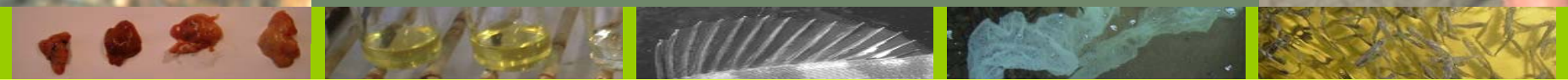


# Percid fish nutrition - from reasearch to production

Namur 23-24 Janvier 2008

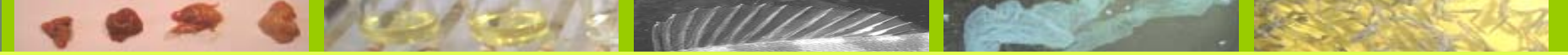


**Blanchard Gersande URBO University of Namur**

Design by Gersande Blanchard

## Feeding and nutrition of percid fish during ongrowing

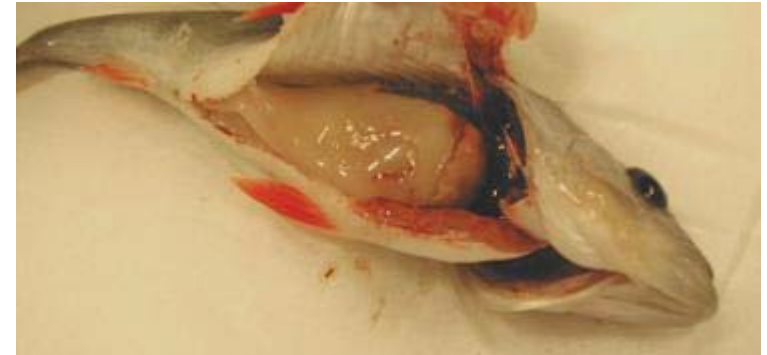
# Introduction



Design by Gerardo Blanchard

Percids are lean fish storing excess lipids mainly in peri-intestinal cavity

The sparing of dietary protein by lipids is quite limited in perch and pikeperch



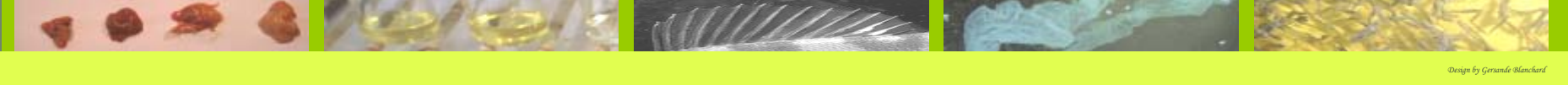
High protein and low lipid levels in the diets are generally required

**Eurasian perch**

**pikeperch**

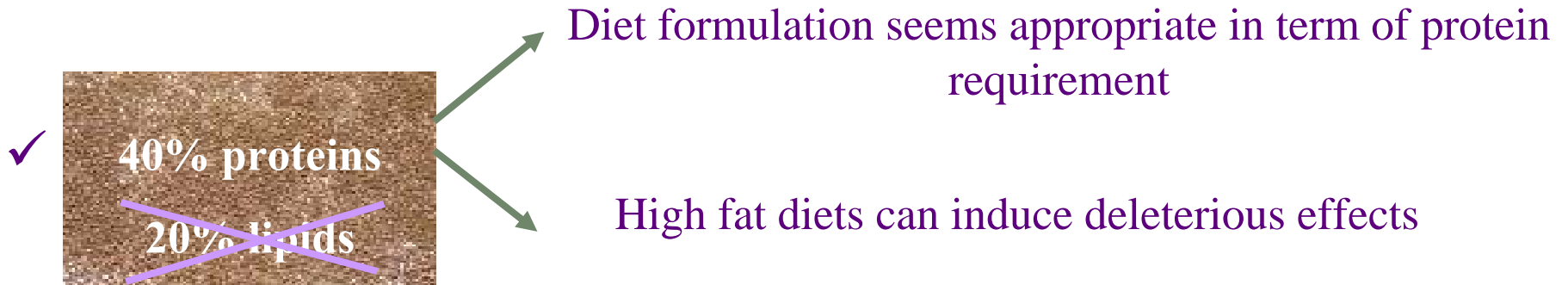


# Eurasian perch



Design by Gerardo Blanchard

Starting the ongrowing phase, perch is usually fed diets formulated for salmon, trout or sea bass

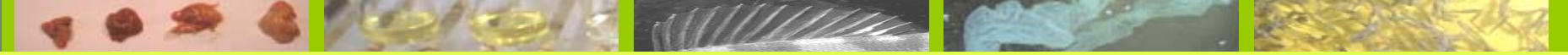


- decrease of growth performance
- reduction of immune capacity in intensive rearing conditions
- increase of fat storage
- fat accumulation in hepatic tissues inducing liver steatosis
- increase of the mortality





# Eurasian perch



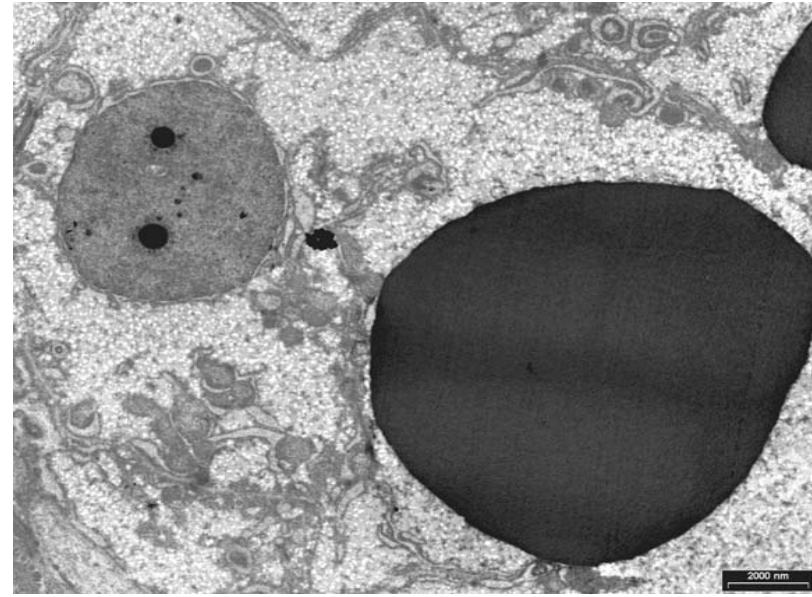
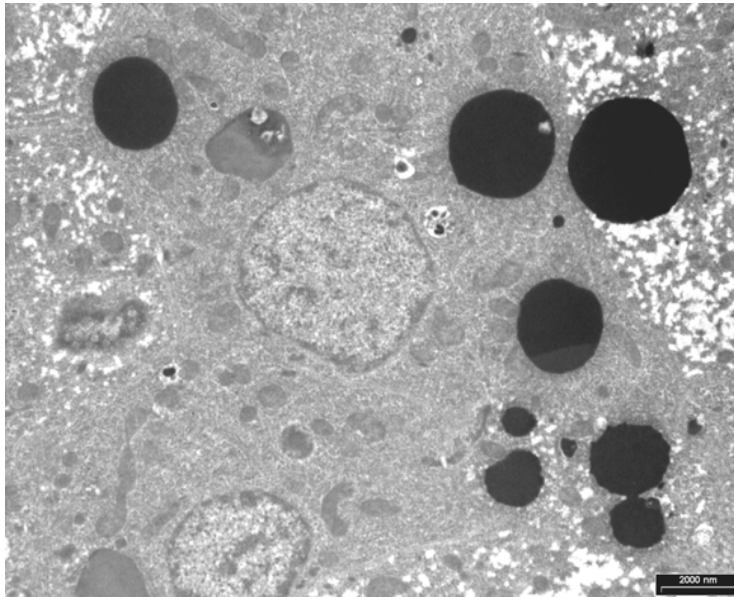
Design by Gerardo Blanchard

High lipid diets →

pale and fatty livers

Wild specimen

Reared specimen



Electron microscopy of perch hepatocytes

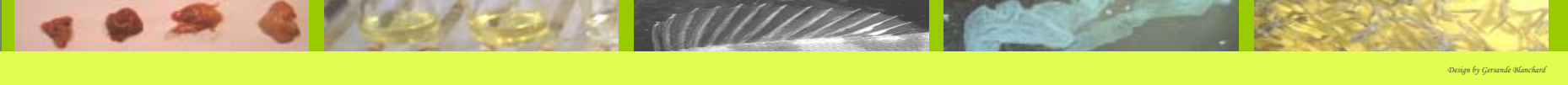
Blanchard *et al.*, (2004)



Feeding and nutrition studies of perch juveniles were performed in order to adapt a diet satisfying the nutritional requirements



# Eurasian perch



Design by Gerardo Blanchard

## Liver fulfilled numerous functions

Digestion

Metabolism

Lipid assimilation

Glycogen and fat supplies  
management



Excretion

Detoxification

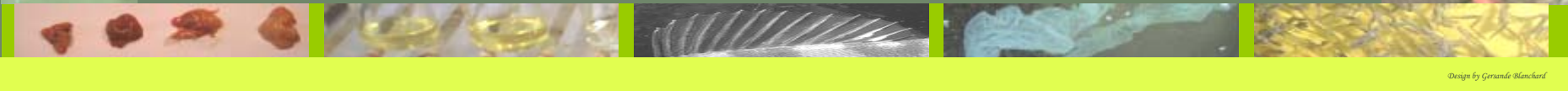
Given the importance of hepatic metabolism in overall health of fish, impaired liver function could contribute to induce deleterious effects



To study **liver** in lipid nutrition of perch is of main importance



# Eurasian perch



Design by Gerardo Blanchard

## Effect of dietary lipid content

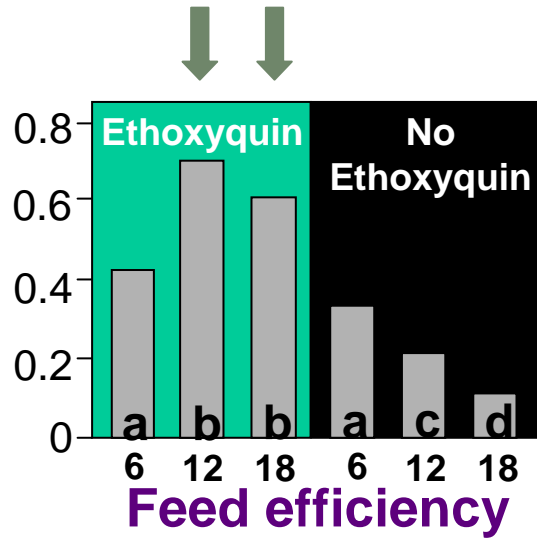
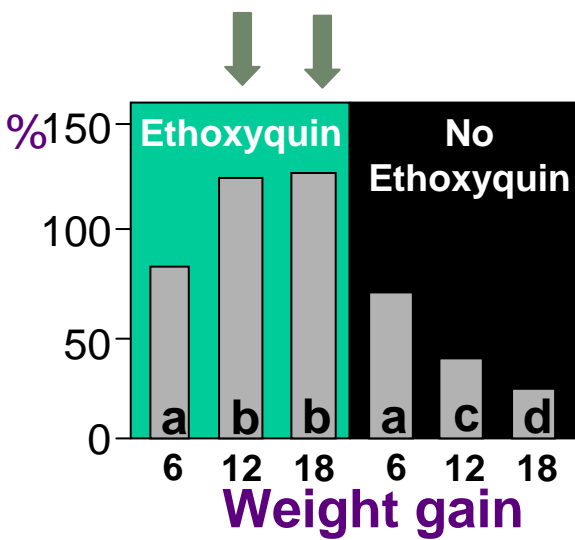
Graded levels of lipids

6

12

18

+ or - antioxidant



Dietary lipid content of 12% or 18% enriched with ethoxyquin were both beneficial for growth and feed efficiency

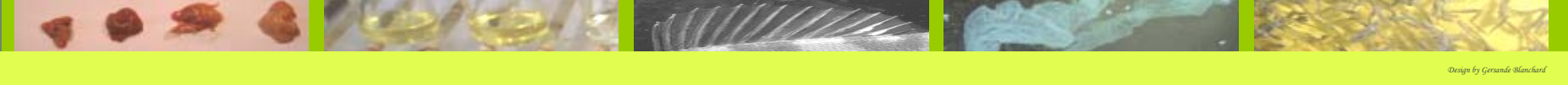
Perch is sensitive to lipid peroxidation

Kestemont et al., 2001





# Eurasian perch



Design by Gerardo Blanchard

## Dietary lipid content

Commercial diets enriched with 3 fat levels:

11.7

15

19.3

Main results

the increase of fat content induced

an increase in growth, feed efficiency and protein utilization

an increase of lipid deposition in viscera and liver

Xu et al., 2002

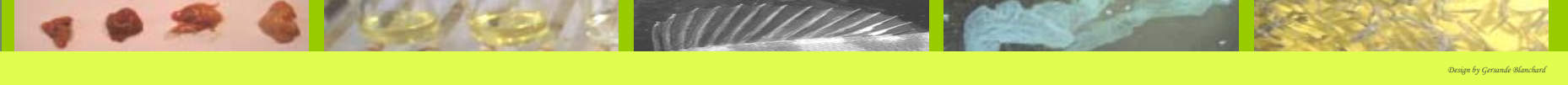
lipid utilisation by perch is influenced by **lipid source**



Future studies in feed and nutrition of perch juveniles were performed in order to determine optimal lipid sources



# Eurasian perch



Design by Gerardo Blanchard

## Dietary lipid sources

Pure different oils characterized by different fatty acid (FA) profiles:

olive

safflower

linseed

cod liver

OO 18:1 n-9

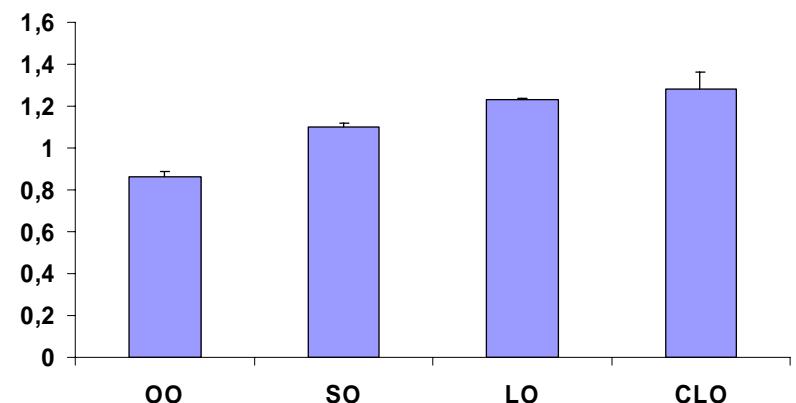
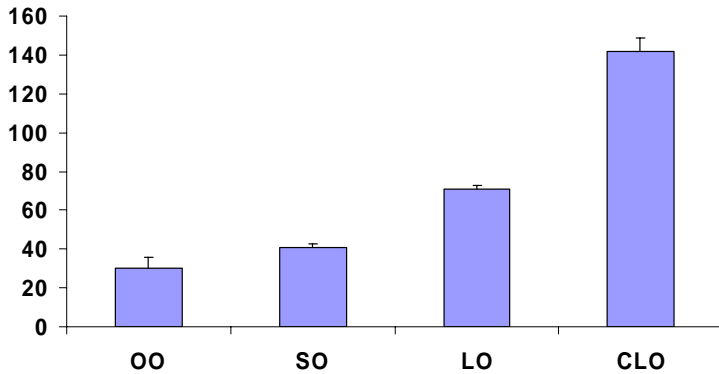
SO 18:2 n-6

LO 18:3 n-3

CLO EPA & DHA

Weight gain (%)

Feed efficiency ratio



Main results

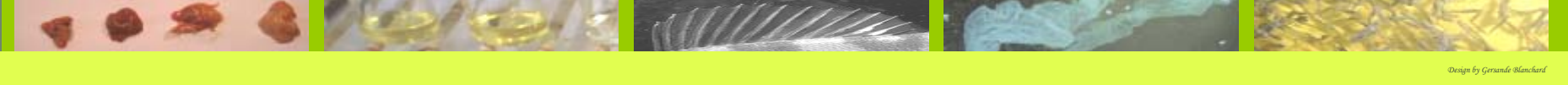
- cod liver oil induced better growth performances
- great ability to elongate and desaturate EPA in DHA
- accumulation of DHA in perch muscle

Xu & Kestemont (2002)





# Eurasian perch



Design by Gerardo Blanchard

## Diet lipid utilization

Numerous factors can lead to fat storing modifications or induce fatty livers

Influence of 12 nutritional and husbandry factors

Discriminate the most influent factors on perch hepatic ultrastructure

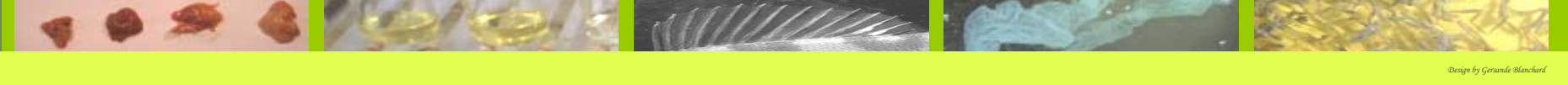
### 12 tested factors (2 modality)

Diet lipid %	21	17
Diet lipid nature	Fish + Rape seed	Fish
Diet protein nature	Fish + Rape seed	Soybean Fish
Diet astaxanthine %	0.4	0
Feeding rate	$22.45W^{-0.68}$	$30.67W^{-0.68}$
Final biomass (kg.m <sup>-3</sup> )	12	4
Coefficient of variation of initial weight %	30	15
Temperature °C	23	16
Photoperiod (L/O)	16/8	8/16
Light spectra	Industrial white	Purple
Number of feed.day <sup>-1</sup>	2	Continue
Number of feed.week <sup>-1</sup>	7	6

Blanchard et al., 2007



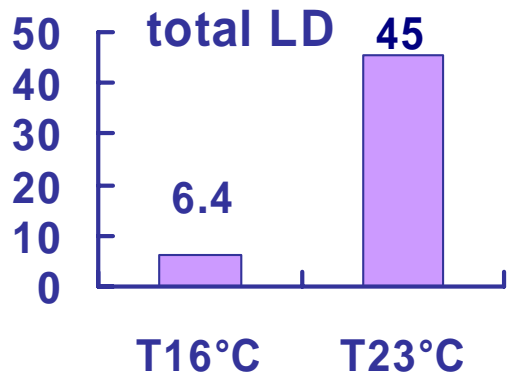
# Eurasian perch



Design by Gerardo Blanchard

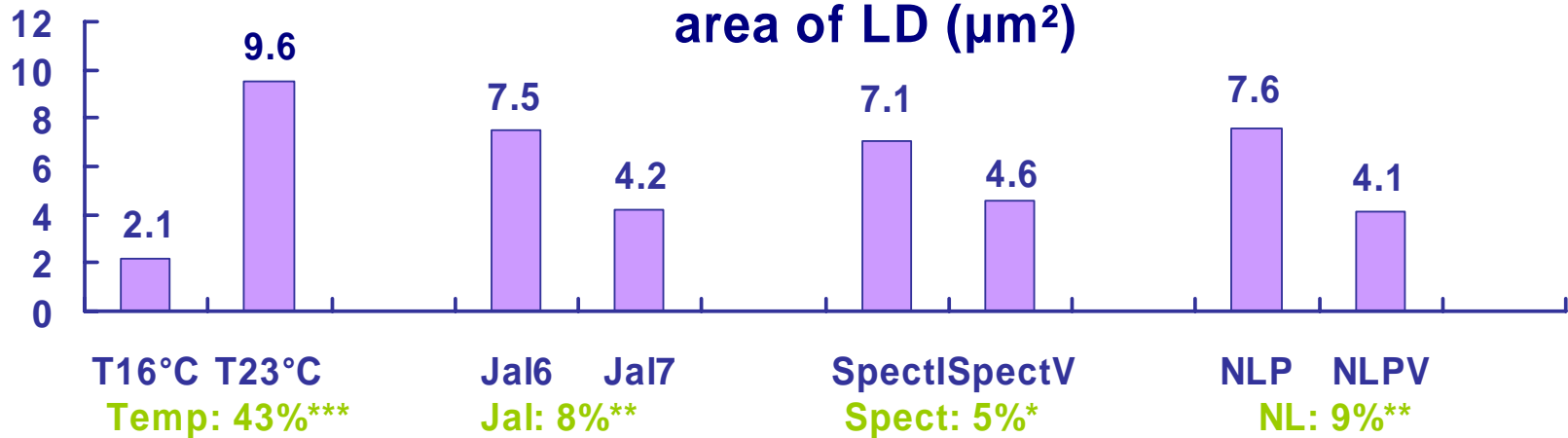
Main results

Among the 12 tested factors, rearing temperature was the main influencing factor



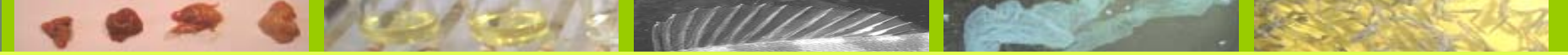
Factors leading to food accessibility as well as lipid and protein sources intensify or compensate the effect of temperature mainly on lipid droplet accumulation and RER development

Temp: 61%\*\*\*





# Eurasian perch



Design by Gerardo Blanchard

Intensive rearing conditions



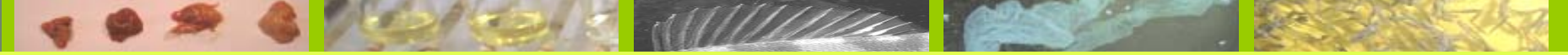
optimal rearing temperature is 23°C

Combination of factors can lead to a limitation of lipid accumulation in the perch liver :  
23°C – vegetable sources of proteins and lipids – optimal feeding ratio – 17% dietary lipids – 7 days a week feed distribution - etc





# Eurasian perch



Design by Gerardo Blanchard

## Influence of n-3/n-6 dietary lipid ratio

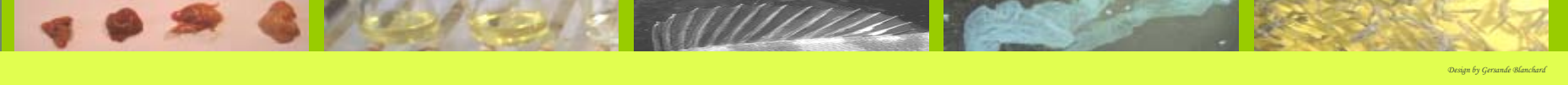
Diets	CO	SO	LO	SLO
Oil ratio	CO	CO/SO (2/1)	CO/LO (2/1)	CO/SO/LO (1/1/1)
Protein (%)	45	45	45	45
Fat (%)	19	19	19	19
Cod liver oil (g kg <sup>-1</sup> )	190	127	127	63
Safflower oil (g kg <sup>-1</sup> )	0	63	0	63
Linseed oil (g kg <sup>-1</sup> )	0	0	63	63
Σ SFA	19.1	15.8	15.4	12.3
Σ MUFA	49.1	34.1	36.6	26.6
18:2	1.3	25.6	6.0	30.3
Σ n-6 PUFA	2.4	26.3	6.7	30.7
18:3	0.5	0.4	17.7	17.6
20:4	0.0	0.0	0.0	0.0
20:5 (EPA)	11.0	7.3	7.3	3.6
22:6 (DHA)	10.8	7.1	7.1	3.6
Σ n-3 PUFA	24.6	16.3	33.7	25.7
n-3/n-6 ratio	10.3	0.6	5.0	0.8
DHA/EPA ratio	1.0	1.0	1.0	1.0

CO = Cod Liver Oil; SO = Safflower Oil; LO = Linseed Oil

SFA: saturated fatty acids; MUFA: Monounsaturated fatty acids; PUFA: Polyunsaturated fatty acids

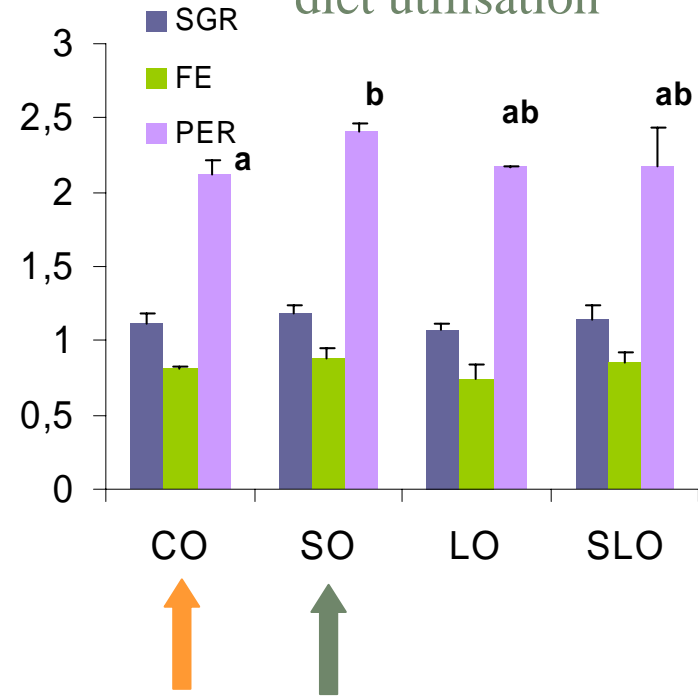


# Eurasian perch



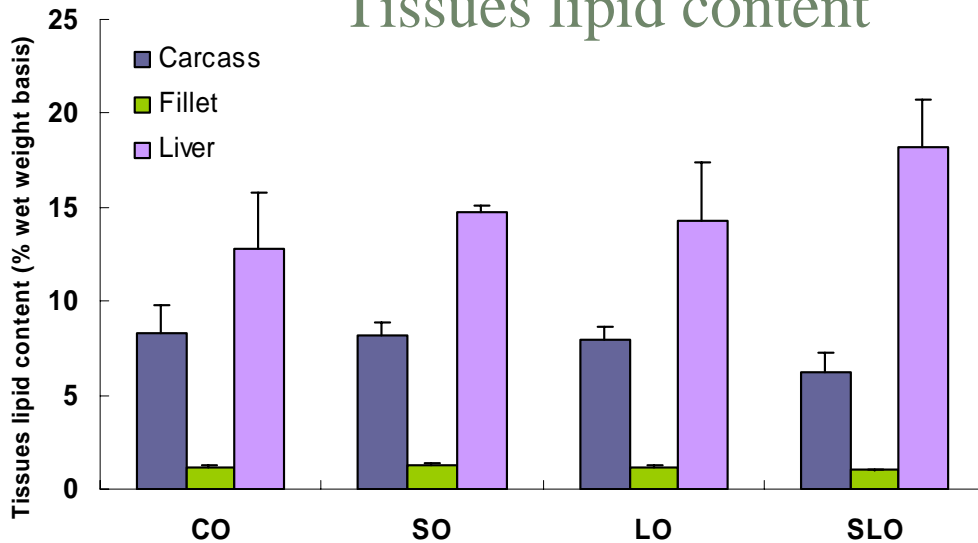
Design by Gerardo Blanchard

## Growth performances and diet utilisation



Main results →

## Tissues lipid content

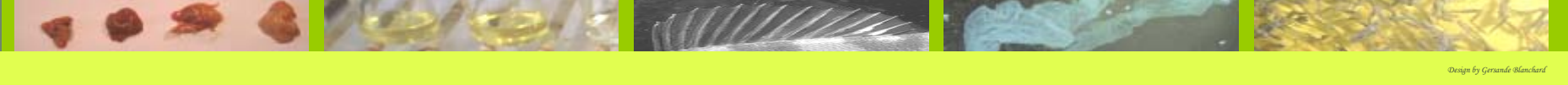


A partial substitution of fish oil by vegetable oil, does not appear to impair growth performances, tissue lipid contents and hepatic ultrastructure of juvenile perch

Blanchard *et al.*, 2008 submitted



# Eurasian perch



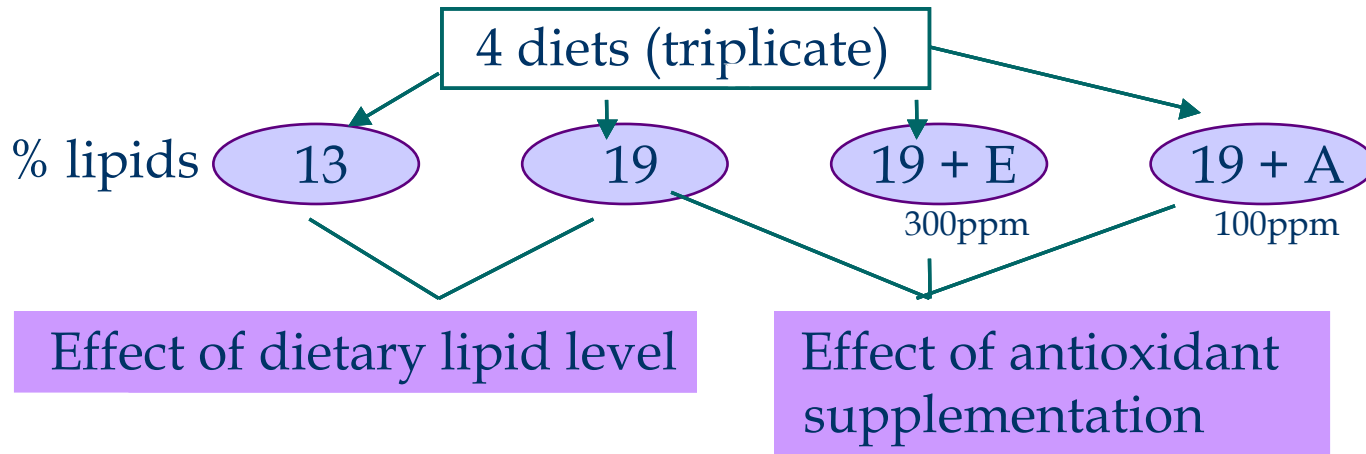
© Design by Gerardo Blanchard

## Effect of dietary lipid content and antioxidant supplementation

### Assumptions

fish tissues contain high levels of polyunsaturated FA (PUFA)

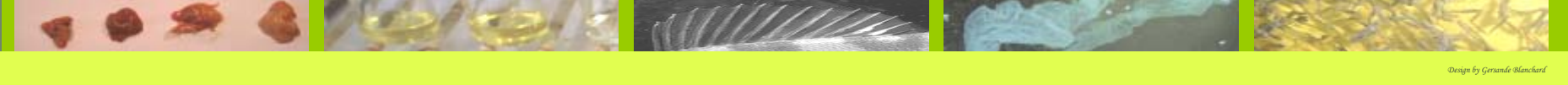
PUFA are sensitive to lipid peroxidation that can induce deleterious effects particularly on liver



Blanchard *et al.*, 2007 submitted



# Eurasian perch



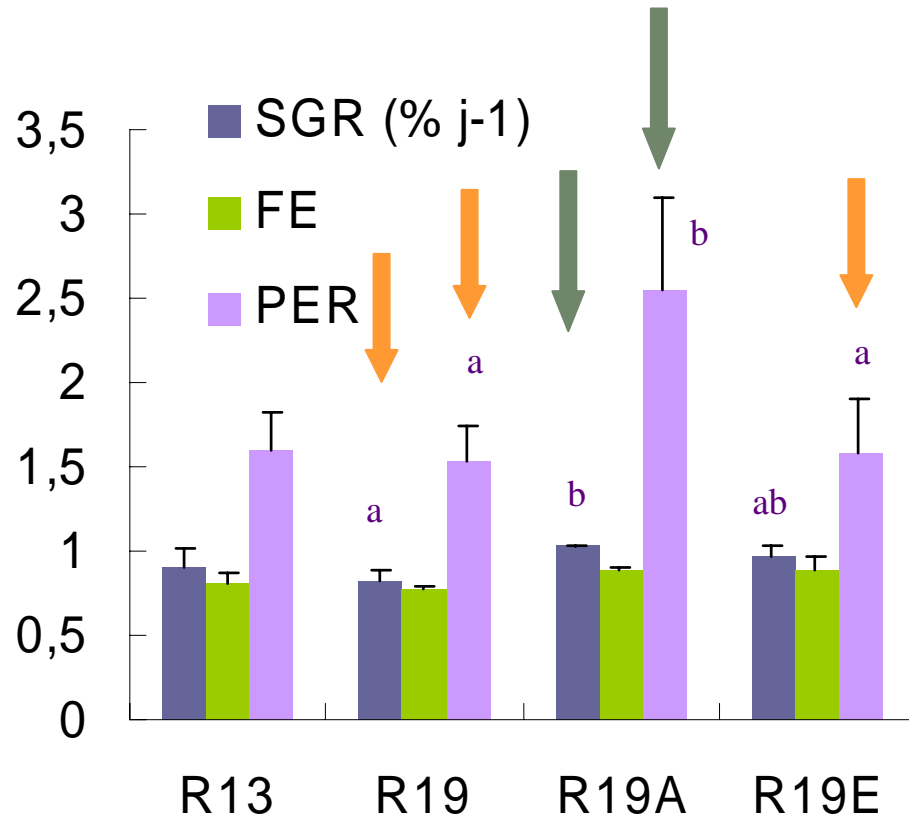
Design by Gerardo Blanchard

## Main results

Higher Specific Growth Rate (SGR) in fish fed with astaxanthin

Fish fed R19A significantly displayed better Protein Efficiency Ratio (PER) than fish fed R19 or R19E

Feed efficiency (FE) was not significantly influenced by antioxidant supplementation



Astaxanthin seems to be beneficial for rearing of juvenile perch.

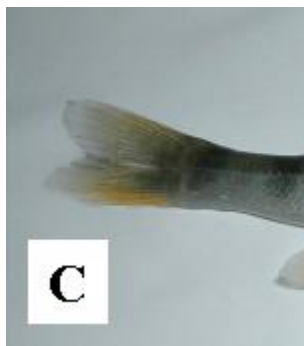


# Eurasian perch



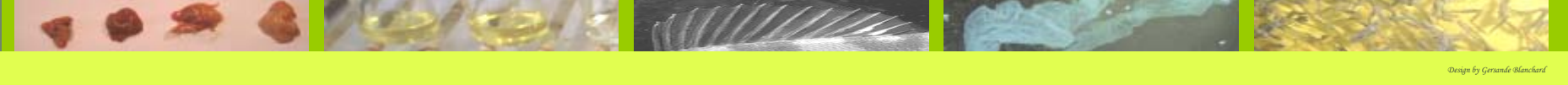
Design by Gerardo Blanchard

Aspect of perch reared with astaxanthin compared to non-supplemented one





# Eurasian perch

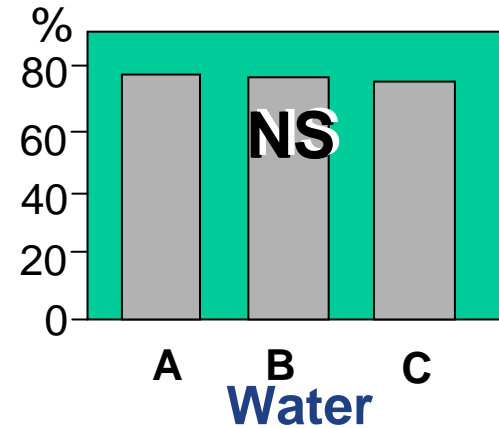
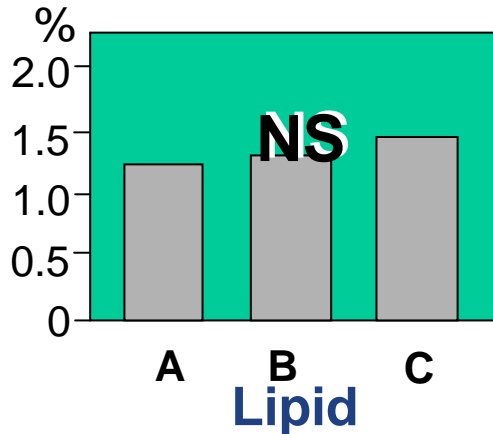
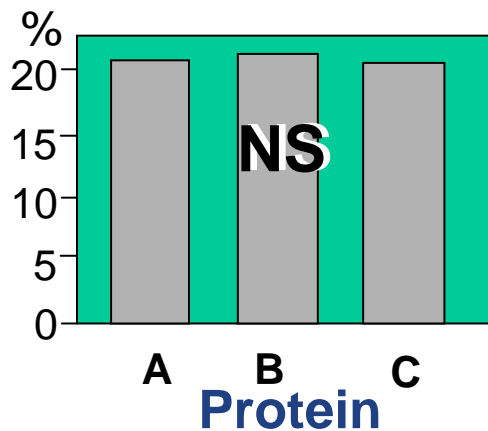


Design by Gerardo Blanchard

## Lipid nutrition and flesh quality

Feeding *ad libitum* 3 commercial diets with different protein/lipid contents (%) :

Diets	A	B	C
Protein (%)	49.2	46.6	43.2
Lipid (%)	11.9	16.3	22.2
Protein/energy ratio (mg KJ <sup>-1</sup> )	25	22	19

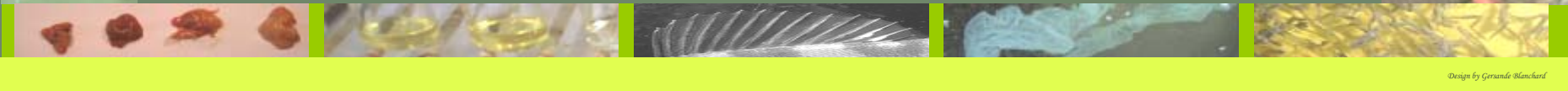


Limited influence of dietary treatments on biochemical and organoleptic characteristics of the flesh

Mathis *et al.*, (2003)



# Eurasian perch

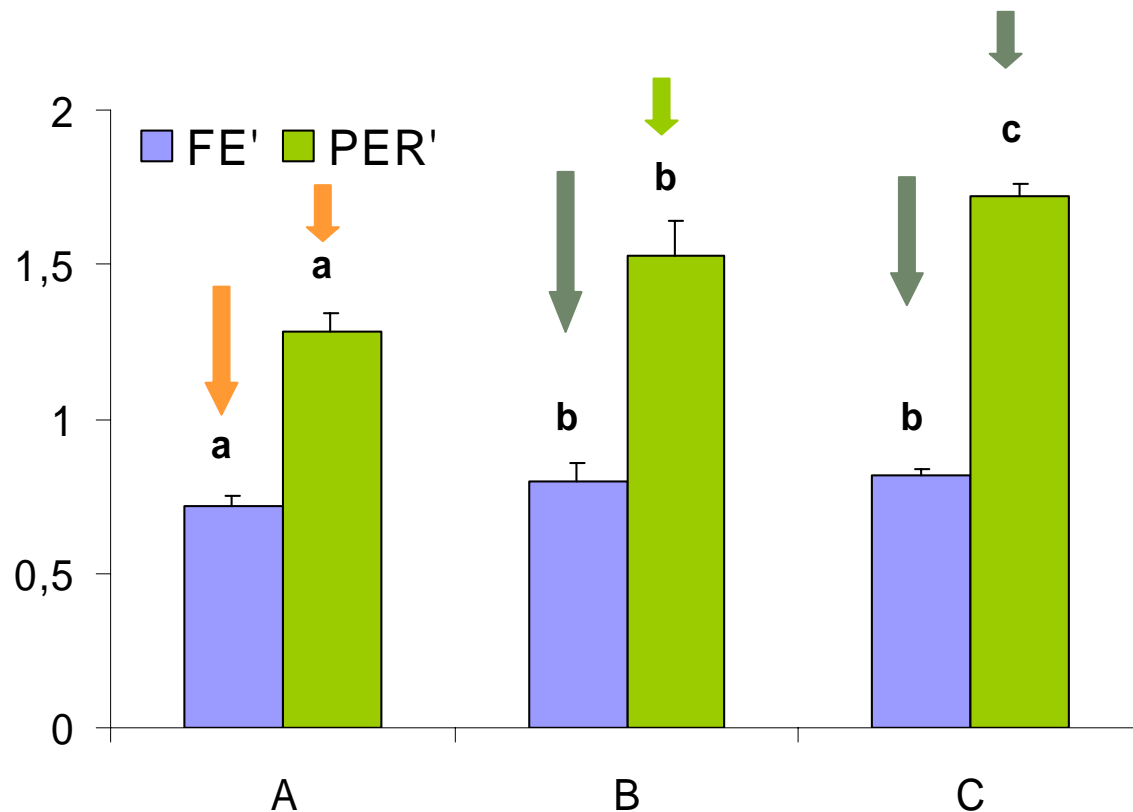


Design by Gerardo Blanchard

## Influence of diet on flesh quality

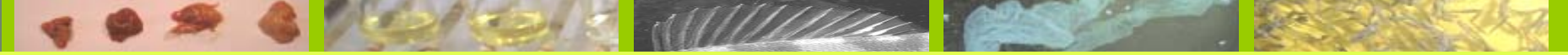
Main results

Improvement of FE' and PER' with the decrease of protein energy ratio (based on eviscerated weight)





# Eurasian perch



Design by Gerardo Blanchard

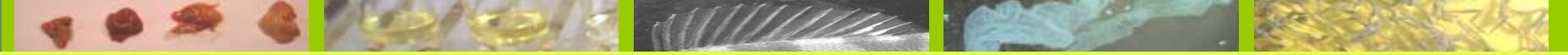
## Conclusions

Regarding recent progress in feed and nutrition of Eurasian perch during ongrowing following requirements could be recommended:

- 40% protein
- maximum 19% lipid
- Astaxanthin supplementation (100ppm)
- 18:2 n-6 and 18:3 n-3
- EPA and DHA



# Pikeperch

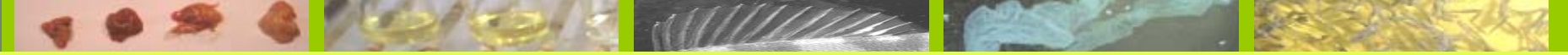


Design by Gerardo Blanchard

- Thermophilic Species
- Fast growth: 500 to 700g per year
- Sensitive to stress: pathologies
- Low light intensity: 50-100 lx

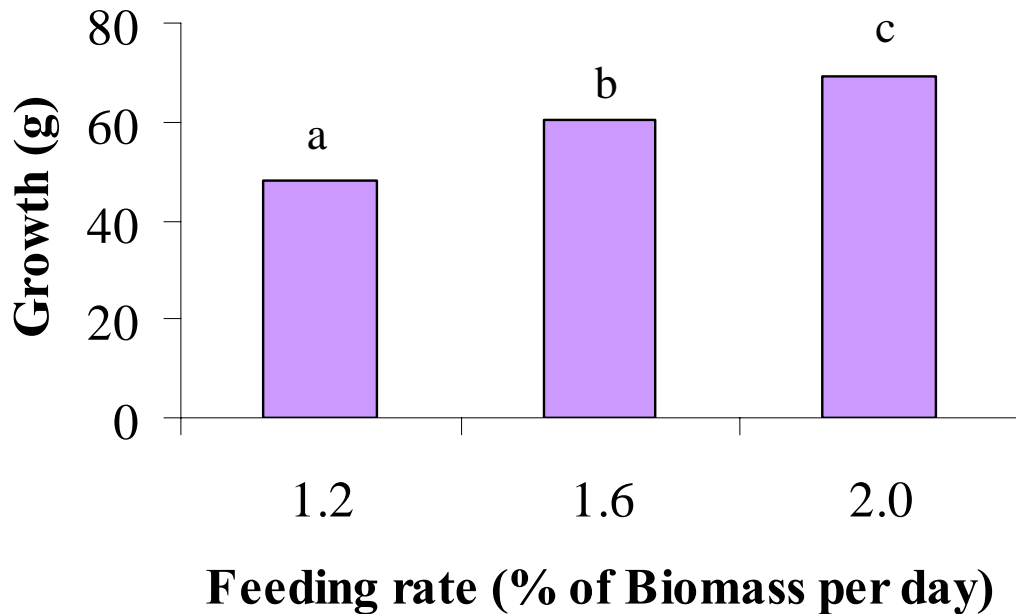


# Pikeperch



Design by Gerardo Blanchard

Effect of feeding rate on growth of pikeperch juvenile

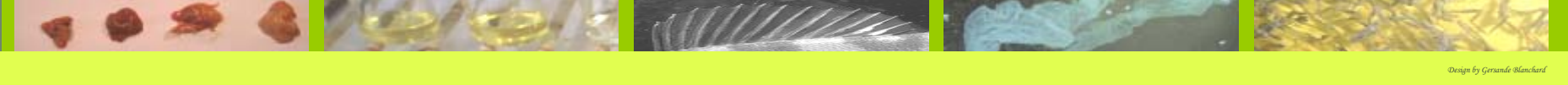


Main results

Optimal feeding rate  $> 2\%$   
(Zakes *et al.*, 2003)

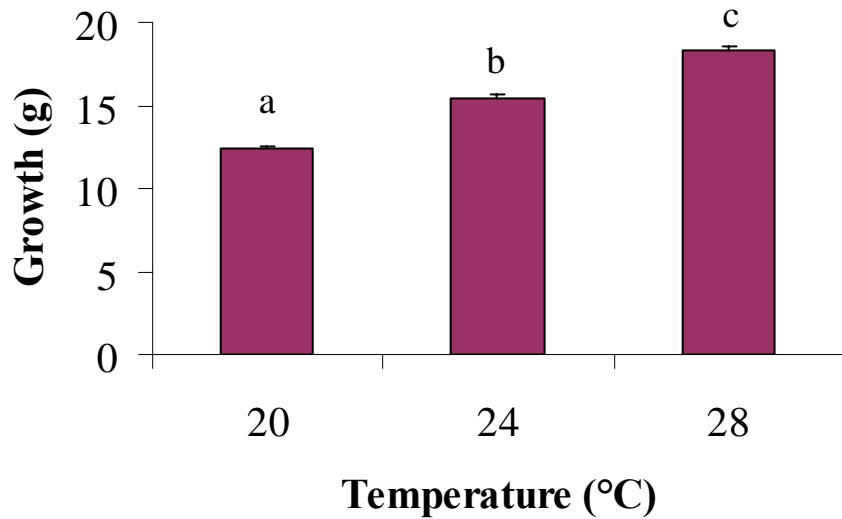


# Pikeperch

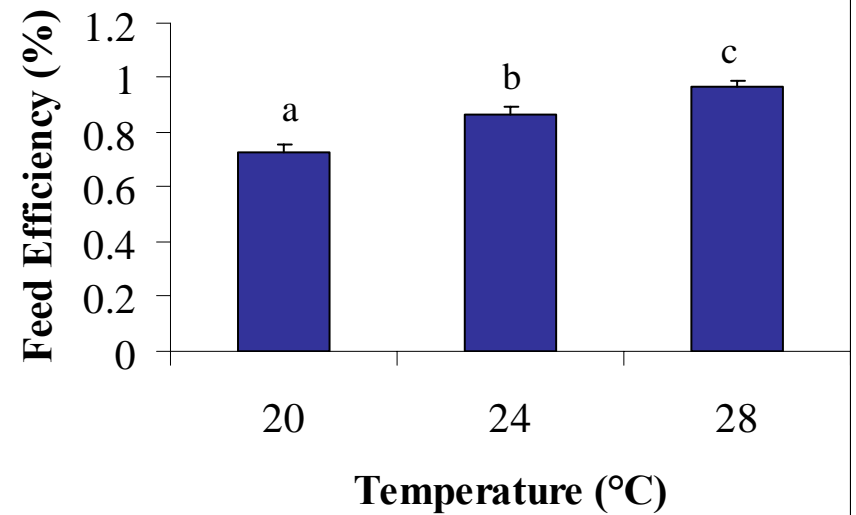


Design by Gerardo Blanchard

Effect of temperature on growth of pikeperch juvenile



Effect of temperature on feed efficiency of pikeperch juvenile



**Optimal temperature: 28°C** (Wang *et al.*, submitted)



# Pikeperch



©Design by Gerardo Blanchard

## Optimal protein/lipid/carbohydrate ratio

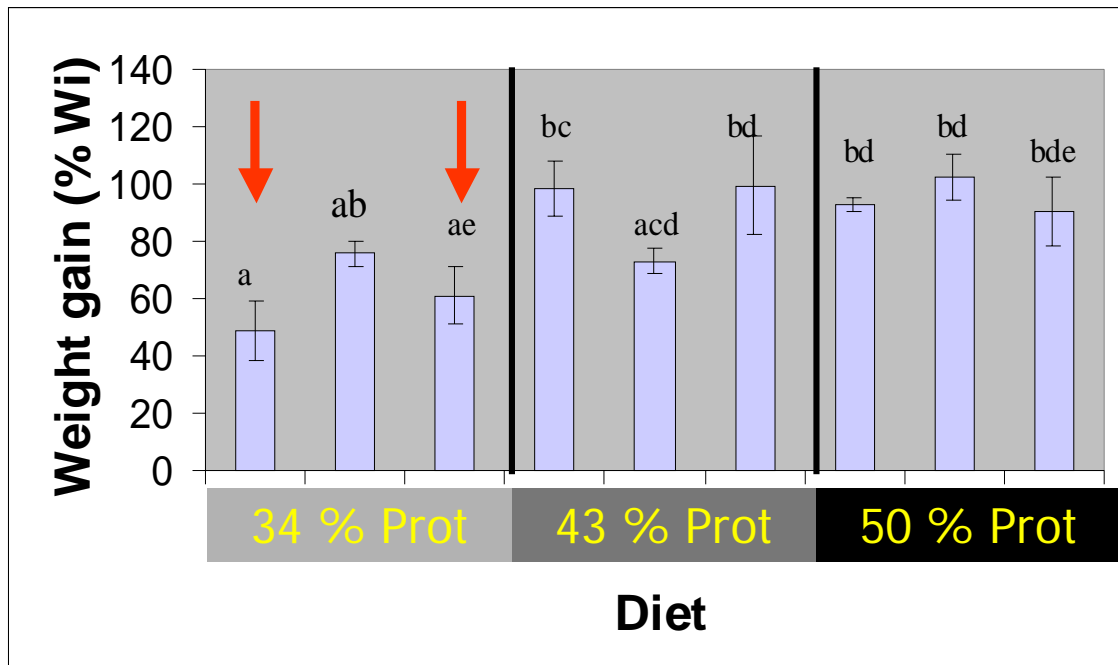
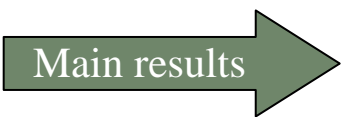
Feeding *ad libitum* 9 experimental diets with different protein/lipid/carbohydrate ratios (protein/energy ratio ranging from 18.4 to 28.5 g MJ<sup>-1</sup>)

Orthogonal design including  
3 levels of:

protein : 34, 43, 50%

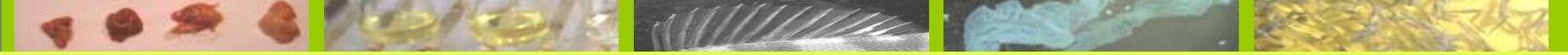
lipid : 10, 16, 22%

carbohydrate : 10, 15, 20%



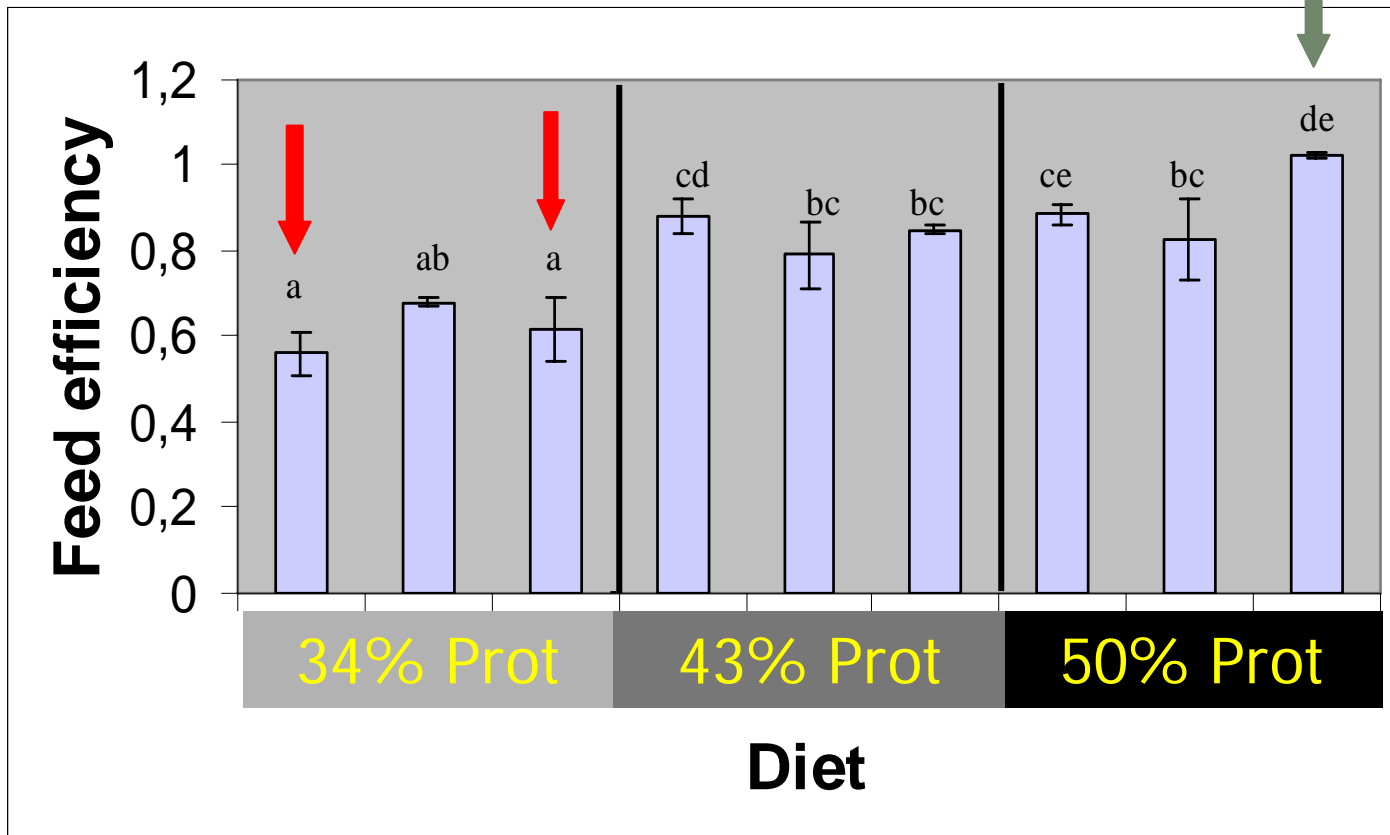


# Pikeperch



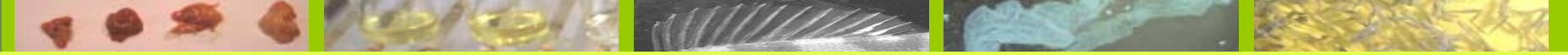
Design by Gerardo Blanchard

## Optimal protein/lipid/carbohydrate ratio

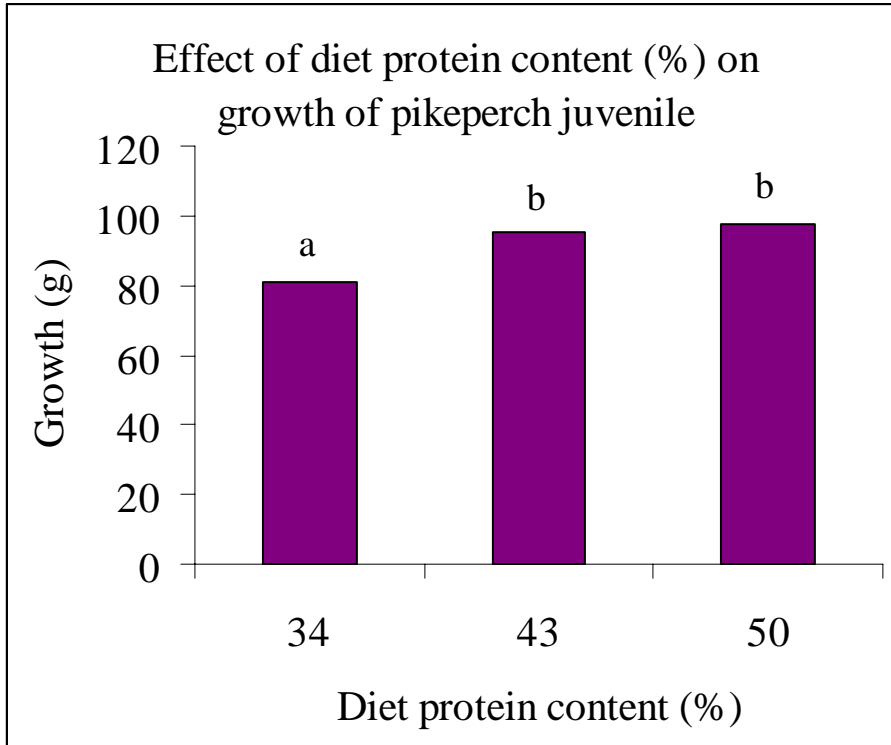




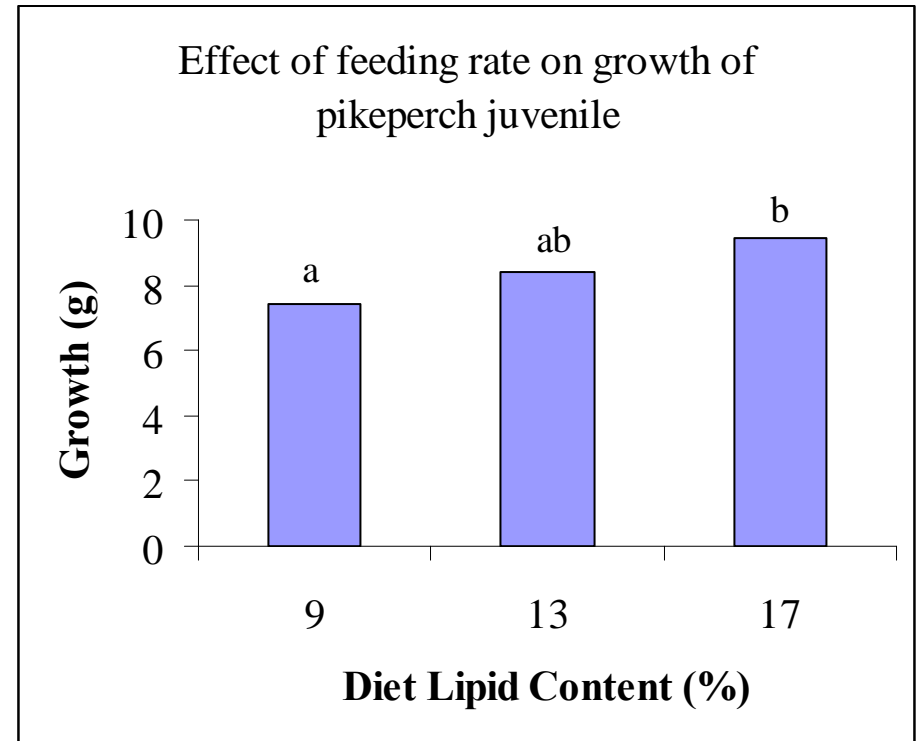
# Pikeperch



Design by Gerardo Blanchard



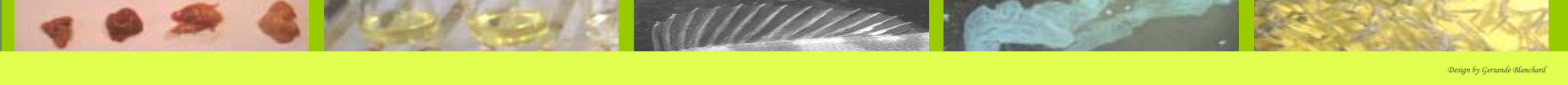
Optimal diet protein content: 43-50  
(Nyina-wamwiza et al., 2005)



Optimal diet lipid content: 13-22  
(Schulz et al., 2007)



# Pikeperch



Design by Gerardo Blanchard

## Conclusions

Optima:

Temperature: 28°C

Feeding rate: >2%

Diet protein content: 47-54%

Diet lipid content: 13-22%

Carbohydrates: 10-20%

However:

New species

Few studies conducted

Further investigation required

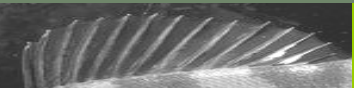


# General conclusion

- Nutritional requirements of Eurasian perch and pikeperch seem similar
- Pikeperch may need slightly more protein and fewer lipids than perch (pikeperch display faster growth)
- More studies are required for pikeperch to identify the optimal rearing conditions for its production
- Recent advances in specific nutritional requirements of juvenile perch during the ongrowing phase are stimulating and should help the Percid industry to considerate the necessity for the production of a specific percid diet.



Thank you for your  
attention



*Design by Germaine Blanchard*