UNIVERSITÉ DE LORRAINE

INRA
Institut National de la Recherche Agronomique

« Welcome to DIVERSIFY Workshop on recent progress in pikeperch culture »

Nancy, France, 27th June, Faculty of Sciences and Technologies

Co-funded by the Seventh Framework Programme of the European Union

DIVERSIFY

« Bottlenecks of pikeperch culture »

State of the art and survey done in 2012!!

aquapri handpicked luxury seafood → Asialor ÉLEVAGE DE PERCHES ET SANDRES → Fish2Be

2012 2013 2016

Co-funded by the Seventh Framework Programme of the European Union

Which bottlenecks as priorities?

- **Lack of knowledge of the genetic variability of the used broodstocks**

- **high sensitivity to stressors, handling and husbandry practices** that result in **high and sudden mortalities**.

- **low larval survival** (typical 5-10%) and **high incidence of deformities** (confirm by recent results in Fish2Be and Asialor)

Which objectives and tasks (DoW 2013)?

- To **characterize genetically wild and available cultured broodstocks** and to provide **tools to establish genetic breeding programs**.

C. Tsigenopoulos

- To study the **effect of selected dietary nutrients** on pikeperch **larval development** and performance, and particularly of EFA on **long-term stress sensitivity**.

I. Lund

- To develop **effective larval rearing and weaning protocols** that reduce cannibalism and mortality while improving growth.

P. Fontaine

Which objectives and tasks?

- To study the effect of (i) **husbandry practices and environmental factors on growth, immune and physiological status** and (ii) of **domestication level and geographical origin** on growth and stress sensitivity and immune performances.

P. Kestemont

- To **analyze the consumer market and to develop new products** ending with physical prototypes, accompanying **marketing and communication strategies** for these products, and **market and business models** for the introduction of these products in the market.

G. Tacken

Presentation of results + invited speakers

- Environmental control of the reproductive cycle for out-of-season spawning.

  M. Stüeken

- Hormonal treatments to induce spawning

  D. Zarski

- Production of high quality juveniles for ongrowing farms with combined system using pond/RAS

  T. Policar

- Major diseas risks related to pikeperch culture

  L. Bigarré

Technical Leaflets for pikeperch

- A document will be sent to all participants in few weeks by –mail.

WP 16 - PIKEPERCH LARVAL REARING

Optimization of the protocol for larval rearing in RAS

Co-funded by the Seventh Framework Programme of the European Union

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, EAS meeting)

WP16 - 2 : Nutritional factors (feeding strategy)

WP16 - 3 : Populational factors (Colchen *et al.*, 2017, EAS meeting)

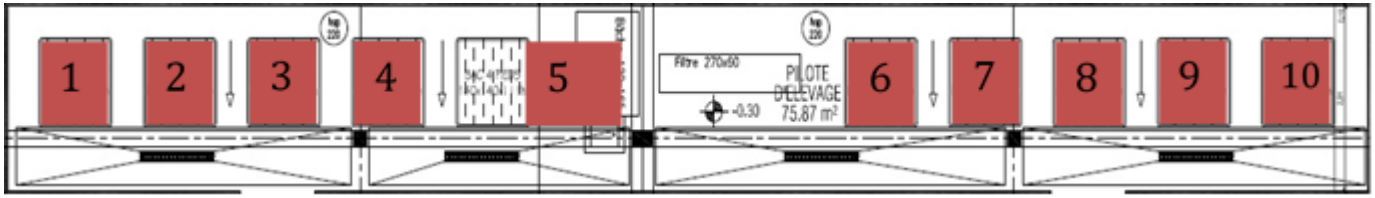
WP16 - 4 : Validation of optimal combinations (February – April 2018)

Use of the same broodstock for all the experiments (Asialor, Czech strain)

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) => trials at pilot scale!



No possibility to test the temperature !!!

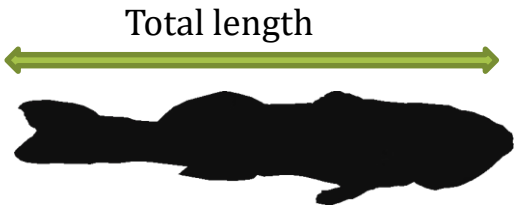
2 – Integrative approach, not focused on a specific step (first feeding of larvae, weaning or growth of weaned juveniles) => long duration : 7-8 weeks (52-53 dph)

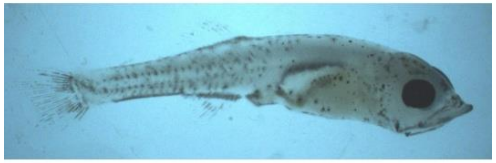
3 – Use of standard protocols and commercial diets (according SMEs practices):

+ Photoperiod (12:12)
+ Small (430 µm) and large (550-600 µm) size *Artemia* nauplii, Catvis, Hertogenbosch, The Netherlands)
+ Prowean 100, BioMar, Åarhus, Denmark

Sampling : each week (30 larvae per tank)

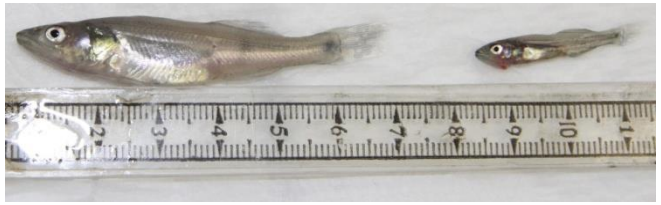
Total length (TL)
Body weight (W)
Coefficient of variation of TL (CV TL)
Coefficient of variation of W (CV W)
Specific growth rate (SGR)





At the end

Final fish biomass
Biomass gain
Survival rate
Rate of inflation bladder



Experiment 2 : Effects of four environmental factors

January – March (2015)

Factors fixed: 62,500 larvae/tank (ca. 90 larvae l^{-1}), 15°C at day 1 => 20°C at day 5, L:D 12:12, [O2] > 7 mg.l^{-1}, Salinity = 0.7-0.9 ‰

Light intensity:
❑ sensitive to high LI (above 200 lx) (Hamza et al., 2008; Steenfeldt, 2011; Lund, 2012; Francesconi, 2014)
→ **5 vs 50 lx**

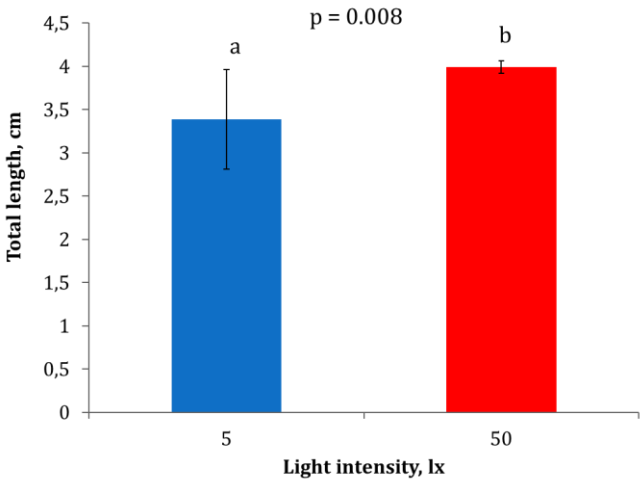
Water renewal rate:
❑ based on previous works (Szkudlarek & Zakes, 2007; Lund & Steenfeldt, 2011; Lund *et al.*, 2012; Ott *et al.*, 2012)
→ **50 vs 100 % / hour**

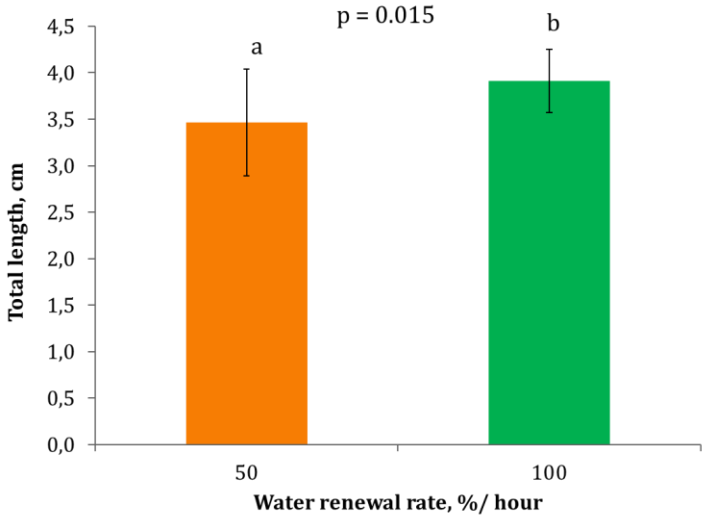
Water current direction:
❑ impacts the position of larvae in the water column
❑ responsible of mortality, deformities (Summerfelt, 1996)
→ **Water arrival: Surface vs Depth**

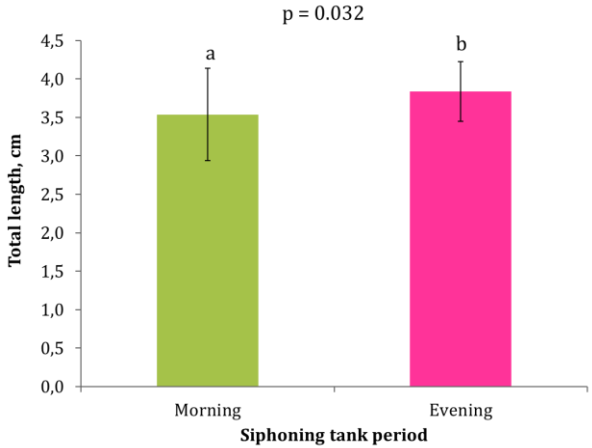
Siphoning tank period:
❑ a time of stress for larvae: impact behaviours (foraging and swimming) and water quality
→ **Morning vs Evening**

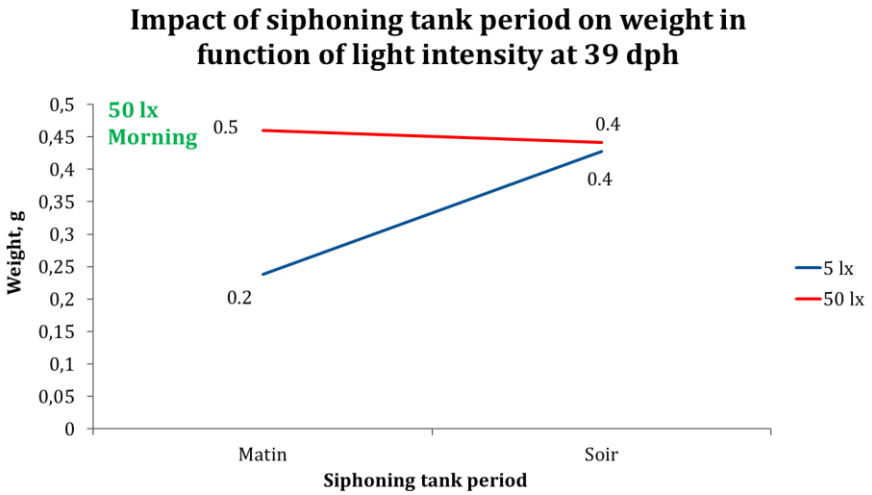
Remark: This trial was firstly done in 2014 and repeated in 2015 due to very high mortality related to high salinity (6 ‰).

Some results :









Conclusion

For environmental factors, the best combination was:

Light intensity: 50 lx
Water renewal rate: 100 % / hour
Siphoning tank period: morning
Water current direction: surface water arrival

- ✓ **Larger larvae**
- ✓ **Heavier larvae**
- ✓ **More homogenous group larvae**

But survival rates were very low (0.3-2.6% at 39 dph) (pb with the eggs shell)!!

Experiment 2 : 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**

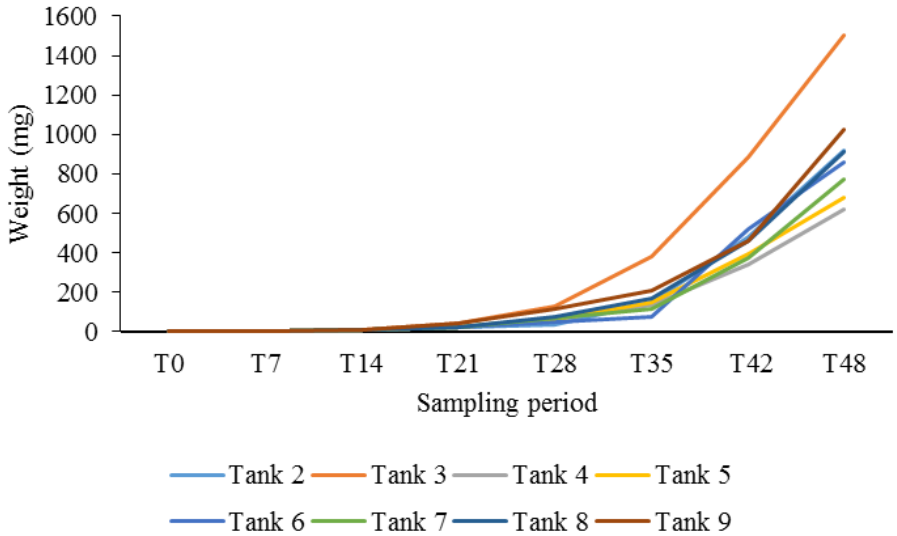
Weaning duration:

❑ 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**

Remark : This trial was also repeated due to very high mortality related to a Perch perhabdovirus infection.

Results



Growth curves:

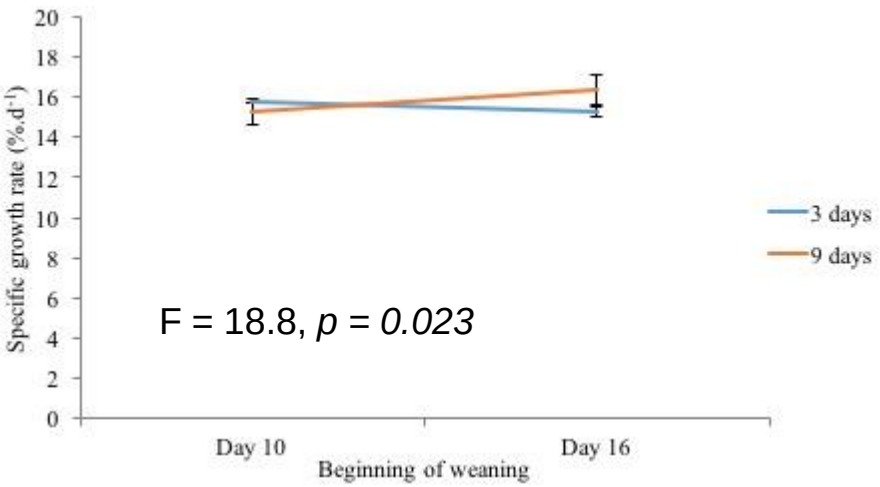
- Mean SGR = 15.6 %.d-1 (16.7 %.d-1 in tank 3)
- Final mean weight between 0.62 g (tank 4) et 1.50 g (tank 3)

- 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

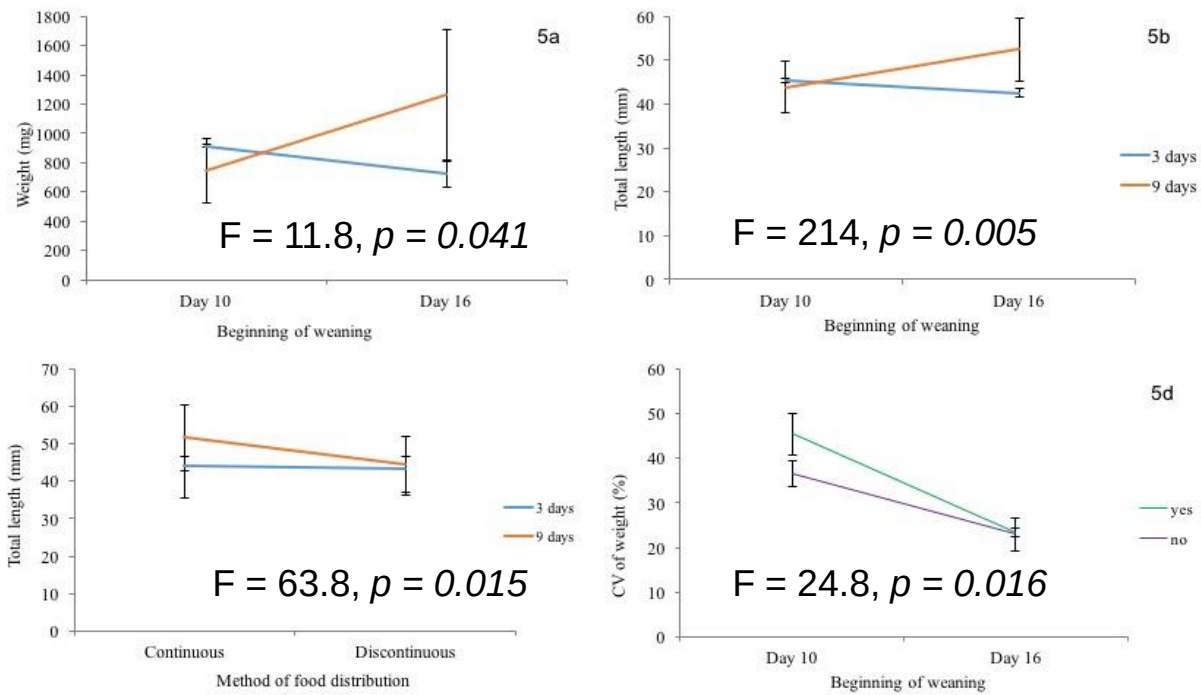


Significant effect of the interaction beginning of the weaning * weaning duration

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 3 : 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

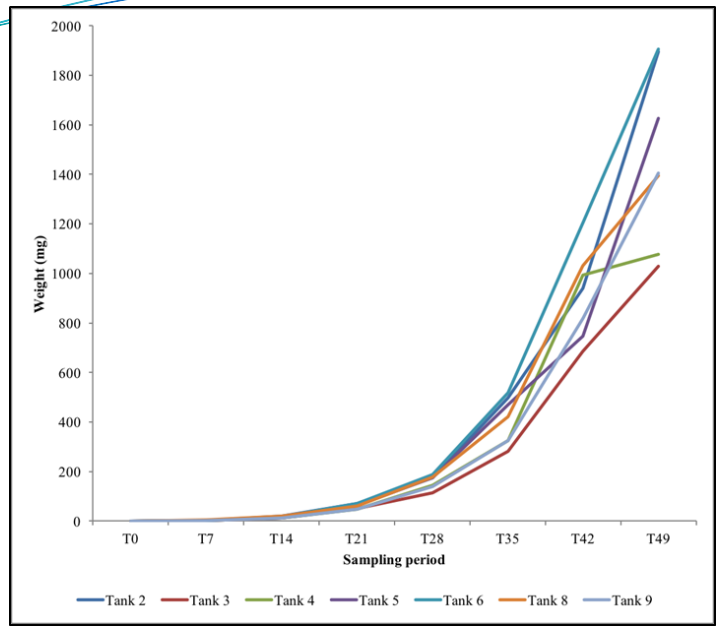
→ **Sibling *vs* not sibling population**

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)!!

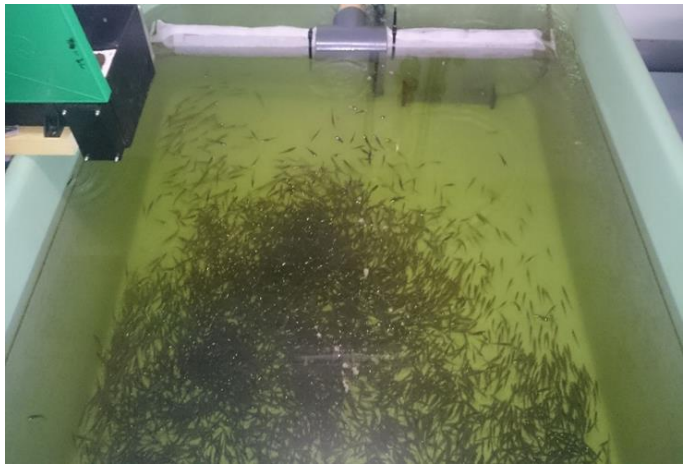
= unexplained mortality

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, no effect of sibling population

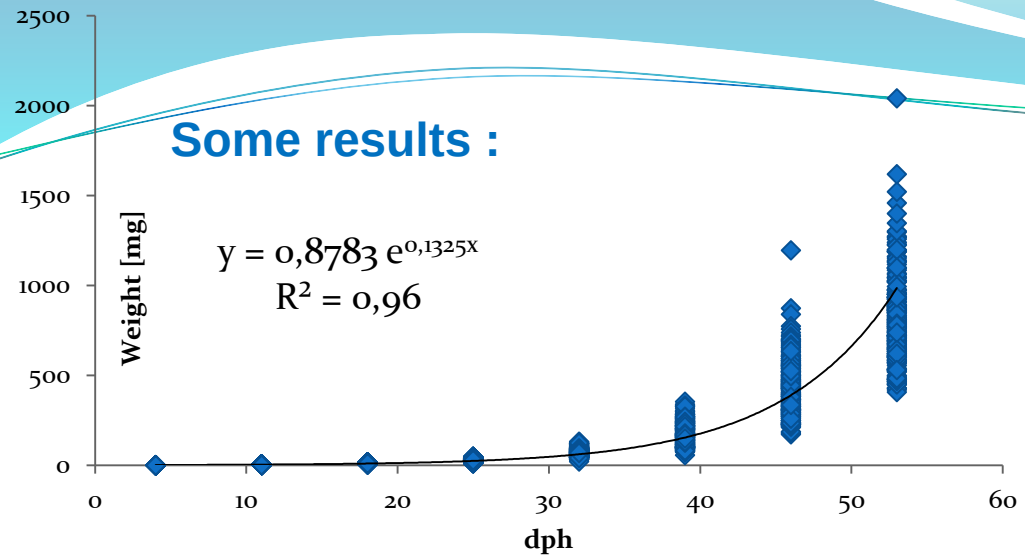
Experiment 4 : Identification of an optimal combination of factors (53 days)

560 000 Larvae from Asialor (February – April, 2018)

Factor	Modality
Density	100 larvae L^{-1}
Sorting of fish jumper	no
Sibling or not sibling	Not sibling
Female weight	Large (> 3.3 kg)
Feeding schedule	Discontinuous
Light regime	12:12
Light intensity	50 lx
Weaning start (dph)	16
Weaning duration (days)	9
Water renewal rate (tank vol./h)	1
Tank cleaning period	Morning
Tank current direction	Bottom to top

This combination was repeated 7 times (n = 7).

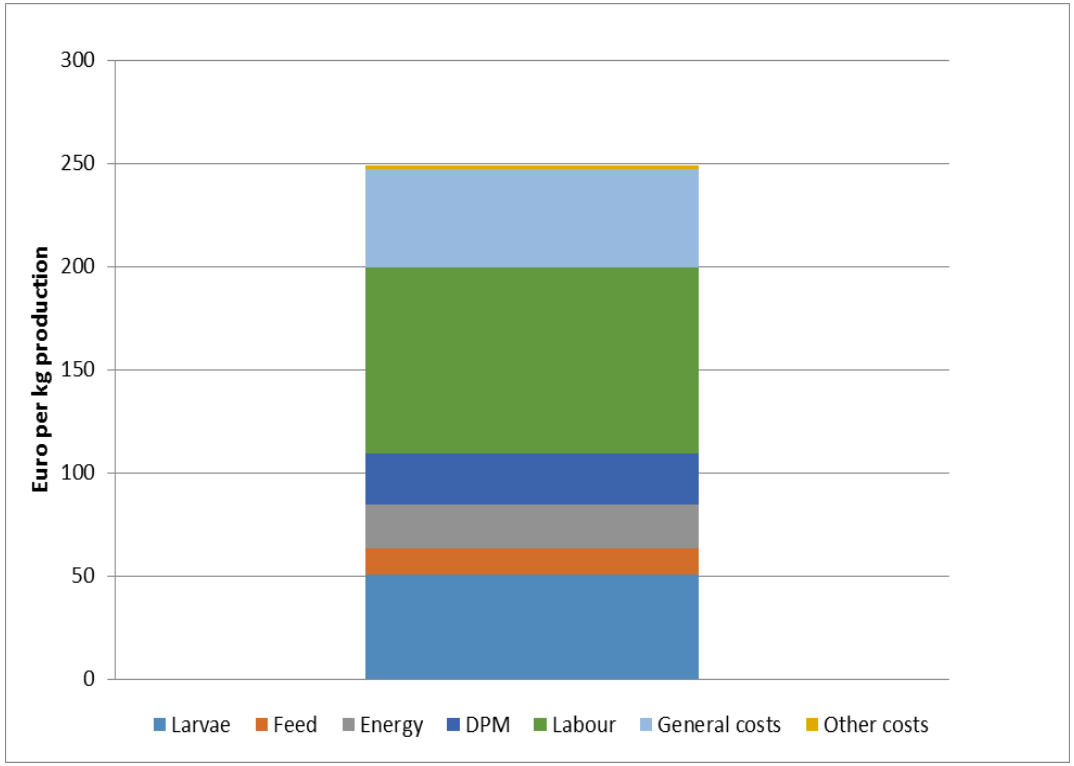
Some results :



final density of 14 kg. m^{-3}

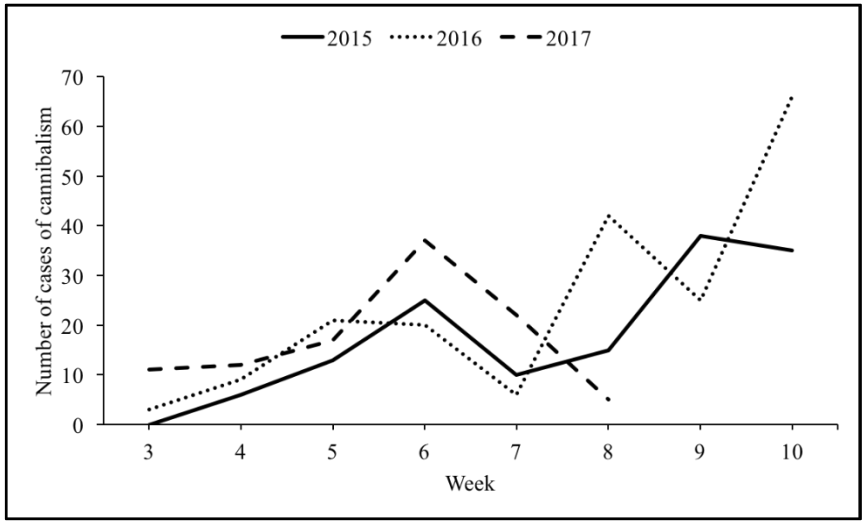
Tanks	Swim bladder inflation rate (%)	Final biomass (g)	Mean final body weight (mg)	Survival rate (%)	SGR (%/day)	FCR
2	90.8	9526	710.0 ±161.7	19.2	14.8	0.66
3	96.9	9722	938.3 ±177.4	14.8	15.2	0.65
5	88.1	9754	945.4 ±311.9	14.0	15.1	0.65
6	94.7	9638	740.6 ±258.0	13.7	14.8	0.65
7	90.4	9658	806.8 ±259.0	14.0	15.2	0.65
8	95.5	9483	827.8 ±273.6	14.7	15.9	0.66
9	91.8	9075	740.6 ±163.4	13.7	14.8	0.69
Average	92.6	9550.9	816.0 ±248.8	16.9	15.1	0.66

Production cost of 1 kg of 0.8 g juveniles :

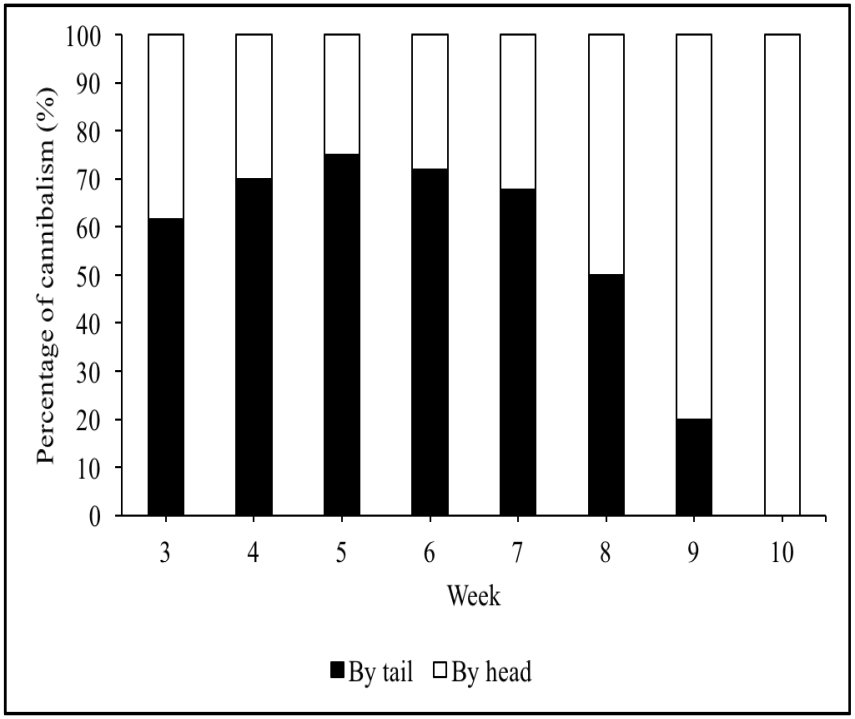


0,20 euros per 0.8 g juvenile

Specific study on the emergence of cannibalism and cannibals behavior (PhD Colchen T., 2017)



Total number of cannibals / week



Percentage of cannibalism in function of age and type of ingestion

See Alain for more details

Prospects

Short term:

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

Development of an **industrial protocol** to improve larval performance during rearing (2018) **– D16-6 (integration temperature effect => experiment in DTU)**

Long term:

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

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

Thank you for your attention

UNIVERSITÉ DE LORRAINE

DTU

Asialor
ÉLEVAGE DE PERCHES ET SANDRES

Fish2Be

IRTA
RECERCA I TECNOLOGIA AGROALIMENTÀRIES

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This project received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration (KBBE-2013-07 single stage, GA 603121, Diversify)

Co-funded by the Seventh Framework Programme of the European Union

DIVERSIFY

Thank for ALL the DAC team (including numerous students like Aurore, Yannick …)

What about tomorrow

- **RDV at 8: 45** for all people in front of the entrance E2A
- A group (3 persons) will visit our Experimental plateform with Y Ledoré + other people (Taina)
- A group (5 persons) will discuss about further opportunities for European projects with members of the UL staff (Sylvain)
- A group (22 persons) will visit the ongrowing perch farm of Asialor (follow Pascal)

Happy birthday to

Jan ZIMMERMANN !!!


I wish you a very
nice evening at the
Stanislas place!!!