Recent improvements in the control of the Percid reproductive cycle

Jansen H., Fontaine P.

Institute for Marine Research and Ecosystem Studies (Wageningen IMARES), Haringkade 1, 1970 AB, Ijmuiden, The Netherlands

Research Unit on Animal and Animal Product functionality, Nancy-University, INRA, MAN, 34 rue Sainte Catherine, 54000 Nancy, France

PERCID FISH CULTURE - FROM RESEARCH TO PRODUCTION. Namur (Belgium), 23-24 January 2008

Introduction

New farms in percid culture = mainly intensive farms using water recirculating systems.

Markets : Product demand (whole fish or fillet) is continue over the year.

=> Requirement of 3-4 supplies of juveniles / year

=> Control of out-of-spawning season

A – Recent advances in Eurasian perch reproduction control

Framework : 2 CRAFTs projects (including Percatech) + 1 Eurêka project ⇔ a high European support

1 – Induction of a reproductive cycle (gametogenesis)

2 – Obtention of out-of season spawning

1 – Gametogenesis induction

Identification of an optimal environmental protocol based on photoperiod and temperature manipulations :

- Respect of a timing (photoperiod decrease, then temperature decrease)

- A high decrease of photoperiod (4 or 8 hours vs 1 hour)

- A temperature decrease in 2 steps

=> 100% of females and males induced

A total inhibition of the induction of the reproductive cycle if application of:

- A continuous lighting (L:D 24:0)
- A constant photoperiod with a long photophase (L:D 16:8)
- A photoperiod increase during the pre-inductive period (acclimatization phase)

=> 0% of females and males induced

Indirect applications for fish farmers :

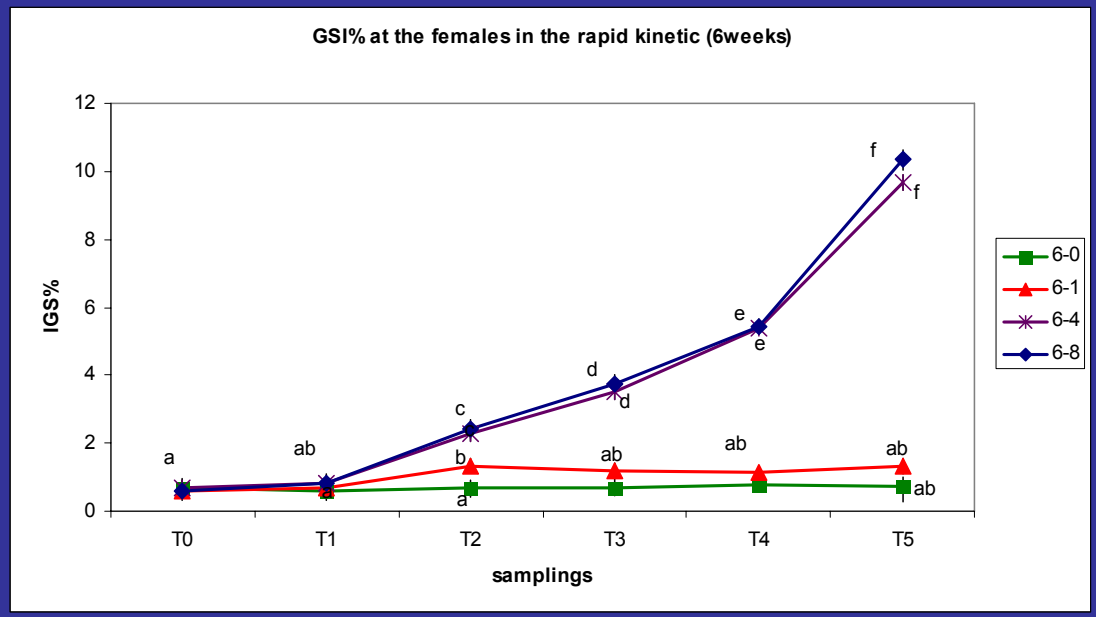
- Inhibition of the reproduction cycle during the ongrowing phase
- Transfer conditions must be controlled.

PERCATECH

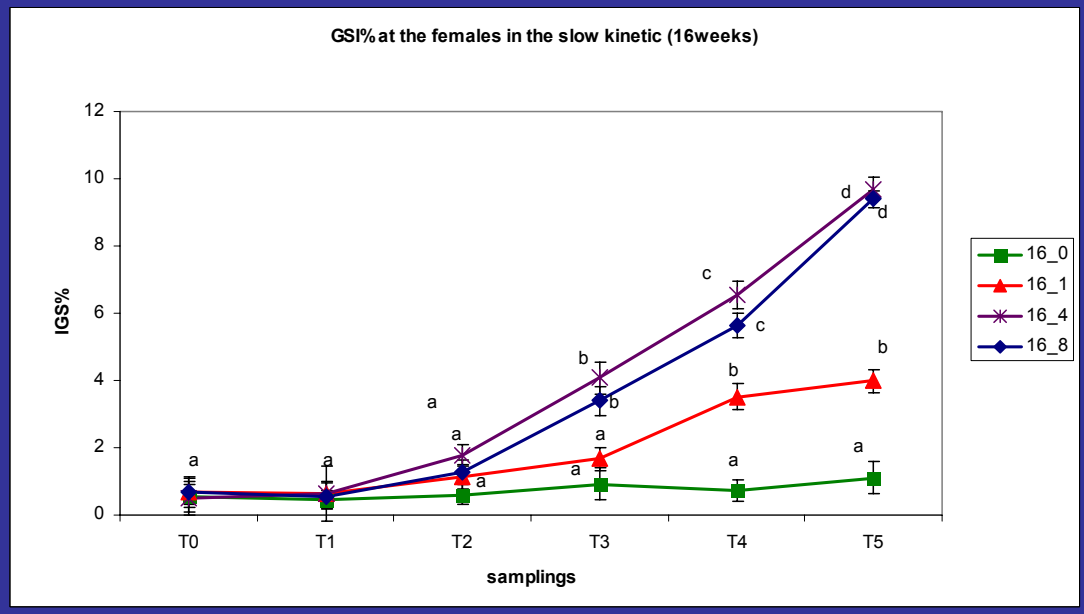
PP↓ then ↓ T

T : 21 => 6°C

PP : various amplitudes



A rapid decrease of PP and T over 6 weeks



A slow decrease of PP and T over 16 weeks

2 – Out-of season spawning

Obtention of out-of-season spawning in January – December (60 ribbons) with ONLY photoperiod and temperature manipulations

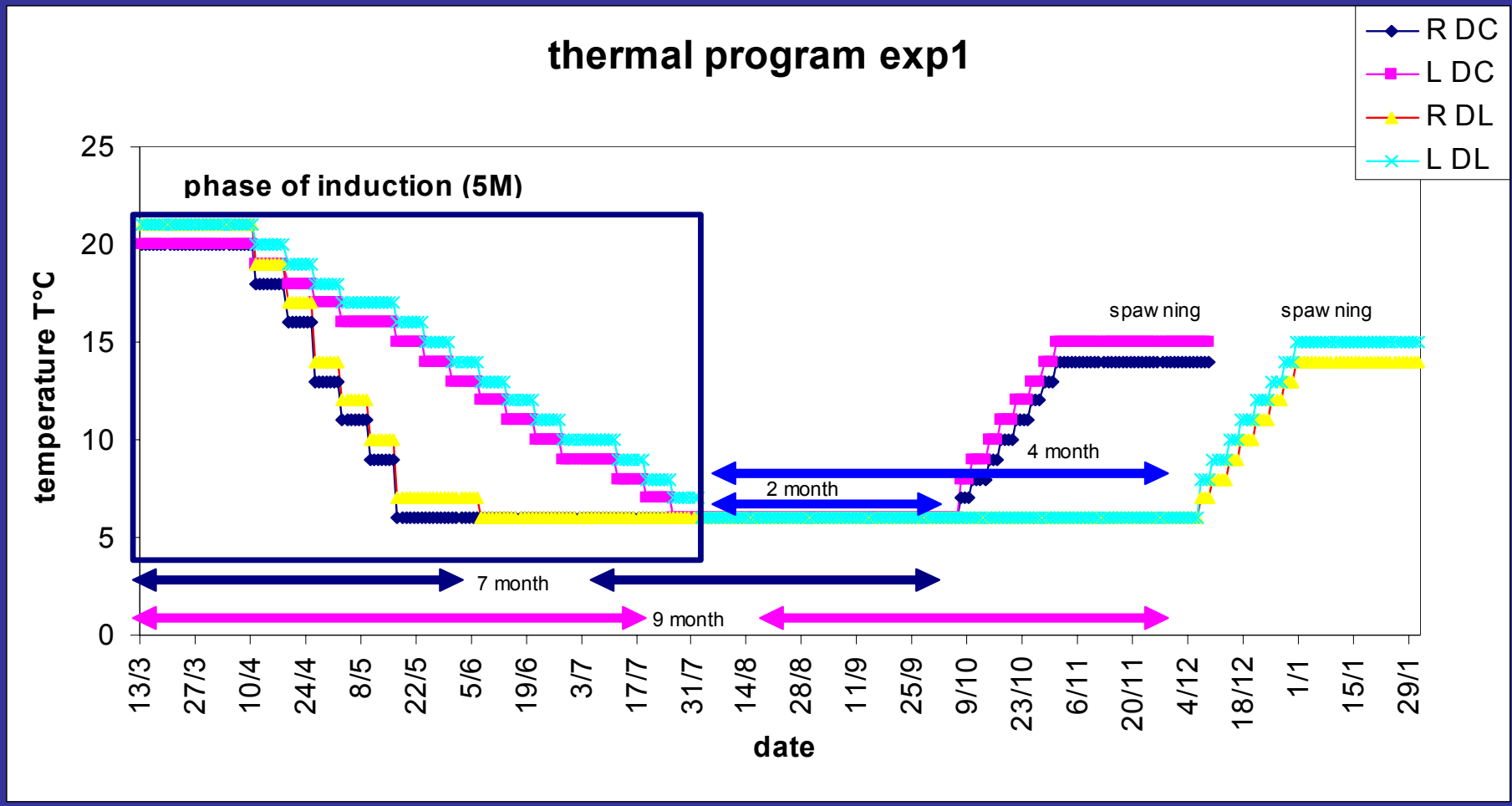
(no hormonal injection) :

- Use an optimal protocol to induce gametogenesis

- A long chilling period (4 months)

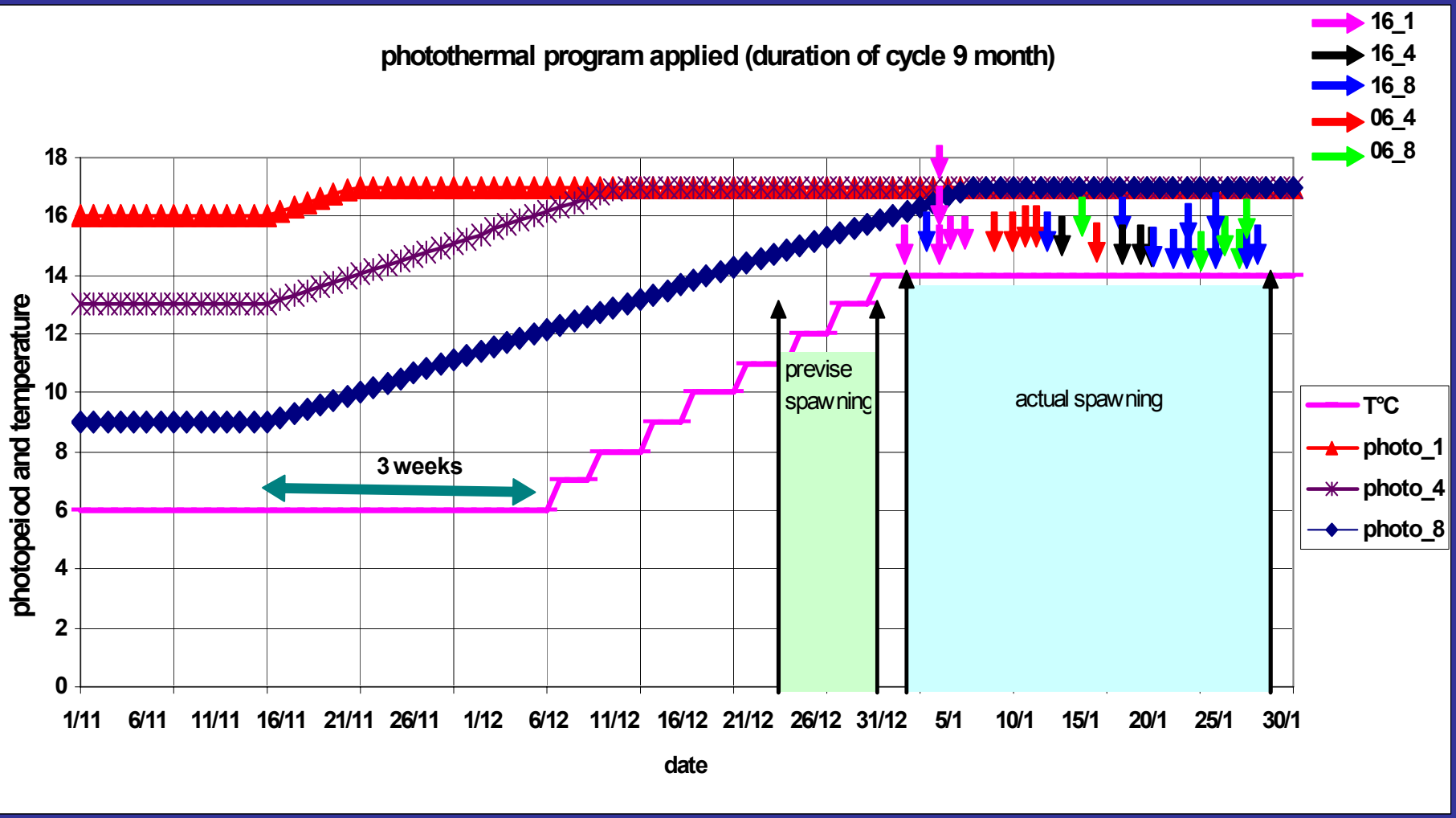
- A final progressive photoperiod increase up to L:O 17:7,
then a temperature increase up to 14°C over one month

=> Spawning rates : 100%, Fertilization rates : 50%



Combinaison optimal (see poster) :

slow and long initial photo-thermal decrease (16 weeks) + a high initial photoperiod decrease (4 or 6 hours) + long chilling period (4 months)



Spawning have started on month after the beginning of the temperature increase.

Conclusion

Suitable protocols are now available to induce out-of season gametogenesis and spawning

Remarks : methods exist for artificial fertilization and sperm cryoconservation .

Further improvements will concern :

- The effect of constant short days / gametogenesis induction

- The role of temperature during the chilling period (10°C = a threshold?)

- The respective roles of photoperiod and temperature increases over the final step

B – Recent improvements in pikeperch reproduction control

Framework : 2 CRAFT projects (including *Luciopercimprove*)

New (intensive) production systems desire new approaches:

1. Captive versus wild breeders
2. Photothermal manipulations
3. Hormonal stimulation
4. Artificial reproduction
5. Cryopreservation

1. Wild versus captive breeders

Is there a differences in reproductive cycle and reproduction performance between wild and captive breeders?

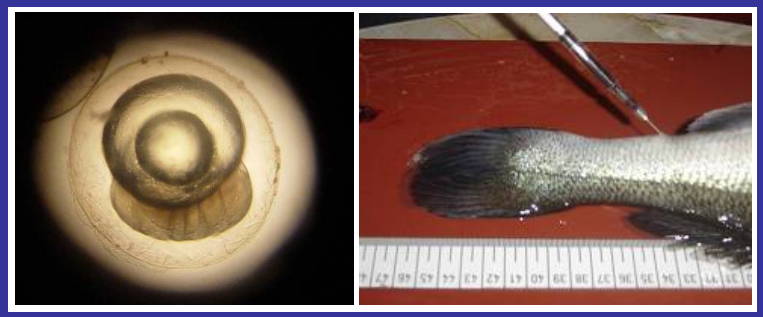
4 broodstock groups:

A – F1 breeders in tank

B – F1 breeders in pond

C – Wild breeders in pond

D – Wild breeders from fishery



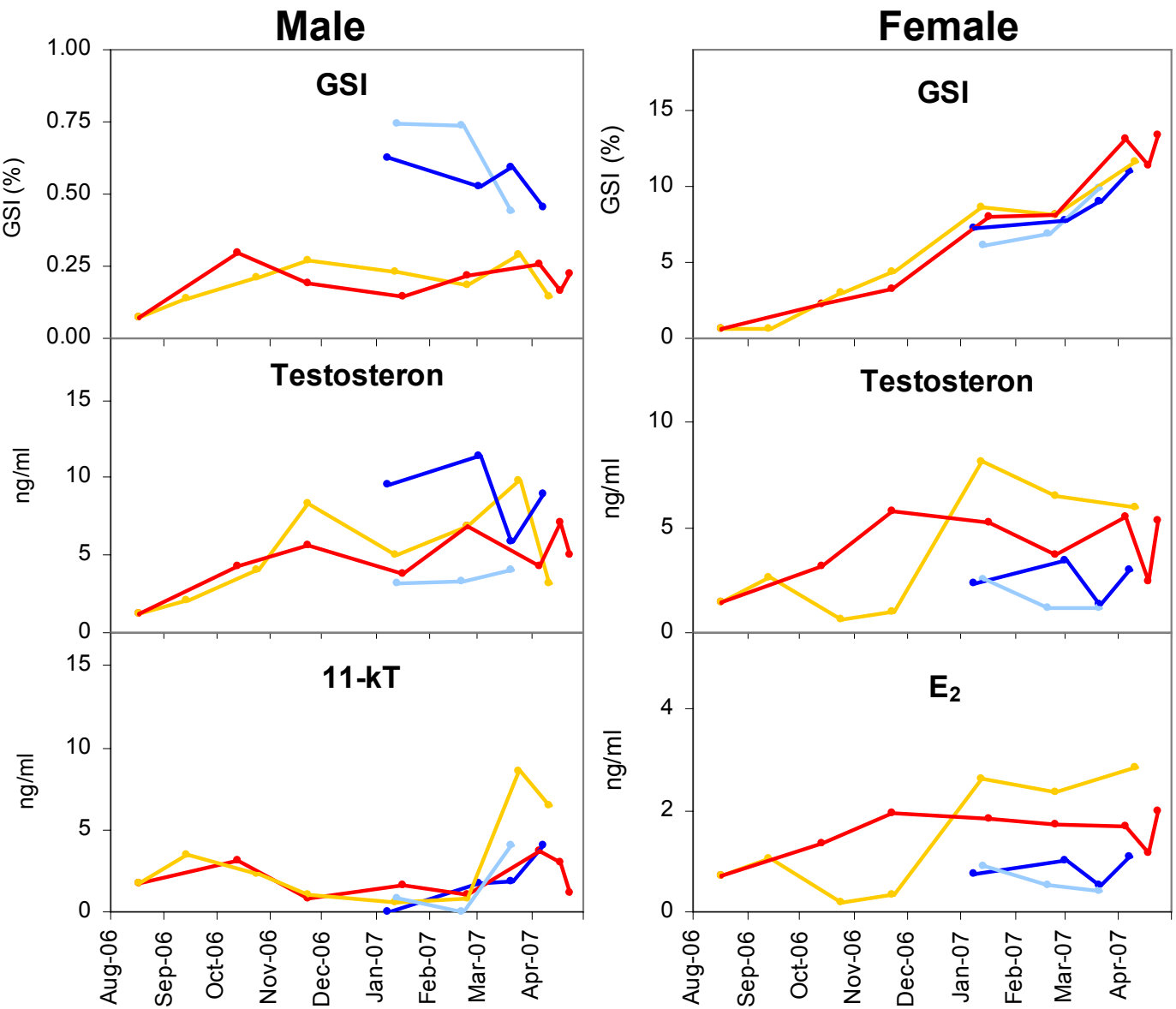
Reproductive cycle:

- GSI, VSI, HSI
- Sex steroids
- Histology

Reproduction performance:

- ♀ Fecundity
- ♂ Sperm quality (CASA)

Reproductive cycle



A: F1 tank
B: F1 pond
C: Wild pond
D: Wild fishery

Male

GSI: Wild > F1

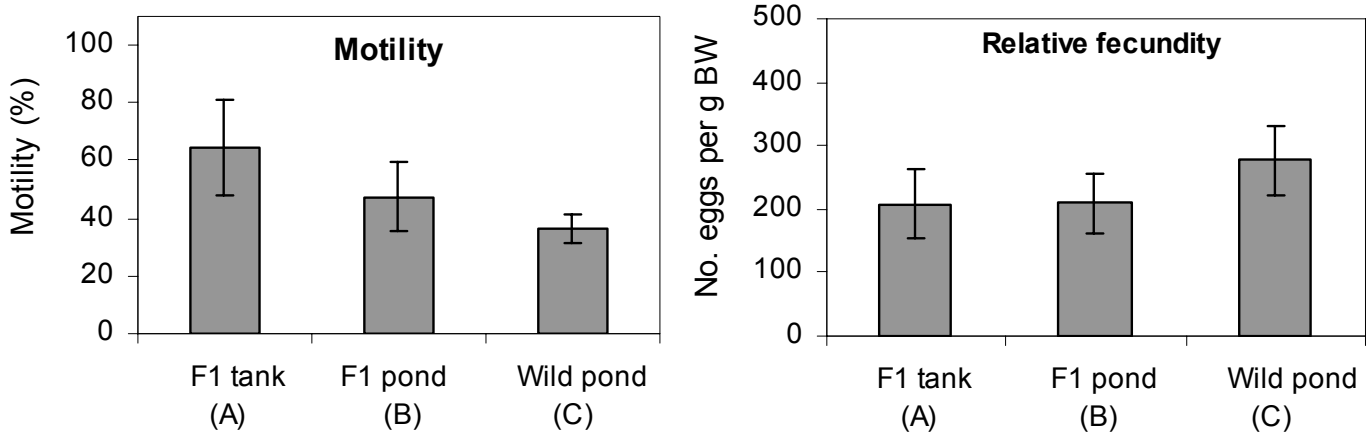
Steroids: Wild = F1

Female

GSI: Wild = F1

Steroids: Wild < F1

Reproduction performance



- Reproduction performance male: F1> Wild
- Reproduction performance female: Wild > F1 (effect of age?)

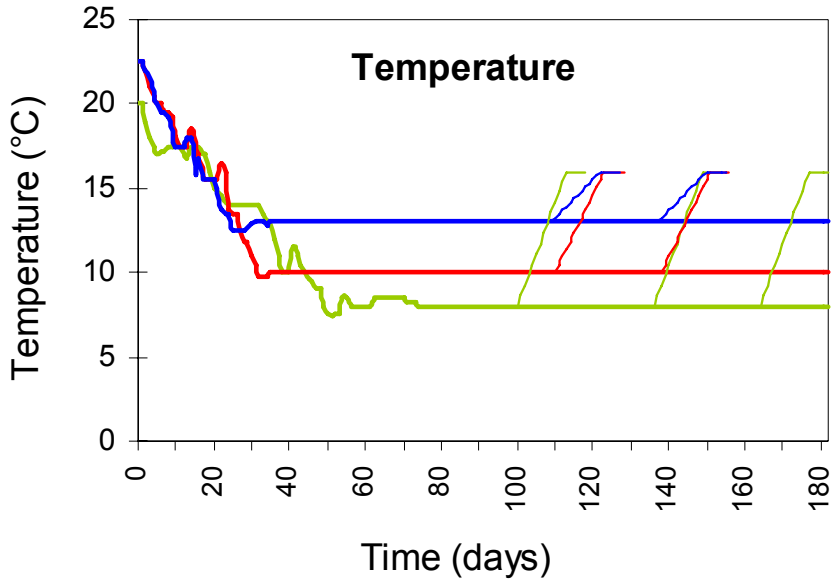
Final conclusions:

- Captive (F1) breeders held in intensive culture conditions do not lose their reproductive capacity
- Good perspective for intensive culture of pikeperch

2. Photothermal regulation

Aim: Optimize the out-of-season spawning protocol

Ongrowing stage	Cooling down stage	Cold stage	Reproduction
Temp = 20°C Light = 24:0	Temp = 20°C → 8°C Light = 24:0 → 8:16 Duration= 1 month	Temp = 8°C Light = 8:16 Duration= 4 months	Temp = 8°C → 20°C Light = 8:16 → 24:0 Duration= 2 weeks

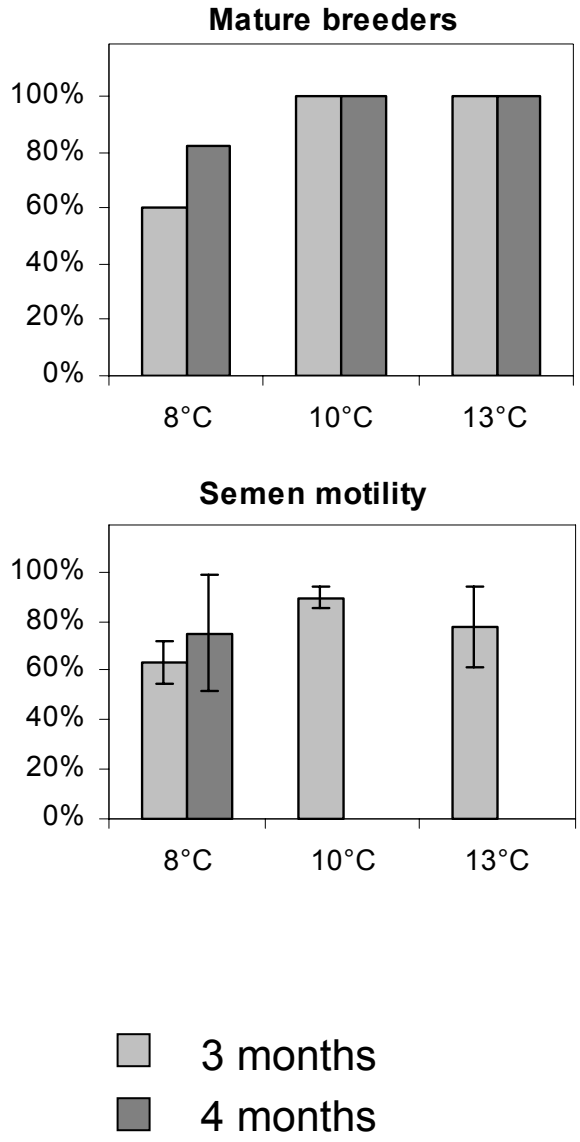


Monitor:

- Maturing breeders (%)
- Successful spawnings (%)
- Sperm quality (CASA)

- 60-100% of breeders were mature
- Mediocre results in terms of spawning, fertilization and hatching rates
- Time between injection and spawning longer than during natural season
- Condition of fish held by 8°C decreased

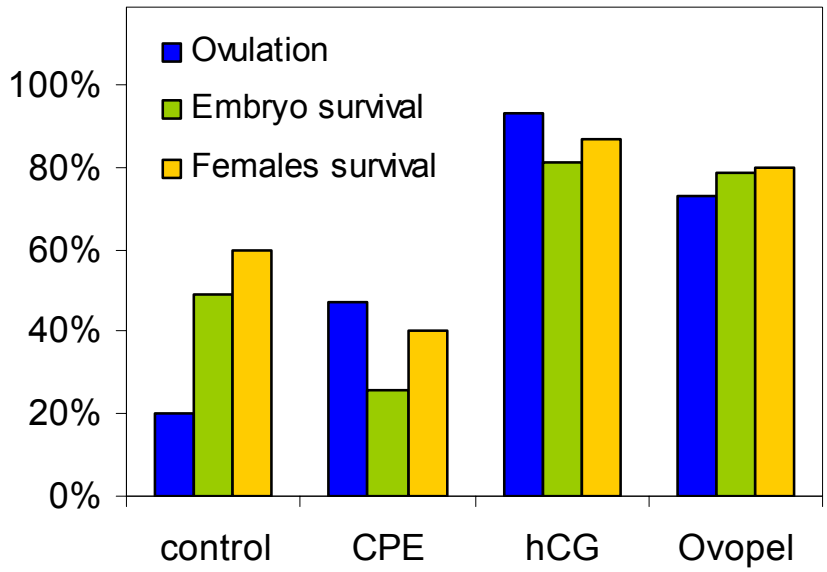
- Reproduction performance 8°C seems slightly lower than 10 & 13°C
- No differences between 3 and 4 months



3. Hormonal stimulation

Different spawning agents were tested: *CPE, hCG* and *ovopel*

Best results with *hCG*

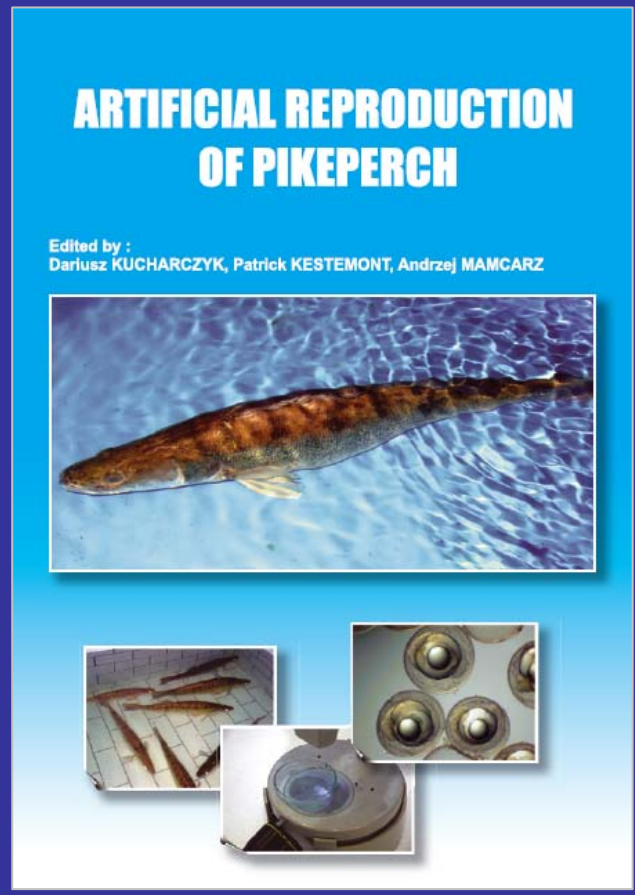


Kucharczyk et al., 2007

4. Artificial propagation

A detailed protocol for artificial reproduction has been developed

1. Handling of breeders
2. Checking the female maturation stages
3. Spawning agents and their application
4. Obtaining gametes and short storage
5. Fertilization and incubation
6. Hatching
7. Veterinary purposes



Kucharczyk et al., 2007

5. Cryopreservation

- Different extenders, cryoprotectants and activating solutions were tested.
  Best results achieved with:
  - Extender: NaCl 200 mM
  - Cryoprotectants: methanol & methyl glycol
  - Activating solution: NaCl 50 mM & tank water

- A preliminary on-farm protocol for cryopreservation of pikeperch semen has successfully been developed (using a dry-shipper)

Conclusion

- Protocols have been developed to induce out-of season gametogenesis and spawning but the protocols need to be optimized to obtain higher spawning and fertilization rates

- Artificial spawning techniques have been developed

Further improvements will concern :

- The environmental control should be better understood in order to optimize out-of-season spawning protocols (chilling rates, dawn simulation etc.)
- Reproduction using nest-material should be abandoned