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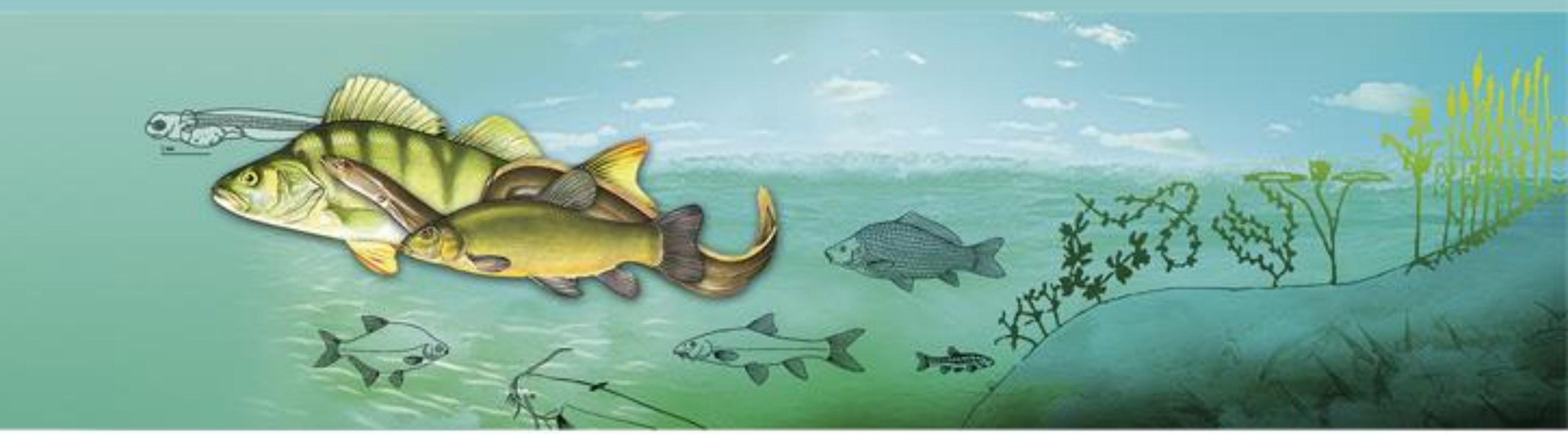
MINISTRY OF AGRICULTURE OF THE CZECH REPUBLIC

MINISTERSTVO ZEMĚDĚLSTVÍ

Production of juveniles for RAS ongrowing farms with a combined system using POND / RAS



T. Policar, J. Křišťan, M. Blecha, O. Malinovskyi

AQUA EXCEL

Národní agentura pro zemědělský výzkum
MINISTERSTVO ZEMĚDĚLSTVÍ

trafoon
Traditional Food Network to improve the transfer of knowledge for innovation

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Team introduction

Laboratory of Intensive Aquaculture

Staff and contacts


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Research interest related to pikeperch:

Controlled reproduction: spawning from Jan. – June, around 5 – 7 millions of high quality larvae;

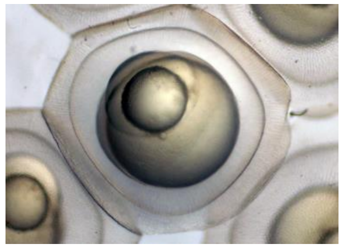
Oocyte quality: cellular and molecular changes associated with oocyte ageing during their incubation;

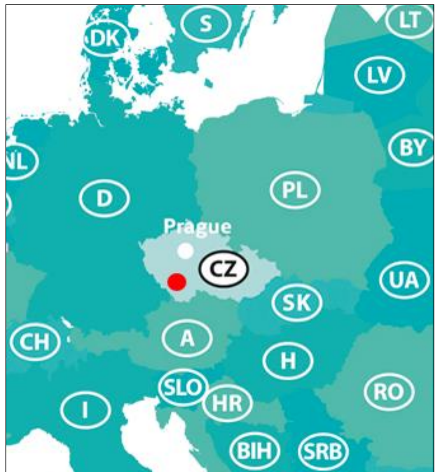
Induction of polyploidy level for production of triploids: effective pond ongrowing production;

The first larval feeding: with using of rotifers *Brachionus plicatillis* under RAS – increasing survival around 25 – 30 %;

Adaptation of autumn and spring juveniles: more batch production;

Optimization of ongrowning phase under RAS.





History of POND /RAS production system development and using

Getting of experience from literature 2004 (e.g. Zakes 1997; Ljunggren et al., 2003);

Using and development POND / RAS system for Eurasian perch (2005 – 2008);

Adaptation of POND / RAS system for pikeperch (2009 – 2010);

Using of POND / RAS system for mass pikeperch juvenile production (2011 – present);

The aim: getting of high quality experimental fish for our experiments and develop effective system for pikeperch juvenile for ongrowing farms in mainly in Central and Eastern Europe.

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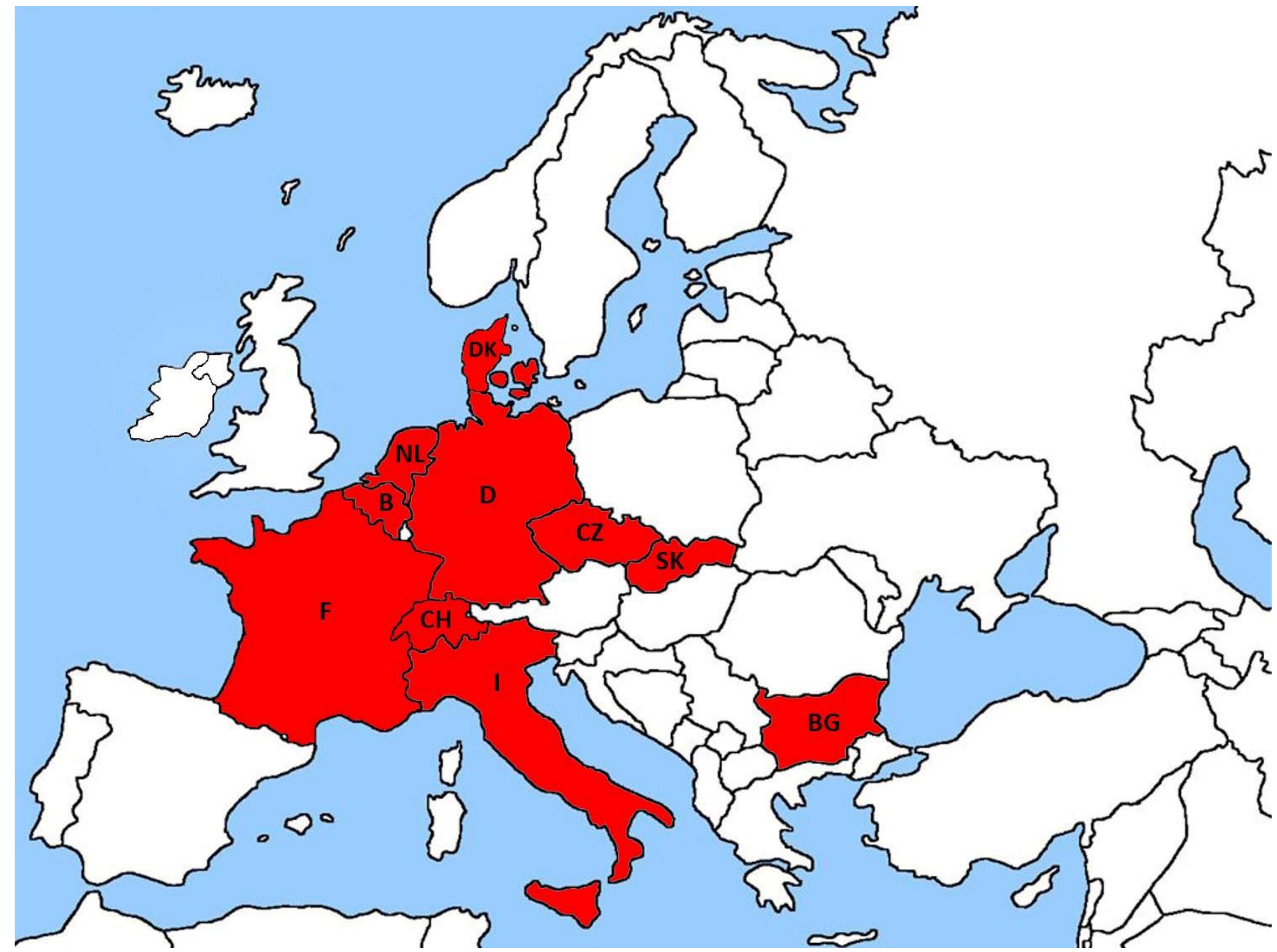
Production during 8 years (2010-2017)

Final product: pikeperch juveniles for RAS culture with BW 10 – 25 g

Year	Produced fish (pcs)
2010	18 000
2011	30 000
2012	55 000
2013	40 000
2014	37 000
2015	80 000
2016	50 000
2017	80 000
Total	**390 000**
Avg.	**48 750**



- 30 – 50% of production was used for our experiments
- the rest was sold to production and research partners in the Czech Republic, Netherlands, France, Belgium, Italy, Bulgaria, Germany, Switzerland, Denmark and Slovakia.

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Detailed technology steps of POND/RAS system




Broodstock management under pond/RAS conditions

⬇

Reproduction and egg incubation under conrolled conditions

⬇

Stocking of larvae into prepared ponds

⬇

6-weeks pond culture of larvae and juveniles under pond conditions

⬇

Harvest of pikeperch juveniles from ponds

⬇

Weaning and adaptation of juveniles under RAS

⬇

Following juvenile culture under RAS to BW 25 grams







Broodstock management and reproduction

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Size of broodstock

Pond cultured broodstock with TL= 520 – 570 mm, W= 1200 – 1800 g not bigger;

Better and easier manipulation;

Lower egg fecundity and better egg distribution on the artificial nests providing good incubation conditions and high hatching rate and larval production;

Lower demanding for tanks capacity and culture place;

We can use higher number of fish for higher genetic diversification.

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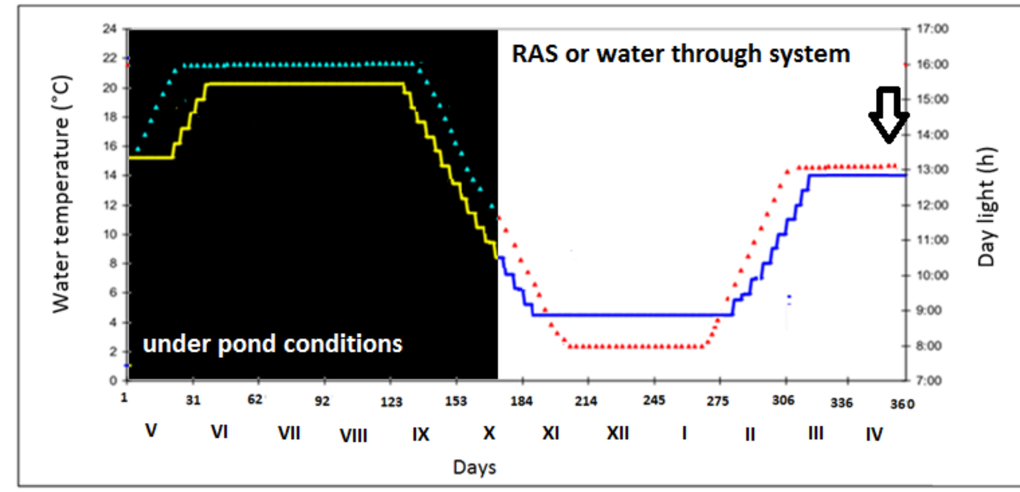
Broodstock culture

- Natural environmental stimulation for gonadal development and maturation (6 periods before spawning) – control and cutting of summer or wintering periods for different terms of spawning (from January till June);

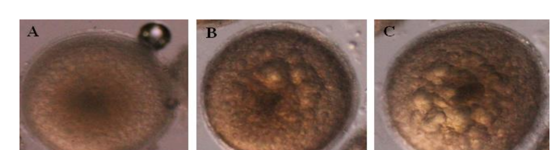
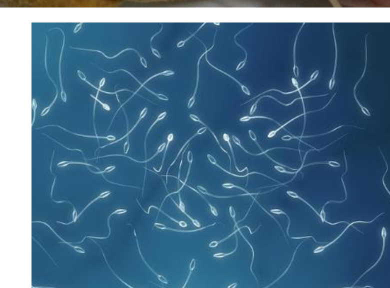


- Broodstock culture under POND and RAS conditions with stable and good supply of prey fish (15 kg of prey fish. kg^{-1} of broodstock per year);


- Broodstock protection in ponds against otters and cormorants;


- Selection of the best broodtock 40 days before spawning acording conditions;


- Checking of maturation stages of oocytes and selection of maturated broodstock for final hormonal stimulation.

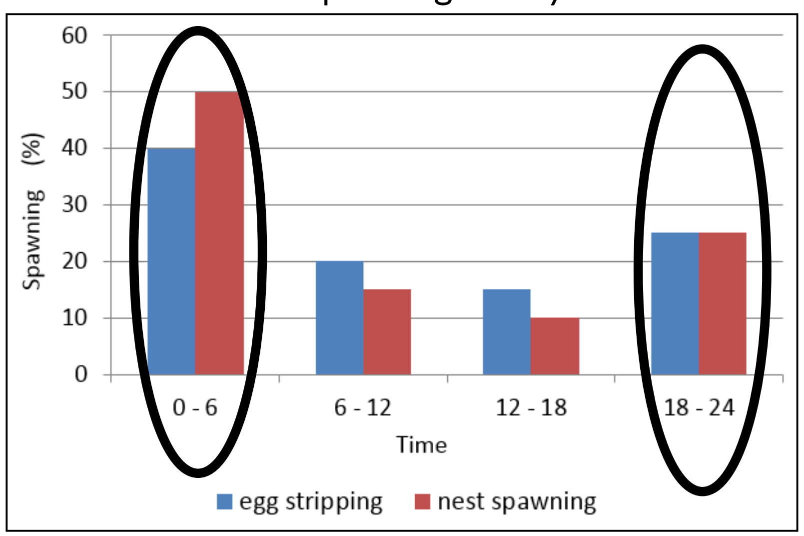



Spawning

Final hormonal treatment of both sexes: HCG (Chorulon) - one dose 500 $IU.kg^{-1}$
GnRa (Supergestran) – one dose 25 $mg.kg^{-1}$

Spawning technique: Preferred is nest spawning – less time consuming, easer way and higher hatching rate

X



Parameter	Egg stripping (artificial fertilization)	Nest spawning (natural fertilization)
Spermation rate (%)	100_a	100_a
Ovulation rate (%)	$78.0 \pm 11_a$	$95.0 \pm 5.0_b$
Spontaneous spawning without fertilization (%)	35_b	0_a
Fertilization rate (%)	$78.7 \pm 5.5_a$	$91.5 \pm 3.0_b$
Hatching rate (%)	$63.5 \pm 4.5_a$	$75.6 \pm 2.7_b$
Production of larvae per female (thousands of pcs)	$81.6 \pm 19_a$	$97.3 \pm 23.8_b$

Broodstock post-spawning care and mortality

Tanks within RAS (clean and filtrated water, with constant water parameters;

Removal of female from tanks immediately after spawning;

Long salt bath during 48 hours (7.5 – 10 g NaCl per liter);

Intensive feeding with prey fish (5 prey fish per one broodstock);

Water temperature 16 – 18 °C and light 10 – 12 hours;

Fish density 30 – 40 $kg.m^{-3}$.

Mortality	Female	Male
During spawning	8 %	5%
10 days after spawning	10 % (90%)	8% (95 %)
100 days after spawning	25 %	25%

Preparation of ponds for larval stocking

Choice and preparation of ponds

- Small ponds – maximum area 1.5 - 2 ha
- Pond with maximum haversting time about 18 – 24 hours,
- Pond wintering – elimination of weeds, leech and beetle larvae
- Littoral vegetation provides better feeding supply in ponds for later juvenile culture,
- No fertilization of ponds is used,
- Pond must be fill by water 10 days before stocking of larvae,
- Good supply of cladoceran, coppepods and rotifers must be indicated in ponds before stocking of larvae.








Stocking of larvae to ponds

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Stocking of larvae to ponds

- Larvae are collected 3 - 4 days post hatching (DPH) from nests,

- Larvae are transported in polyethylene bags under density 100 000 larvae per 5 – 7 liters of water (maximum 3 hours),

- Larvae are stocked to ponds under initial stocking density 150 - 300 000 larvae per 1 hectare of pond area.

- Initial density is dependend on pond size and its trophy level and littoral vegetation.

Larval and juvenile culture under pond conditions

Pond juvenile production

Advantages

Natural food supply and high sustainability of culture;

Excellent fish growth (SGR 20 – 23 $\%.d^{-1}$);

Elimination of poor-quality fish during culture;

Good fish survival 25 – 30% = good production efficiency;

High-quality fish production without any deformity;

Low production cost;

Low demand for labor;

Using of small unused ponds.

Disadvantages

Uncontrolled and unexplainable production;

Dependence on the weather and countryside;

Complicated and hard harvesting way;

Potential transmission of diseases;

Seasonal production.

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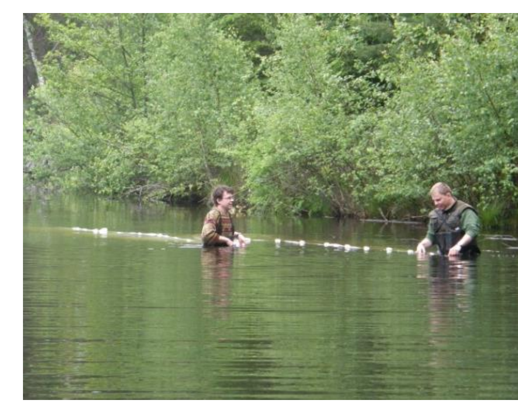
Larval and juvenile culture under pond conditions

- Duration of culture: 42 ± 2 days,

- Needed periodical checking water quality and food supply during culture at one week interval

- Initial fish size: TL= 5.2 – 5.7 mm, W=0.85 – 0.9 mg



- Final fish size: TL= 35 – 50 mm, W=0.3 – 0.8 g

- SGR: 20.3 – 22.5 %.d^{-1}

- Survival rate: 27.4 ± 10.5 % (in total 75 ponds: 0,5 – 70%)

- Cannibalism rate: 1.0 - 20,5 %.

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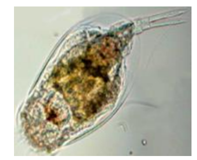
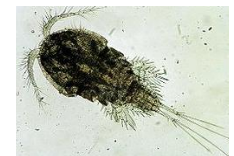
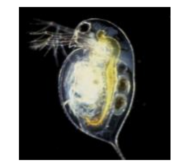
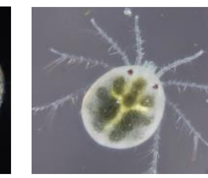
Natural food supply for larvae and juveniles of pikeperch during pond culture

Larval food:

– 85 % coppepods and cladoceran species and 15% rotifers = 100 % zooplankton

Juvenile food:

– 72% zooplankton = coppepods and cladoceran species,
– 20% zoobentos = larvae of insects
– 8% phytophilous invertebrates = larvae of insect



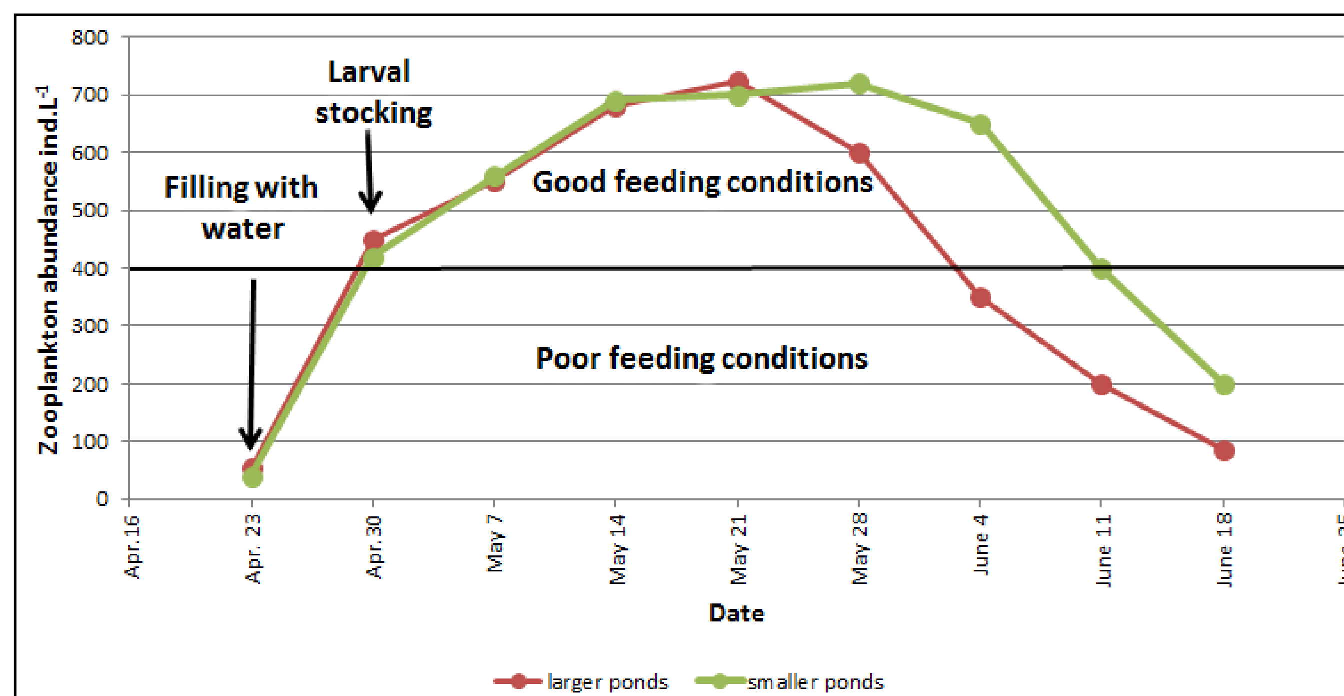




Zooplankton is the most important food for larvae and juvenile

Zooplankton abundance effects efficiency of pond production

Zooplankton abundancy below 400 ind.ml^{-1} – harvesting of juveniles must be quickly organized



Harvest of pikeperch juveniles from ponds

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Harvest of pikeperch juveniles from ponds

- In outlet channel below pond,
- Special nets or cages have been used,
- Final harvesting must be quick (4-6 hours),
- Final harvesting during morning,
- Acceptable summer weather:
    - air temperature (max. 22 – 24 °C),
    - water temperature (max. 20°C),
    - cloudy or rainy,
    - no large change of water temperature,

- After harvesting prophylactic bath during or after fish transport.





Adaptation and weaning of juvenile under RAS

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Juvenile adaptation in RAS

- For controlled conditions in RAS
- For artificial food – weaning of larvae

Conditions during adaptation:

- Same sized fish – after careful grading
- Stocking density – 8 fish per 1 liter
- Light regim – 16 L/8 D , 100 - 200 lx
- Water temperature 23.0 ± 0.5 °C
- Oxygen saturation 100 %

Weaning of pond-cultured pikeperch juveniles

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Stocking of juveniles to RAS (day 1)

↓

Set-up enviromental conditions: t= 23°C, O_2= 80-100%, 18L/6D (day 2)

↓

Starvation of stocked juveniles (day 1 – 2)

↓

100 % feeding rate with frozen chiromonids (red worms) (day 3 – 4)

↓

Feeding with 75% red worms : 25% artificial food 0.8-1.1 mm (day 5 – 6)

↓

Feeding with 50% red worms : 50% artificial food 0.8-1.1 mm (day 7 – 8)

↓

Feeding with 25% red worms : 75% artificial food 0.8-1.1 mm (day 9 – 10)

↓

Feeding with 100% artificial food 0.8-1.1 mm (day 11 – 12)

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Juvenile weaning and adaptation in RAS

Results:

- Duration of adaptation: 12 days
- Initial fish size: TL= 35 – 50 mm, W=0.3 – 0.8 g
- Final fish size: TL= 37 – 52 mm, W=0.45 – 1.0 g
- SGR: 2 - 3.8 %.d^{-1}
- Survival rate: 72.5 – 84.0 % (cumul. s. 21.5 %)
- Canibalism rate: 3.0 - 5.0 %
- Initial feeding rate: at libitum (0.8 mm)
- Final feeding rate: at libitum (0.8 mm)
- Feed Conversion Ratio FCR: 4.2 - 5.0

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Juvenile culture under RAS up to BW 25 grams

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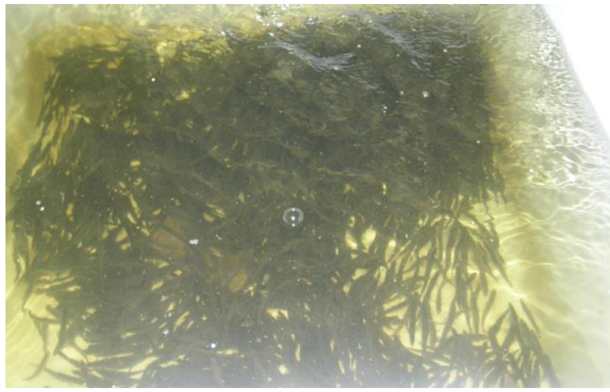
Juvenile culture under RAS up to 25 g

Conditions:

- Directly after weaning and adaptation
- Water temperature 22.5 ± 0.7 °C
- Oxygen saturation 100 %
- Light regime 16L/8D, 100 - 200 lx
- Initial fish density: 8 fish.L^{-1} (5kg.m^{-3})
- Final fish density 2 fish.L^{-1} (49.2 kg.m^{-3})
- Initial feeding rate 10 % (1.1 mm)
- Final feeding rate 5 % (2 mm)
- Fish grading at 14-21days interval
- Duration of juvenile culture 90 days



Juvenile culture under RAS up to 25 g

Results:

- Initial fish size: TL= 37 – 52 mm, W=0.45 – 1.0 g
- Final fish size: TL = 141 ± 10 mm, W= 24.6 ± 5.6 g
- Survival rate: 87.5 - 90.0 % (cumul. s from larvae 19 - 20%)
- Canibalism rate: 2.0 – 3.0 %
- SGR= 3.0 – 4.0 %.d^{-1}
- Feed Conversion Ratio (FCR) = 1.3 – 1.6

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Already presented information about our POND/RAS production system

EPFC 2012 Policar, T., Overton, J., Toner, D., Mandiki, S.N.M., 2012: How to stabilize supply of larvae and juveniles in Eurasian perch and pikeperch;

AQUA 2012 Policar, T., Kristan, J., Stejskal, V., Blaha, M., 2012: Juvenile production in pikeperch for ongrowing culture;

EPFC 2013 Policar, T., Blecha, M., Kristan, J., Stejskal, V., Blaha, M., 2013: Combination of intensive and extensive aquaculture for juvenile pikeperch production (*Sander lucioperca*);

AE 2013 Policar, T., Blaha, M., Kristan, J., Stejskal, V., Blecha, M., 2013: Juvenile production of pikeperch (*S. lucioperca*) under pond conditions – experience for three years;

AE 2014 Blecha, M., Křištan, J., Policar, T., 2014 Adaptation of the intensively cultured pikeperch (*Sander* lucioperca) juveniles to pond culture during winter and their following adaptation and culture under RAS

EPFC 2015 Policar, T., Blecha, M., Křišťan, J., Svačina, P., 2015: Broodstock management of pond cultured pikeperch for effective larval production;

AE 2015 Policar, T., Šetlíková, I., Bláha, M., Blecha, M., Svačina, P., Křišťan, J., Żarski, D., Kucharczyk, D., 2015: Effect of periphyton support on the production of pikeperch *Sander lucioperca* L. juveniles in ponds;

AE 2017 Malinovskyi, O., Křišťan, J., Blecha, M., Veselý, L., Policar, T., 2017: Foraging behavior of pikeperch, Sander lucioperca (L., 1758) broodstock;

AQUA 2018 Policar, T., Malinovskyi, O., Blecha, M., Kristan, J., Samarin, A.M., 2018: Post-spwning treatment and mortality elimination after two different spawning techniques in pond-cultured pikeperch Sander lucioperca broodstock.

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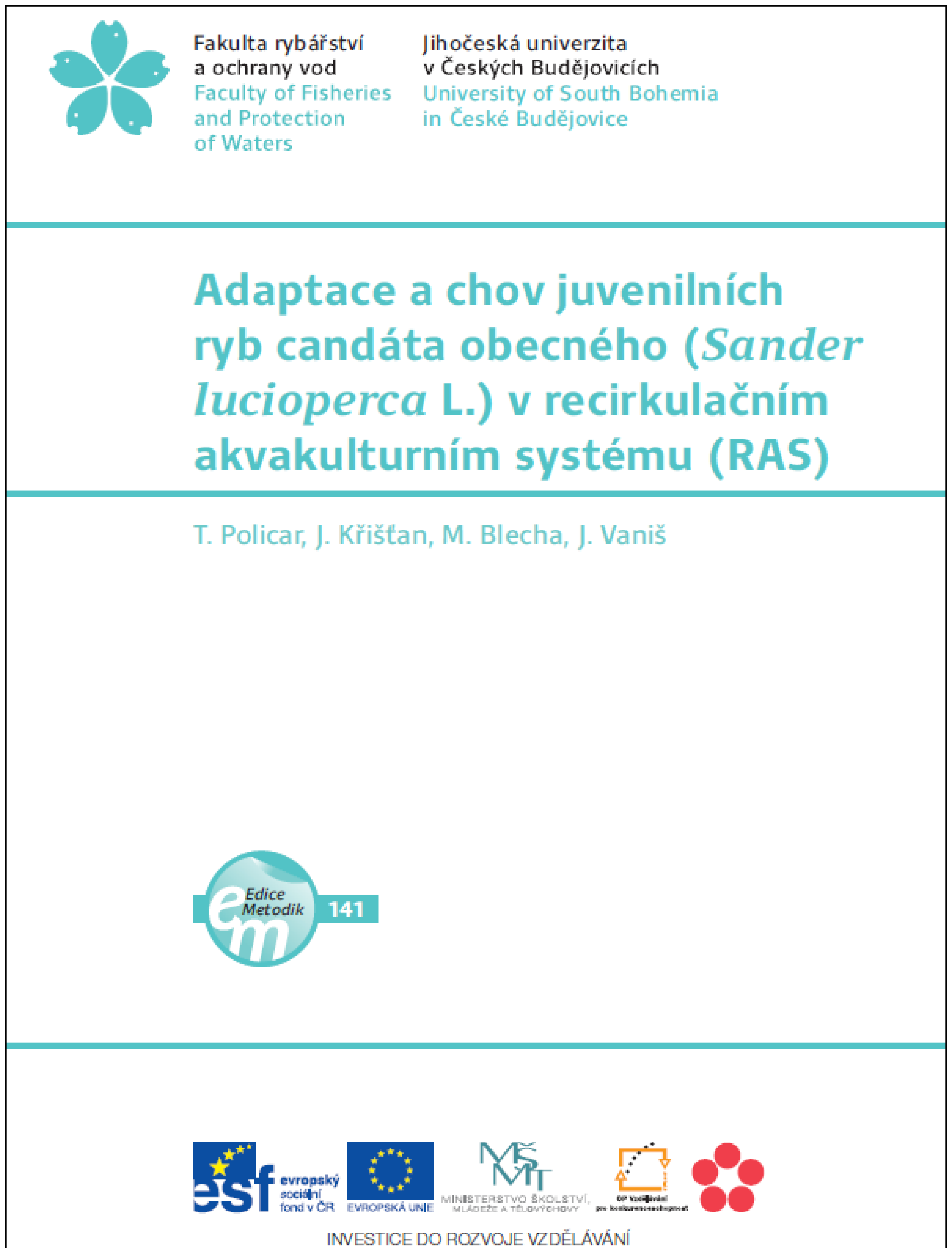
Published handbook in Czech and English

thanks to EU project: trafoon



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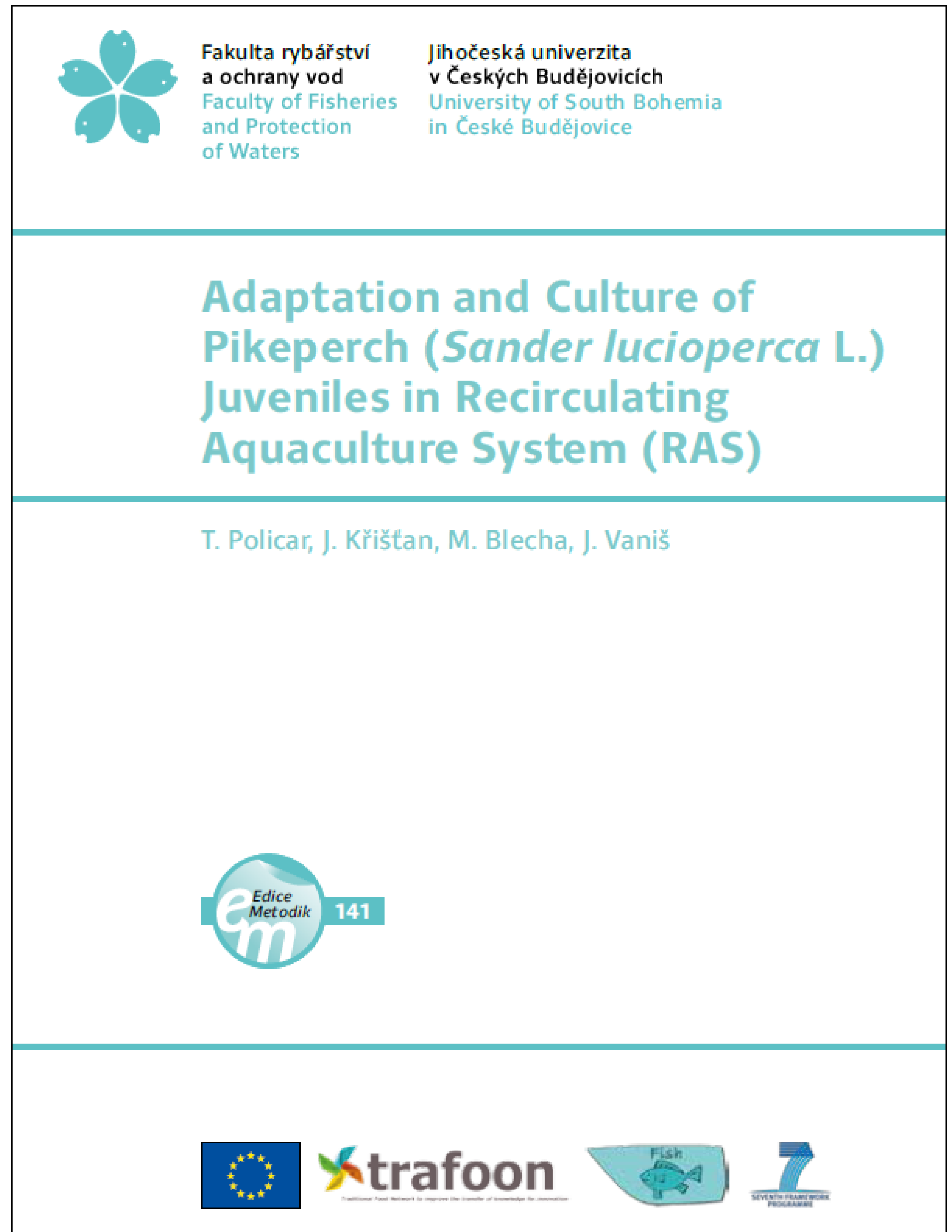
Adaptace a chov juvenilních ryb candáta obecného (*Sander lucioperca* L.) v recirkulačním akvakulturním systému (RAS)

T. Policar, J. Křišťan, M. Blecha, J. Vaniš

Edice Metodik 141

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ



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Adaptation and Culture of Pikeperch (*Sander lucioperca* L.) Juveniles in Recirculating Aquaculture System (RAS)

T. Policar, J. Křišťan, M. Blecha, J. Vaniš

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Scientific papers about POND/RAS production system

Policar, T., Blecha, M., Křišťan, J., Mráz, J., Velíšek, J., Stará, A., Stejskal, V., Malinovskyi, O., Svačina, P., Samarin, A. M., 2016. Comparison of production efficiency and quality of differently cultured pikeperch (*Sander lucioperca* L.) juveniles as a valuable product for ongrowing culture. Aquaculture International, 24: 1607 – 1626

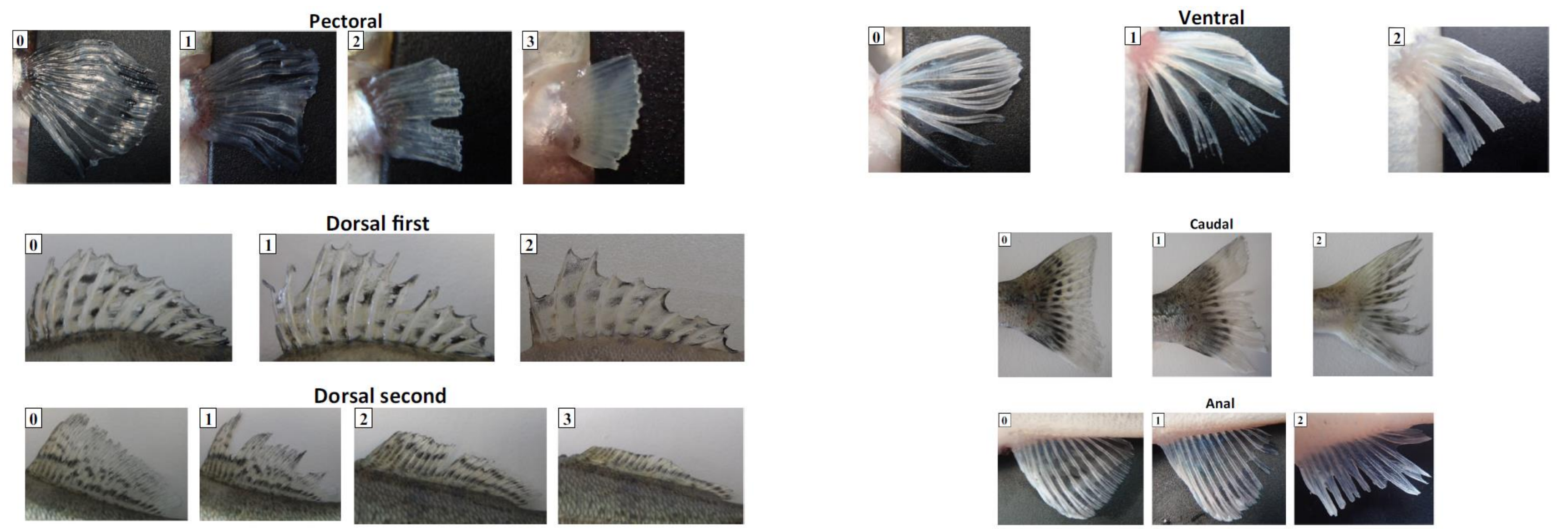
Blecha, M., Kristan, J., Policar, T., 2016. Adaptation of intensively reared pikeperch (*Sander lucioperca* L.) juveniles to pond culture and subsequent re-adaptation to a recirculation aquaculture system. Turkish Journal of Fisheries and Aquatic Sciences, 16: 15 – 18.

Policar, T., Stejskal, V., Kristan, J., Podhorec, P., Svinger, V., Blaha, M., 2013. The effect of fish size and density on the weaning success in pond-cultured pikeperch (*Sander lucioperca* L.) juveniles. Aquaculture International 21 (4): 869 – 882.


The effect of fish size and stocking density on the weaning success of pond-cultured pikeperch *Sander lucioperca* L. juveniles

Comparison of production efficiency and quality of differently cultured pikeperch (*Sander lucioperca* L.) juveniles as a valuable product for ongrowing culture

Adaptation of Intensively Reared Pikeperch (Sander Lucioperca) Juveniles to Pond Culture and Subsequent Re-Adaptation to a Recirculation Aquaculture System



POND/RAS system for pikeperch juvenile production

Conclusion:

- **Very effective and stable system** for juvenile production **with lower cost**:

- **Higher – quality fish** for stocking to RAS and pond culture or for stocking to open waters (lakes, dams etc.):

pikeperch without morphological deformities, fin damage, high level of essential fatty acids, higher growth potential and stress resistance;

- Using in the countries with higher area of **small production ponds:**

high potential mainly for countries from Central and Eastern Europe.

Thanks for your attention