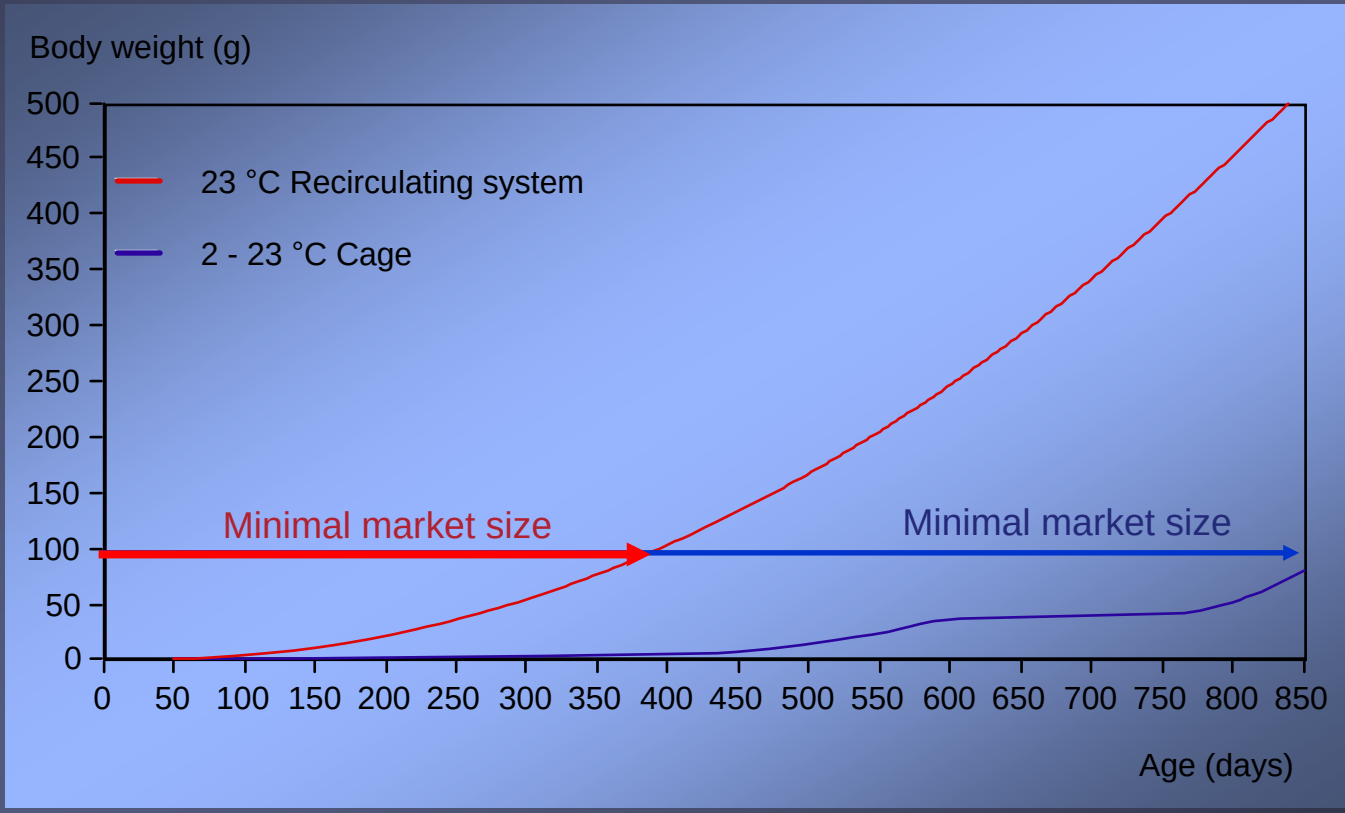
Introduction

- Principal perch productions are done in controlled temperature conditions (23 °C):
  - *In open system (warm water from power plant)*
  - *Mainly in recirculating system heated with warm water from power plant, geothermal water or solar panels*
  - *Recirculating system: control of water quality, control of pathologies (UV)*



Growth - Effect of temperature and body weight

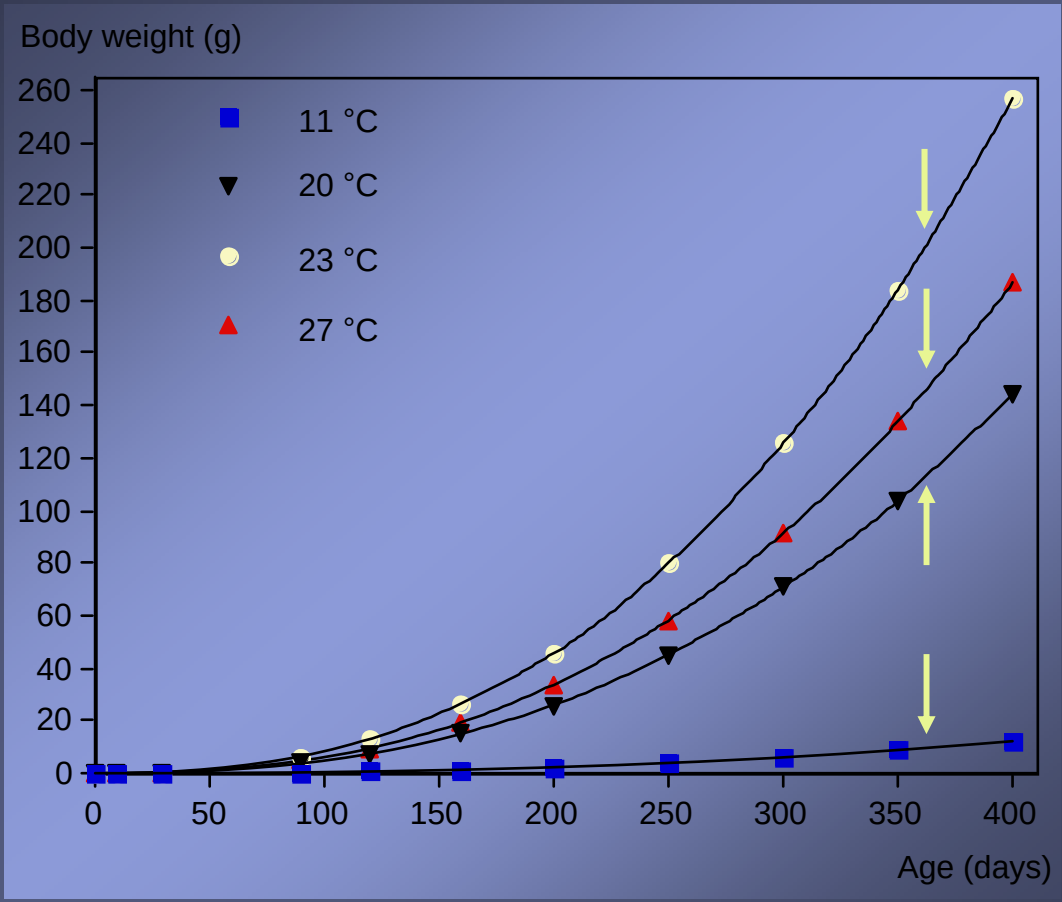
- Starting from F1 larvae (mixed sex populations) :
  - *Marketable 100 g fish produced in more than 800 days under natural temperature condition (cage)*
  - *Marketable 100 g fish produced in one year under optimum conditions (recirculating system)*



Growth curves of perch (mixed sex populations) reared in cage under natural temperature or at 23 °C in recirculating system

Growth - Effect of temperature

- Under intensive culture conditions starting from F4 monosex female larvae :
  - *Slow growth at 11 °C (10 g at 1 year)*
  - *Maximum growth at 23 °C (200 g at 1 year)*
  - *Lower growth at 27 °C and 20 °C*



Growth curves of perch reared in recirculating system at different temperatures

Maximum food ration

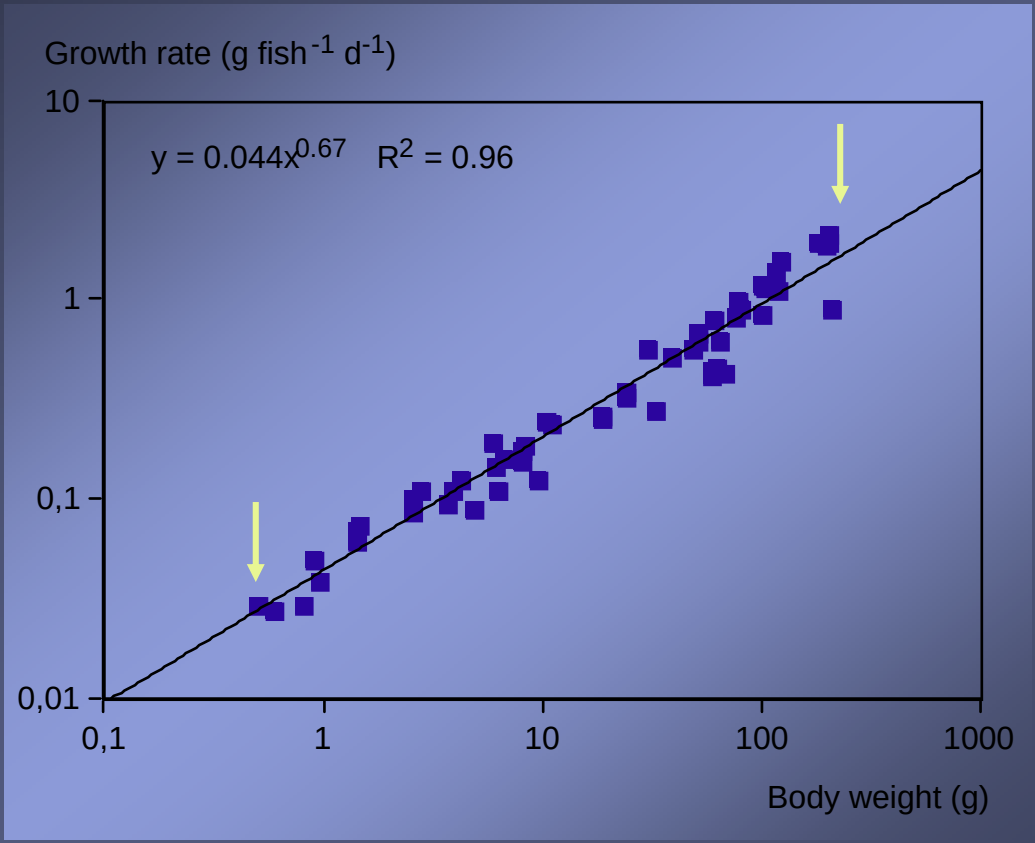
Stocking biomass: 20 - 60 kg m^{-3}

→ *Optimal temperature for growth: 23 °C*

Growth - Effect of body weight

- Under intensive culture conditions starting from F4 monosex female :

  - *At 23 °C, growth rate range from 30 mg /day for 0.5 g fish to 1.5 g / day for 200 g perch*



Effect of body weight on growth rate of perch

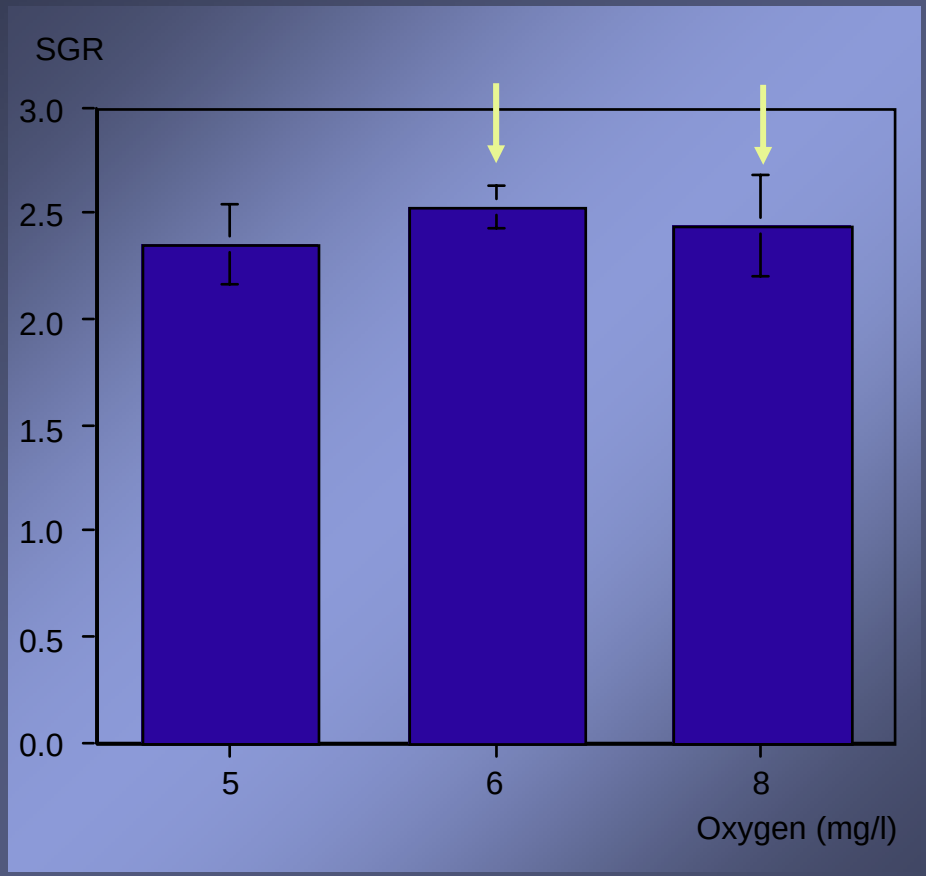
Recirculating system

Temperature: 23 °C

Maximum food ration

Growth - Effect of oxygen

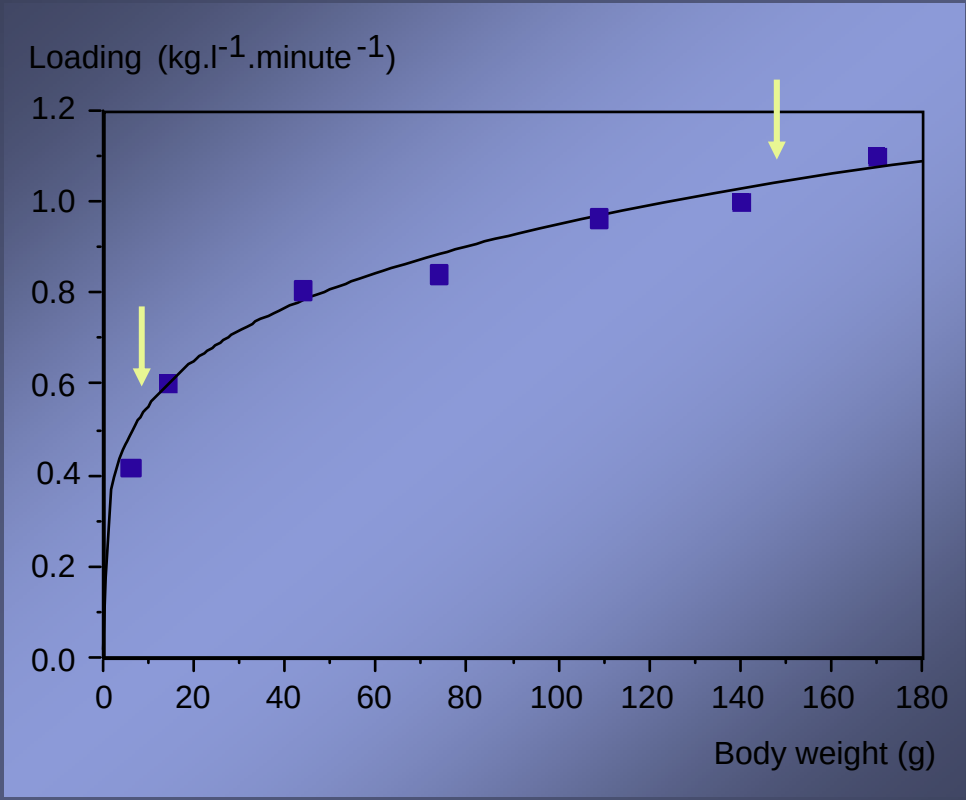
- Under intensive culture conditions (F4 monosex female)
  - *At 23 °C, optimal oxygen level : ≥ 5 ppm*
  - *Higher oxygen level do not improve growth*
  - *Oxygen level ≤ 3 ppm → perch start "air gapping"*



Effect of oxygen level on growth of 30 g perch reared in recirculating system
Temperature: 23 °C
Maximum food ration
Stocking biomass: 30 kg m^{-3}

Growth - Effect of water flow rate

- Under intensive culture conditions (F4 monosex female)
  - *Oxygen level = 5 ppm during feeding without additional oxygenation: loading (kg fish liter $^{-1}$ minute^{-1}) depends of body weight*
  - *Loading range from 0.5 kg l^{-1} minute^{-1} for 10 g fish to 1.0 kg l^{-1} minute^{-1} for 150 g fish*



Relationship between body weight and loading in perch reared in recirculating system

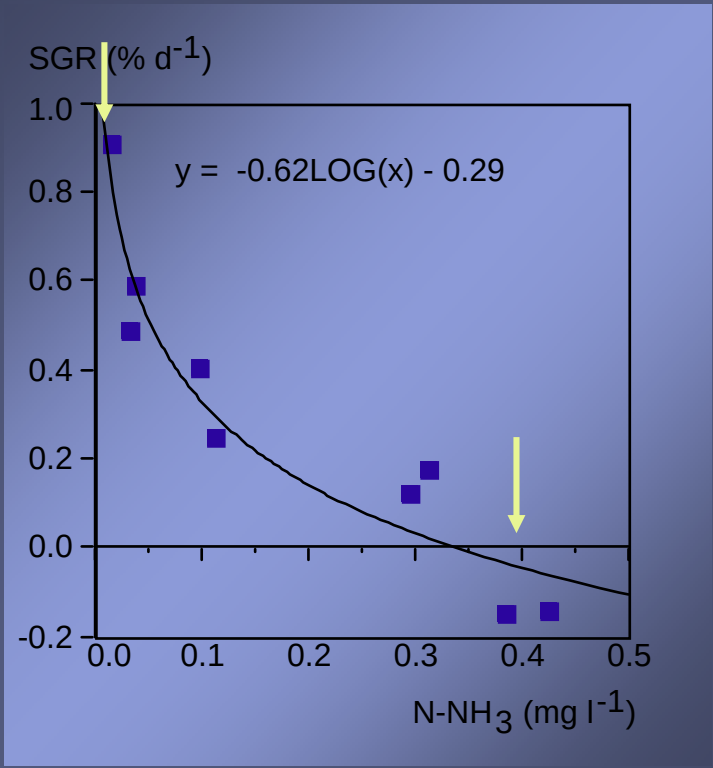
Temperature: 23 °C

Maximum food ration

Oxygen level = 5 ppm during feeding

Growth - Effect of ammonia (NH_3)

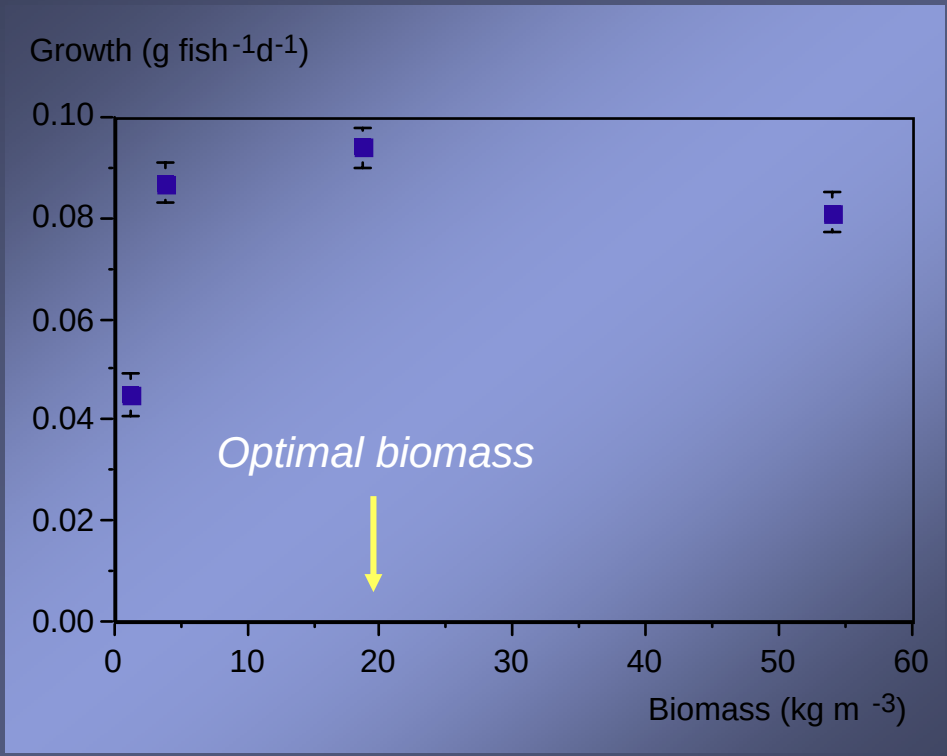
- Under intensive culture conditions (F4 monosex female)
  - *In recirculating system: ammonia = critical factor if biofilter does not work properly*
  - *At 23 °C, LD 50_{96h} = 0.8 mg/l N-NH_3 (poster)*
  - *Critical level of NH_3 for growth = 0.04 mg/l N-NH_3 (1mg /l TAN; pH 8 , T = 23 °C) Higher values induce a significant decrease of growth*
  - *Level of ammonia ≥ 0.4 mg/l N-NH_3 induces a decrease of body weight*



Effect of long time exposure to ammonia on growth of 150 g perch
Temperature: 23 °C
Maximum food ration

Growth - Effect of stocking density and biomass

- Under intensive culture conditions (F4 monosex female)
  - *Perch rearing at low stocking biomass < 5 kg m^{-3} → decrease of growth in comparison with fish reared at stocking biomass > 10 kg m^{-3} (inhibition of territorial and agonistic behaviour) - optimal biomass for growth*
  - *Biomass up to 10-60 kg m^{-3} (depending of body weight) induce a significant decrease of growth (stress)*



Effect stocking biomass on growth of 10 g perch

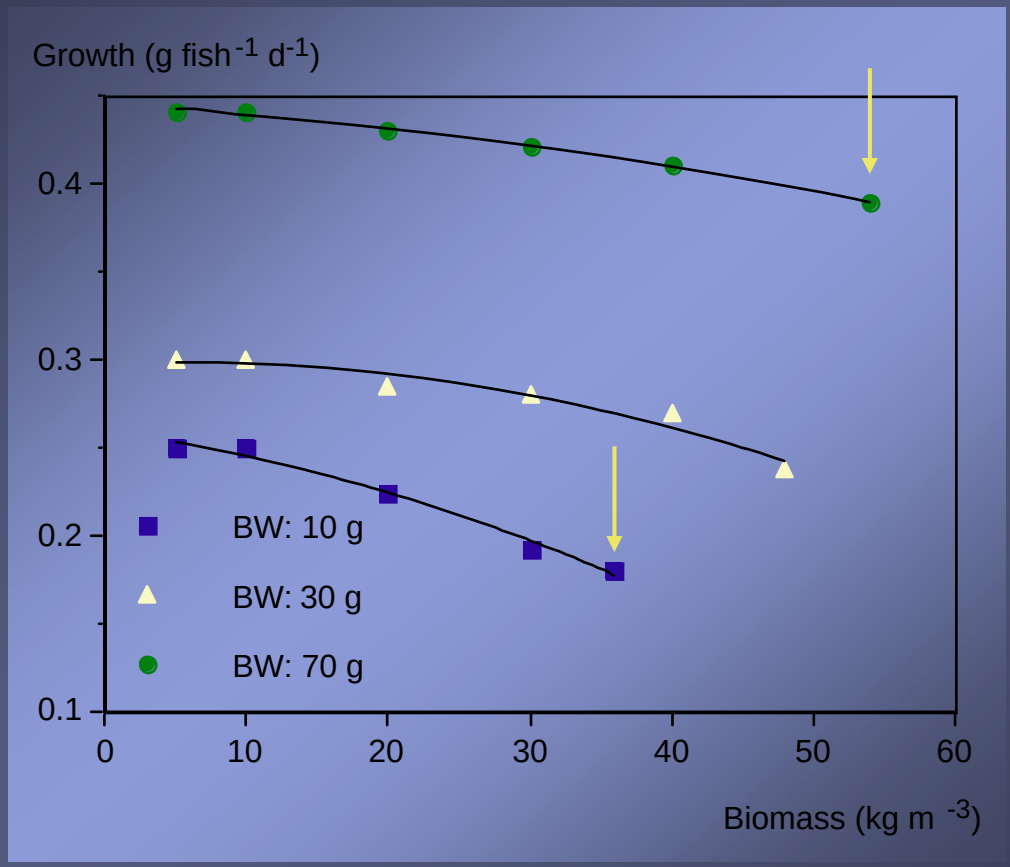
Recirculating system

Temperature: 23 °C

Maximum food ration

Growth - Effect of stocking density and biomass

- Under intensive culture conditions (F4 monosex female)
  - *Biomass up to 10-60 kg m^{-3} (depending of body weight) induce a significant decrease of growth (stress)*
  - *Growth decrease of 15 % for 70 g fish at 55 kg m^{-3} vs. 10 kg m^{-3}*
  - *Growth decrease of 30 % for 10 g fish at 35 kg m^{-3} vs. 10 kg m^{-3}*



Effect stocking biomass on growth of perch

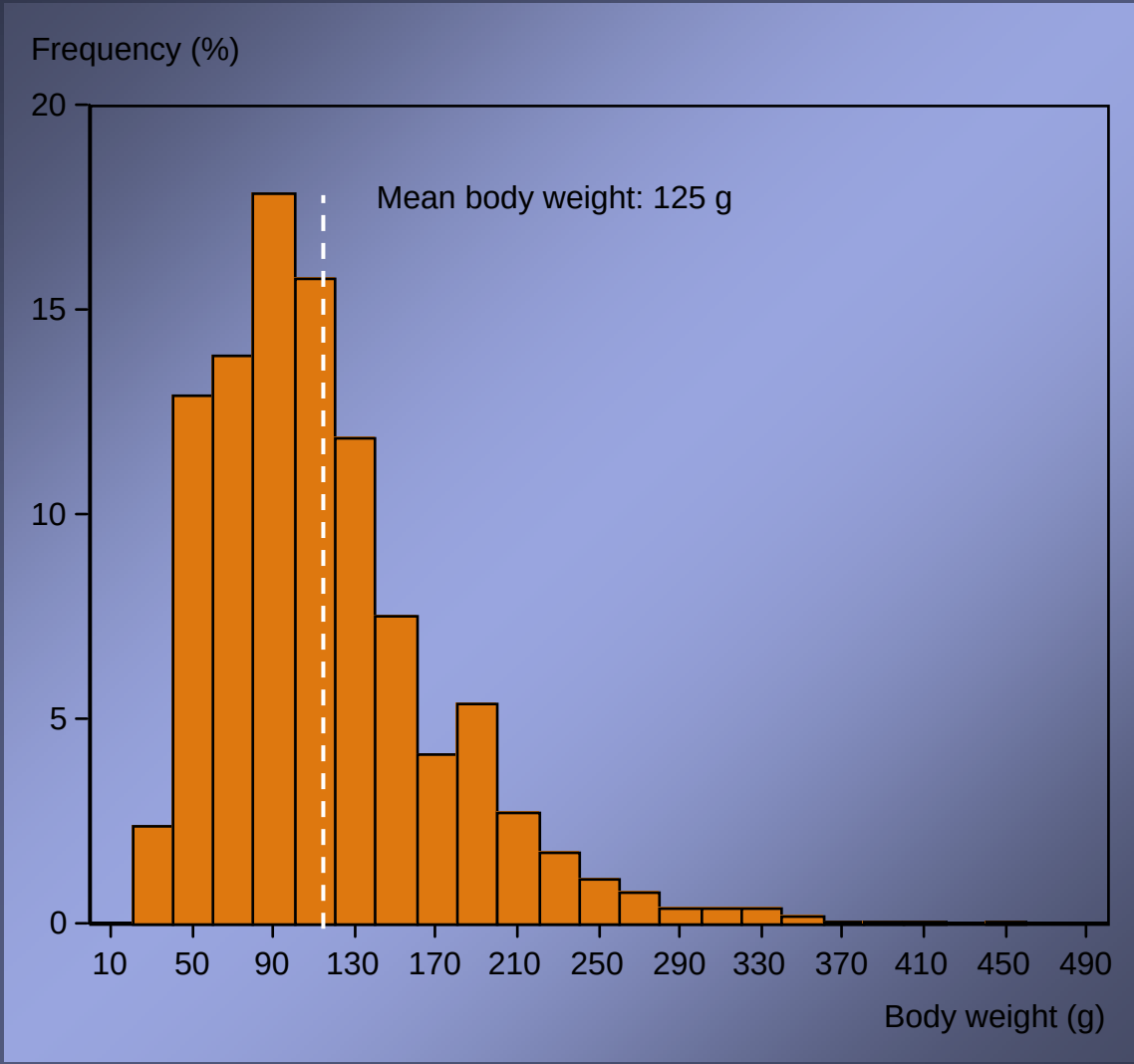
Recirculating system

Temperature: 23 °C

Maximum food ration

Growth - Heterogeneity

- Under intensive culture conditions
  - *Growth heterogeneity (C.V. > 60 %): a major constraint during juvenile ongrowing period (cannibalism and competition for food)*



Growth heterogeneity of a 1 year progeny of perch

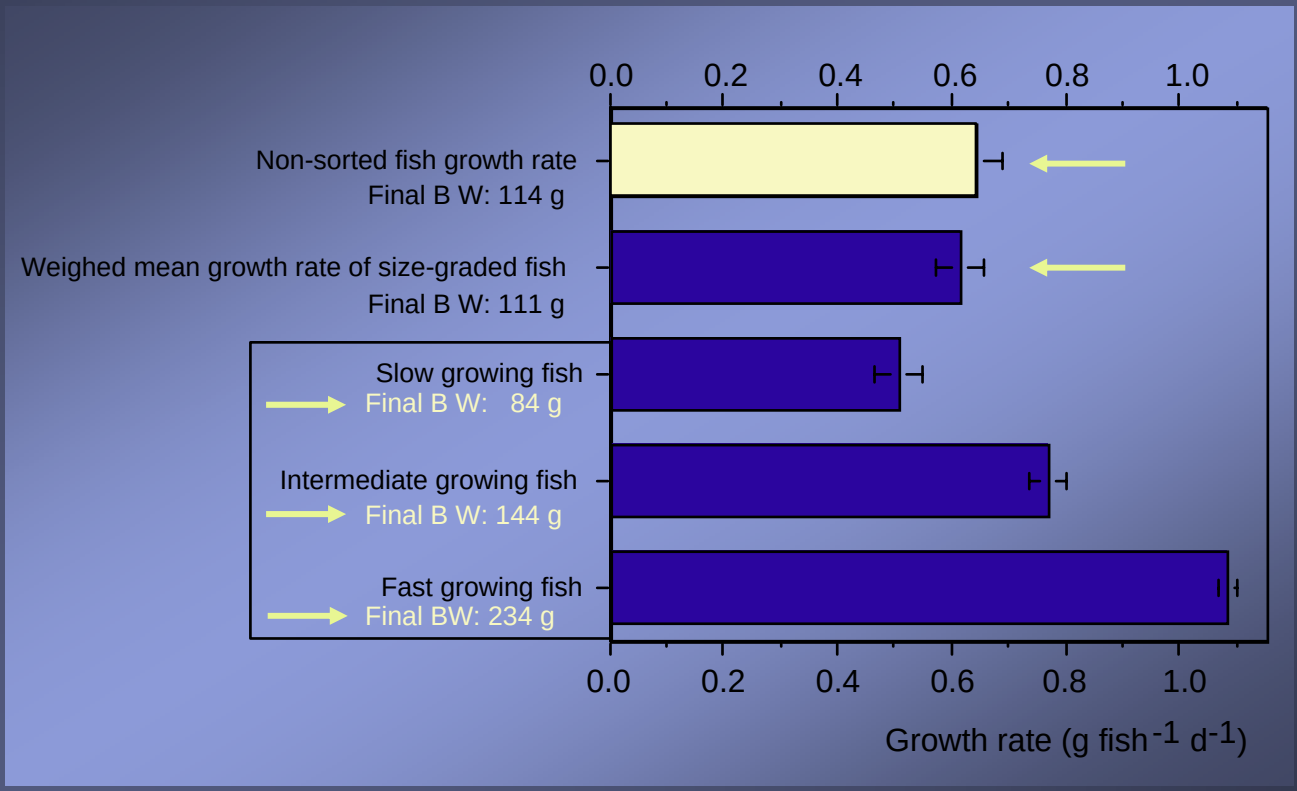
Recirculating system

Temperature: 23 °C

Maximum food ration

Growth - Heterogeneity

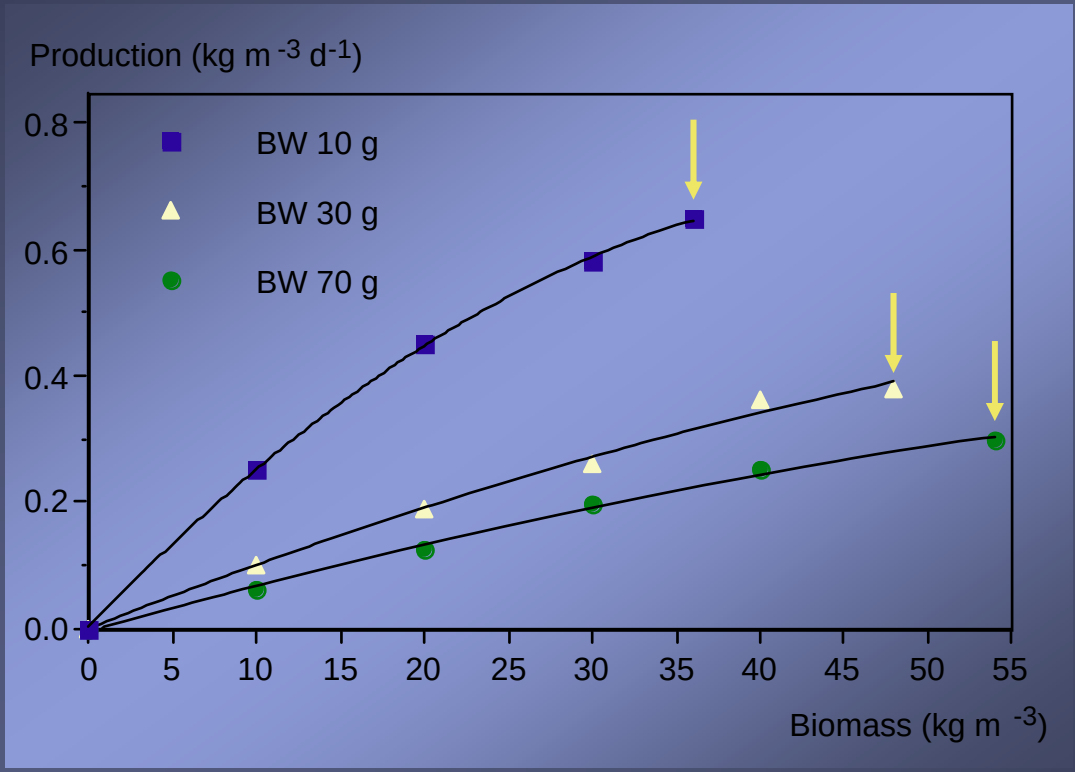
- Under intensive culture conditions
  - *Size grading → emergence of fast growing fish - reduction of cannibalism*
  - *Size grading dot not improve the productivity*



Growth rate of a non-sorted and sized- graded progeny of perch
Recirculating system
Temperature: 23 °C
Maximum food ration

Production - Effect of body weight and biomass

- Under intensive culture conditions (F4 monosex female)
  - *Classical non-linear relationship between production and biomass*
  - *Optimal biomass → maximal production*



Effect of biomass on daily production of perch

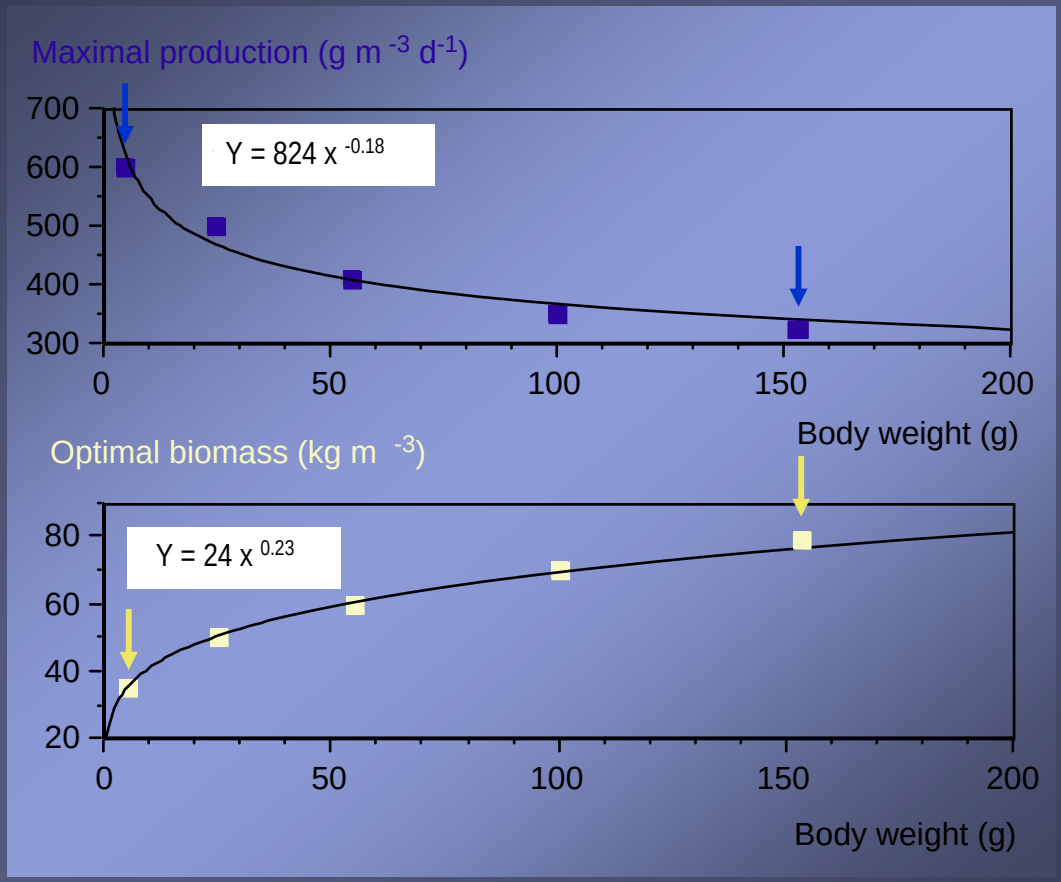
Recirculating system

Temperature: 23 °C

Maximum food ration

Production - Effect of body weight and biomass

- Under intensive culture conditions (F4 monosex female)
  - *Optimal biomass giving maximal production depends of body weight*
  - *Optimal biomass range from 35 kg m^{-3} for 5 g fish to 80 kg m^{-3} for 150 g fish*
  - *Maximal daily production range from 0.6 kg m^{-3} for 5 g fish to 0.35 kg m^{-3} for 150 g fish*



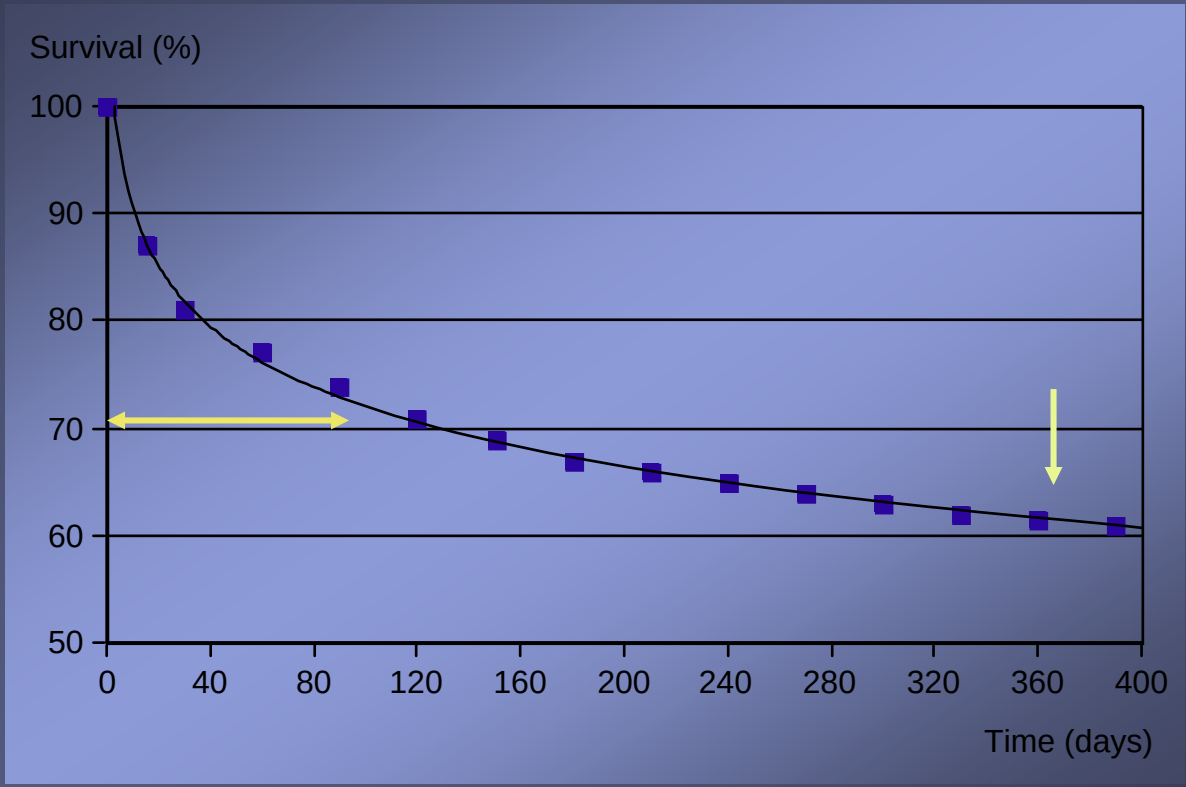
Relationships between body weight, biomass and production level of perch

Recirculating system

Temperature: 23 °C

Survival - Age

- Under intensive culture conditions (F4 monosex female)
  - *High mortality level during the first 3 months (30 %)*
  - *Starting from 0.3 g weaned juveniles, mean survival rate at 1 year : ± 60 % (mean body weight: 200 g)*



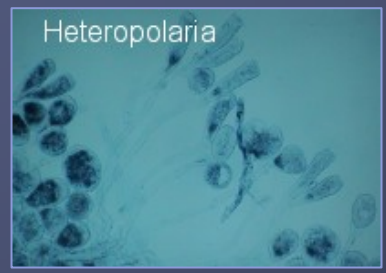
Mean survival of perch in intensive culture starting from 0.3 g weaned juveniles
Recirculating system
Temperature: 23 °C

Survival – Origins of mortality

- Under intensive culture conditions
  - *High mortality level during the first 3 months results from:*
    - *Cannibalism (1 week after grading)*

    - *Parasites (Gyrodactylus, Trichodina)*

    - *Bacteria (Aeromonas)*
  - *Some mortality resulting from infestation by Heteropolaria in larger fish (mainly in open system)*



Conclusion - perspectives

- Intensive culture of perch at 23 °C in recirculating system results in higher growth rate and survival than in conventional system under natural temperature

- The productivity of perch in intensive rearing should be improve by:
  - *Reduction of mortality rate mainly during the beginning of the ongrowing period (reduction of growth heterogeneity and consequently cannibalism, improvement of the quality of weaned larvae, reduction of stress by domestication)*
  - *Growth rate improvement : selection of fast growing strains, quantitative selection and culture of monosex female fish*