IMPROVEMENT OF REARING CONDITIONS FOR JUVENILE PIKEPERCH *SANDER LUCIOPERCA* PRODUCTION IN RAS.

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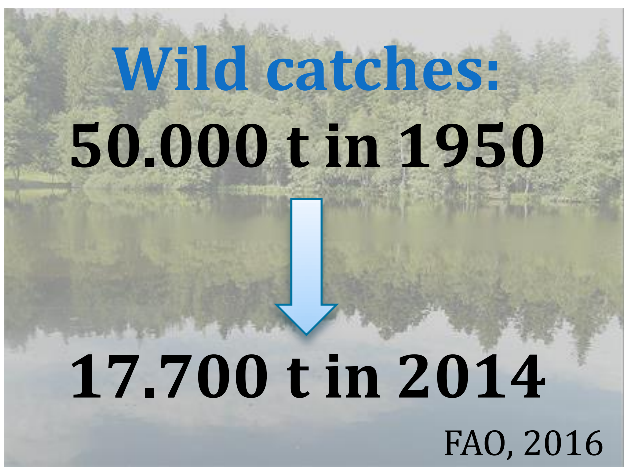
Meet us at Aquaculture Europe 2017

Aquaculture Europe 2017, Dubrovnik, Croatia, October 17-20, 2017

Pikeperch (*Sander lucioperca*)

- Percidae
- Freshwater fish
- Very high potential for inland aquaculture diversification in Europe (Wang *et al*., 2008; Kestemont *et al*., 2015)
- Bio-economic feasibility of its intensive rearing using RAS (Steenfeldt & Lund, 2008; Steenfeldt *et al*., 2010; Dalsgaard *et al*., 2013)



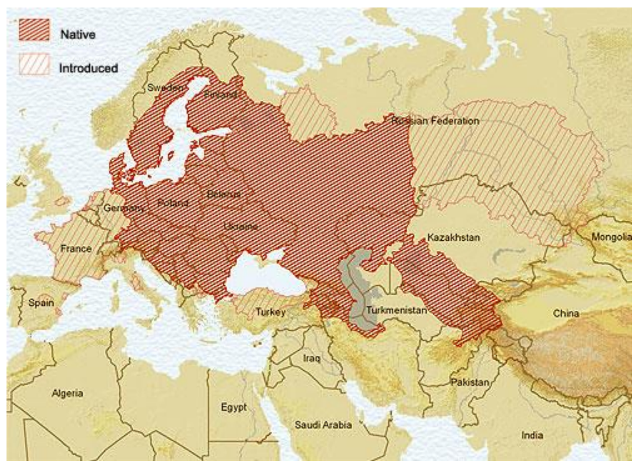
Wild catches:

50.000 t in 1950

↓

17.700 t in 2014

FAO, 2016



European Aquaculture of percids in RAS:

around 1000 tons

Objectives of WP 16 in Diversify (Larval husbandry pikeperch)

1. Improvement of pikeperch larval rearing protocols by using a **multifactorial** approach

2. Reduction of **cannibalism** rate to increase survival

3. Development of an **industrial protocol** to improve larval performance during rearing

Four experiments have been planed:

WP16 - 1 : Environmental factors (Colchen *et al.*, 2015 at EAS meeting 2015)

WP16 - 2 : Nutritional factors (feeding strategy)

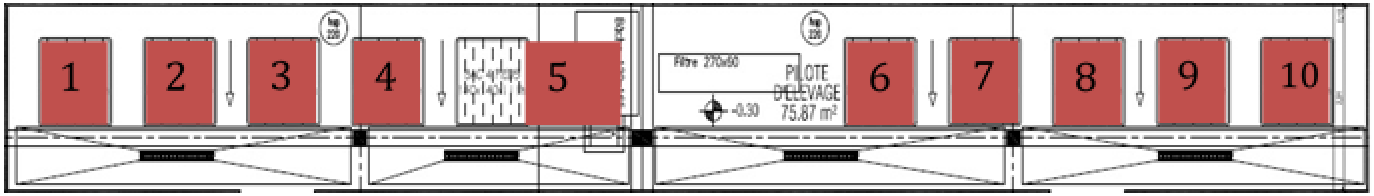
WP16 - 3 : Populational factors

WP16 - 4 : Validation of optimal combinations (2018)

A main goal ⇔ Identification of optimal combinations of husbandry factors to improve survival and growth of larvae and juveniles.

Experimental choices :

1 – Experimental facilities closed to farm conditions (RAS : 10 m3, tanks volume : 700 l)



2 – Integrative approach, not focused on a specific step (first feeding of larvae, weaning or growth of weaned juveniles) => long duration : 7-8 weeks

3 – Use of standard protocols and commercial diets :

+ Photoperiod (12:12)

+ Small (430 µm) and large (550-600 µm) size *Artemia* nauplii, Catvis, Hertogenbosch, The Netherlands)

+ Prowean 100, BioMar, Åarhus, Denmark

Experiment 1 : Effects of four feeding factors

Factors fixed: 30,000 larvae/tank (ca. 43 larvae l^{-1}), 15°C at day 1 => 20°C at day 5, L:D 12:12 (50 lx during light period), [O2] > 7 mg.l $^{-1}$, Salinity = 0.7-0.9 ‰

Factors studied: Modalities tested according to the bibliography

Beginning of the weaning:

- ❑ Reduction of costs related to *Artemia nauplii* (Hamza et al., 2007; Steenfeldt, 2015)

→ **10 dph *vs* 16 dph**

Method of food distribution:

- ❑ based on very variable practices (Hamza et al., 2007, 2010, 2012; Szkudlarek & Zakes, 2007; Lund *et al.*, 2012)

→ **discontinuous (**7 meals day^{-1}) ***vs*** **continuous during the lighting period**

Co-feeding:

- ❑ Applied (Hamza et al., 2007; Szkudlarek et Zakęś, 2007; Ljubobratovic et al., 2015; Król and Zakęś, 2016) or not (Lund et al., 2012, 2014)

→ **Co-feeding (6 before weaning, 3.5 g day $^{-1}$) *vs* not**

Weaning duration:

- ❑ Slow (Kestemont et al., 2007 ; Lund et al., 2014) or rapid (Hamza et al., 2007; ; Lund *et al.*, 2012) weaning transition are applied.

→ **3 days *vs* 9 days**

Multifactorial experimental design

Advantages

Experimentally:
- ❑ Several factors
- ❑ Two modalities
- ❑ Few experimental units

Statistically:
- ❑ Effect of interactions between factors
- ❑ effect of simple factor
- ❑ Analys software ®

With multifactorial

10 dph	16 dph	10 dph	16 dph	10 dph	16 dph	10 dph	16 dph
Contin.	Contin.	Discont.	Discont.	Contin.	Contin.	Discont.	Discont.
Co-feed.	Co-feed.	Co-feed.	Co-feed.	No	No	No	No
3 days	9 days	9 days	3 days	9 days	3 days	3 days	9 days

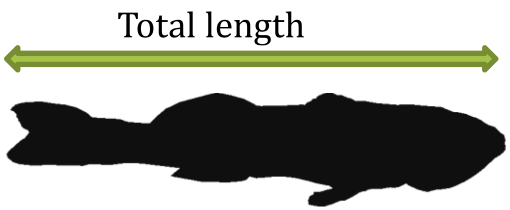
Matrix design to attribute factors to each tank — Planor software ®

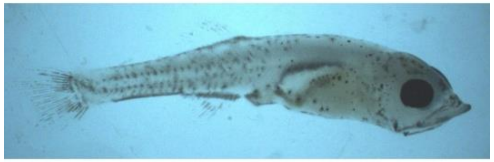
Duration and timing

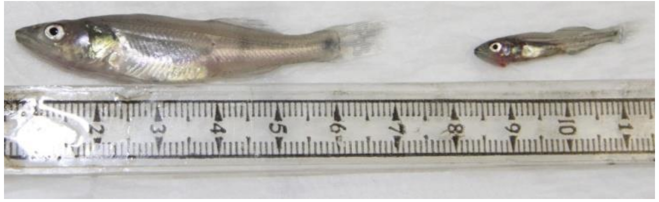
The experiment lasted 49 days (53 dph, from 5th February until 24th March 2016).

Sampling : each week (30 larvae per tank)

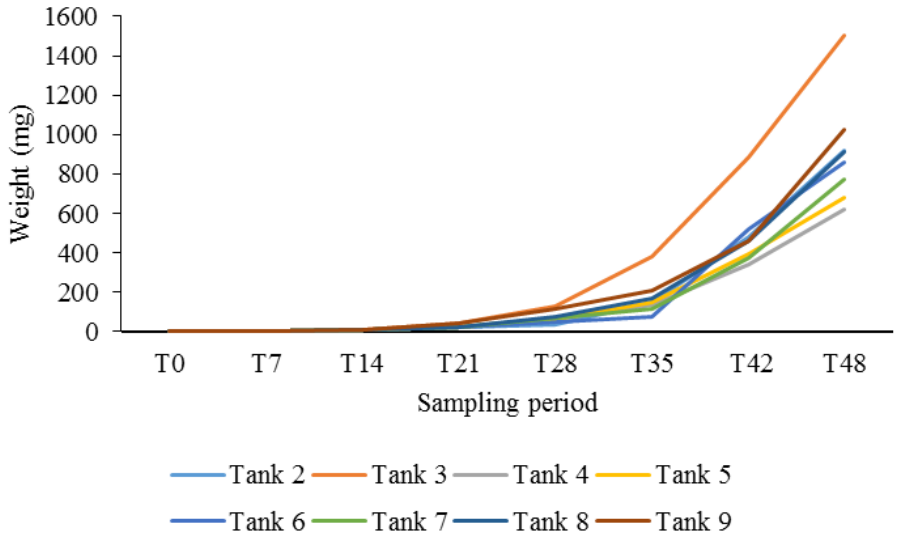
Total length (TL)
Body weight (W)
Coefficient of variation of TL (CV TL)
Coefficient of variation of W (CV W)
Specific growth rate (SGR)
Final fish biomass
Survival rate
Rate of inflation bladder
Growth rate







Results



Growth curves:

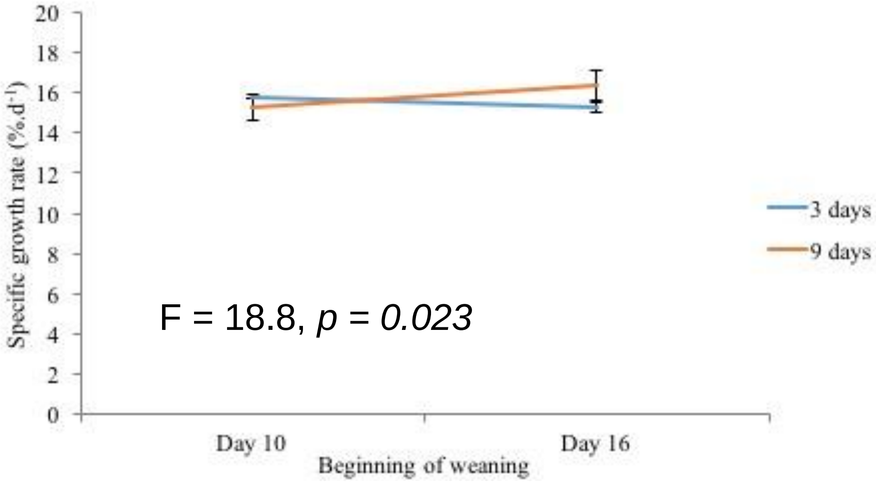
- Mean SGR = 15.6 %.d-1 (16.7 %.d-1 in tank 3)
- Final mean weight between 0.62 g (tank 4) et 1.50 g (tank 3)

- Higher inflation rate (67.8%) of swim bladders after 9 days of weaning *vs* 3 days only (18.2%) (F = 12,4, p = 0.024)

- Two combinations (3, 9) more efficient

Tanks	Swimbladder inflation (%)	Final biomass (g)	Mean weight (mg)	Survival (%)
2	22.51	1026	919.27	5.5
3	**98.11**	**1962**	**1502.31**	**10.5**
4	15.97	2110	623.57	11.3
5	10.43	1361	677.11	7.3
6	86.29	766	861.50	4.1
7	24.63	678	770.95	3.6
8	15.17	1489	913.10	8.0
9	**70.81**	**2443**	**1022.20**	**13.1**

Results

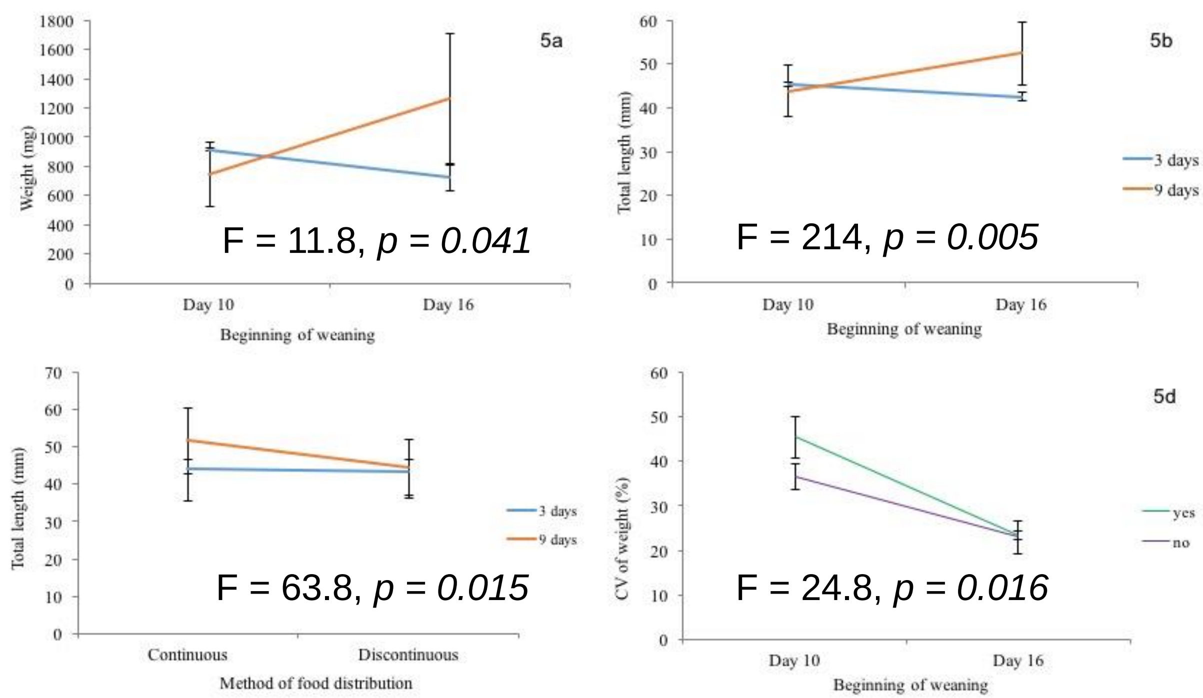


<u>Significant effect of the interaction beginning of the weaning * weaning duration</u>

Higher growth rate with weaning starting at 16 dph and lasting 9 days.

At 53 dph, significant effects of the interactions:

- beginning of weaning *weaning duration on final weight and length,
- weaning duration*method of food distribution on final length,
- beginning of weaning *co-feeding on CV for weight.



Conclusions

For factors related to feeding strategy, our recommendations are :

A later onset of weaning:
A longer duration of weaning:
Discontinouous feeding (mainly after the weaning period)**:**

✓ **Higher survival and growth**
✓ **Higher rate of swim bladder inflation**

No effect of the co-feeding

Experiment 2 : Effects of four populational factors (49 days)

Factors fixed: 15°C at day 1 => 20°C at day 5, L:D 12:12 (50 lx during light period), [O2] > 7 mg.l $^{-1}$, Salinity = 0.7-0.9 ‰

Factors studied: Modalities tested according to the bibliography

Initial larvae density:
- Effect on cannibalism (Baras, 2012)
- Wide range of density used in pikeperch larvae culture: 5 => 100 larvae l $^{-1}$

→ **50 *vs* 100 larvae l $^{-1}$**

Sorting of fish jumpers:
- Jumpers = cannibals (Baras, 2012)
- Jumper sorting generally practiced in nursery, but efficiency not clear (Mandiki et al., 2007)

→ **Applied or not**

Mixed batches or not :
- Mixe applied when lack of larvae
- Risk of increase of the initial size heterogeneity

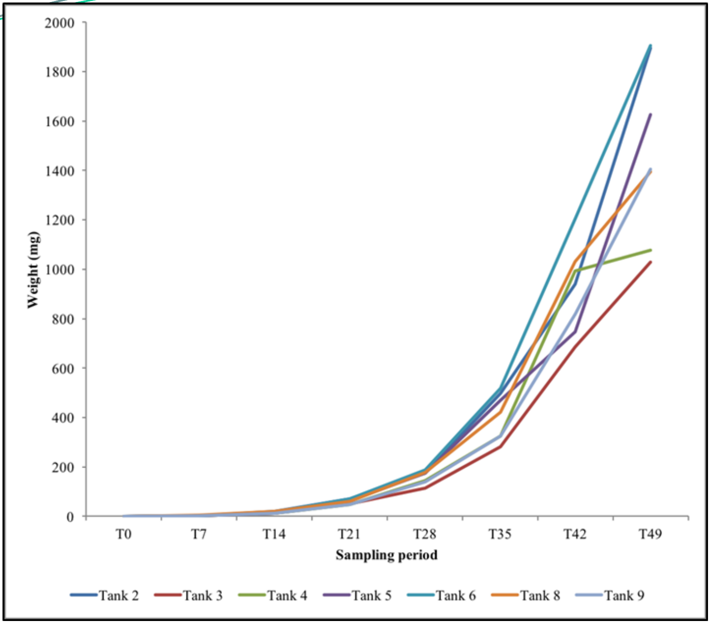
→ **Sibling *vs* not sibling population**

Female weight:
- Effect on eggs and initial larvae size.
- Higher mouth size => higher success for first feeding

→ **Small (< 2.8 kg) vs large (> 3.3 kg)**

Four females were used (spawning in February 12-13, 2017).

Results



Growth curves:

- Final mean weight between 1.02 g (tank 3) and 1.90 g (tank 6)
- Very high rates of swimbladder inflation (86-100%)
- Two combinations (3, 9) more efficient => final density of 8 kg. m^{-3}

Lack of a tank (7)!!

= unexplained mortality

Tanks	Swim bladder inflation (%)	Final biomass (g)	Mean weight (mg)	Survival (%)
2	96.66	2073	1896.37	3.1
3	90.00	5596	1029.58	7.7
4	93.33	3606	1076,00	9.5
5	100.00	3527	1626.94	3.1
6	93.33	3046	1905.66	4.5
8	86.66	1345	1395.8	2.7
9	90.00	5837	1406.90	5.9

Conclusions

For factors related to population variables, our recommendations are :

A higher initial density of larvae:
The use of larvae from larger females:

✓ **Higher final biomass**

No effect of the jumper sorting or mixe of no sibling population

Prospects

Short term:

Validation of few combinations in our experimental facilities (February – March, 2018) **– D16-4**

Test of 2-3 optimal combinations of factors in farm conditions (Fish2Be, Belgium, April-June 2018**) – D16-5**

Development of an **industrial protocol** to improve larval performance during rearing (2018) **– D16-6**

Long term:

1. Integration of factors not yet tested in our multifactorial approach (ex: temperature)

2. Application of some parameter according a dynamic way and not fixed for the whole duration of the nursery stage (ex: light intensity)

Thank you for your attention

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DIVERSIFY

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