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Environmental control of the reproductive cycle for out-of-season spawning in pikeperch

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Funding

„Implementation and development of pikeperch aquaculture in Mecklenburg-Vorpommern “

- *75% European Union*

- *25% Federal State Mecklenburg-Vorpommern: Ministry of Agriculture, Environment and Consumer Protection*

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Where we are!

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Pilot facility Hohen Wangelin

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- Commercial pikeperch production
- Synergetic effects

- Construction: 2009 - 2011
- Start cultivation: 2011
- Evaluation of strains: 2012
- Reproduction: 2012
- Closed cycle: 2014

Team in Hohen Wangelin

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Light & temperature in natural environments

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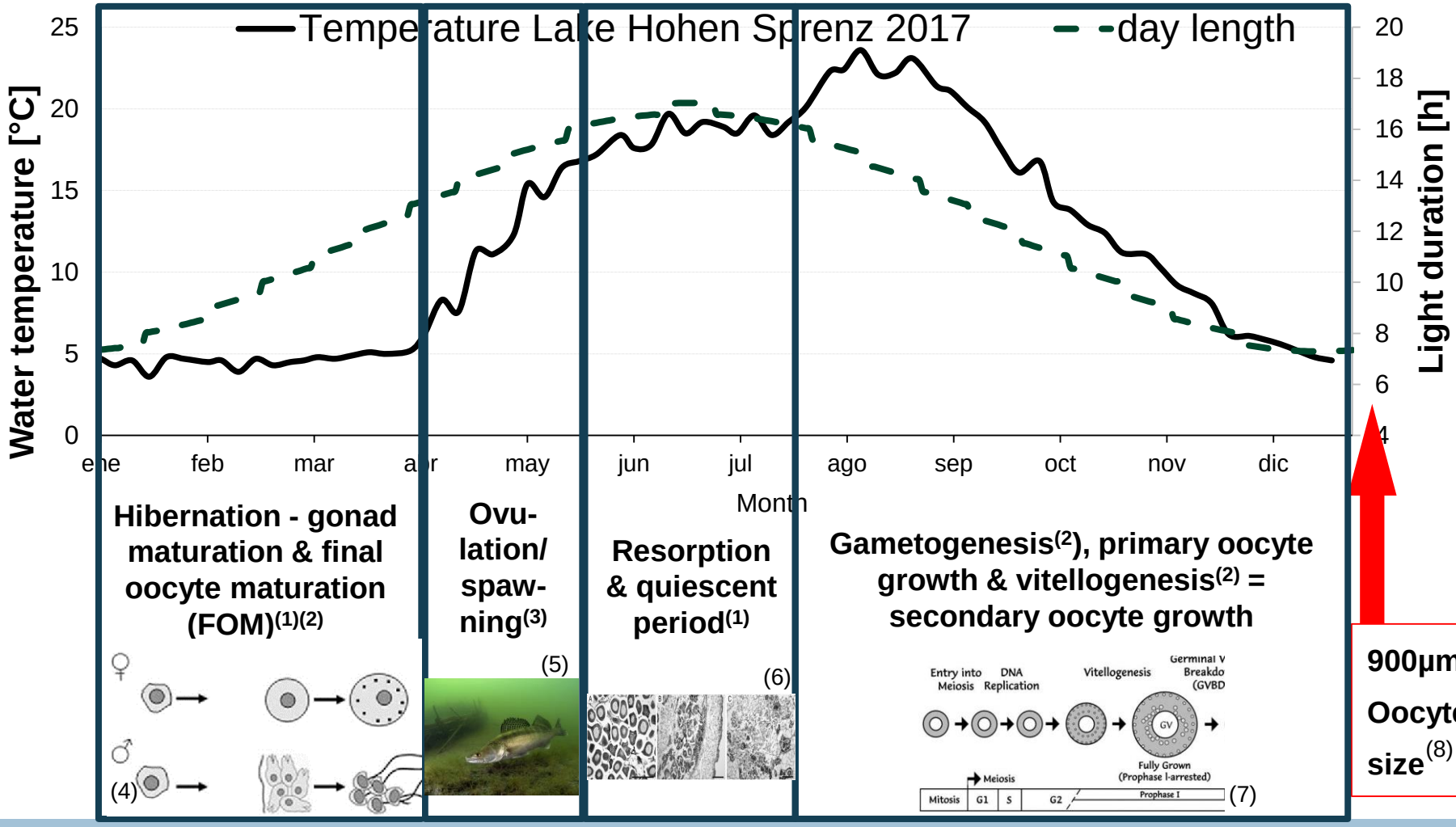

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3. Sandström O, Neuman E, Thoresson G (1995) Effects of temperature on life history variables in perch. J Fish Biol 47:652–670
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8. Unpublished data

Endogenous mechanisms and exogenous inputs in RAS

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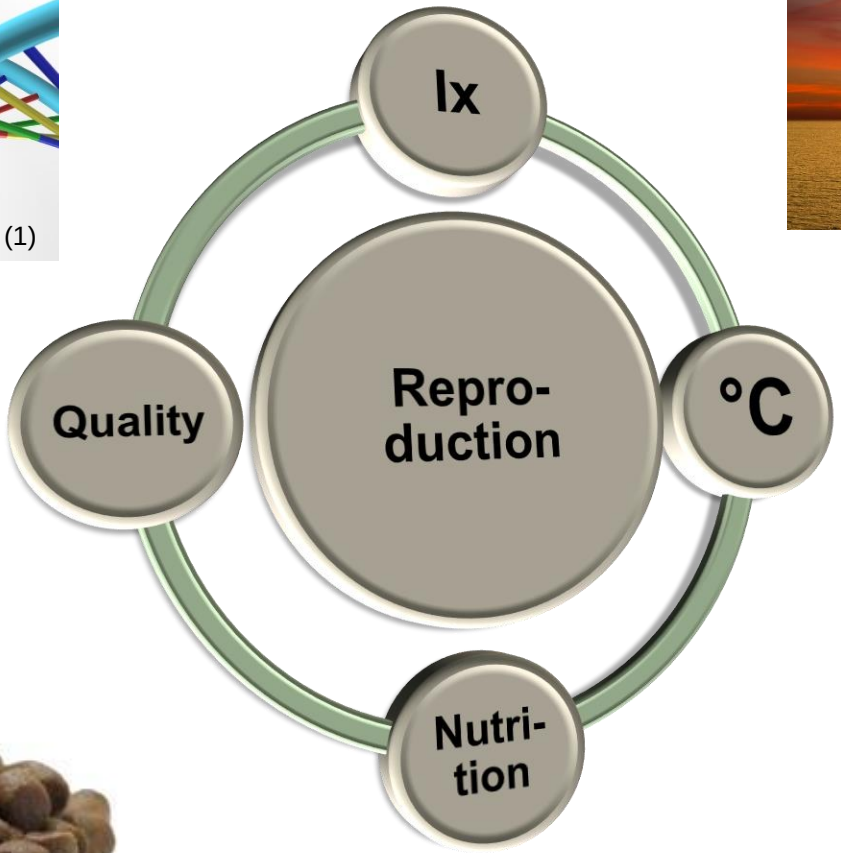
(1)

(2)



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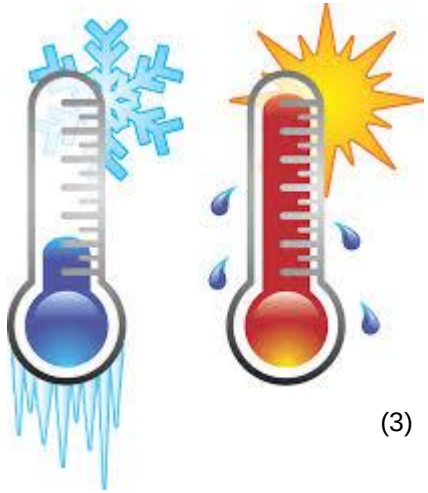

(3)

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3. https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQ1H6EduxvwqUtwlczeKZu3pFYEy3UyNuIh8EA-iTSSMt00rTjMxA
4. BioMar A/S

Two reproduction methods in RAS

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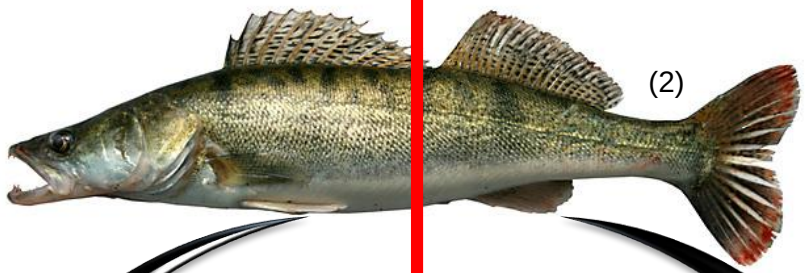
Light

Temperature

Substrate (M/F, 1-2/1)



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Light

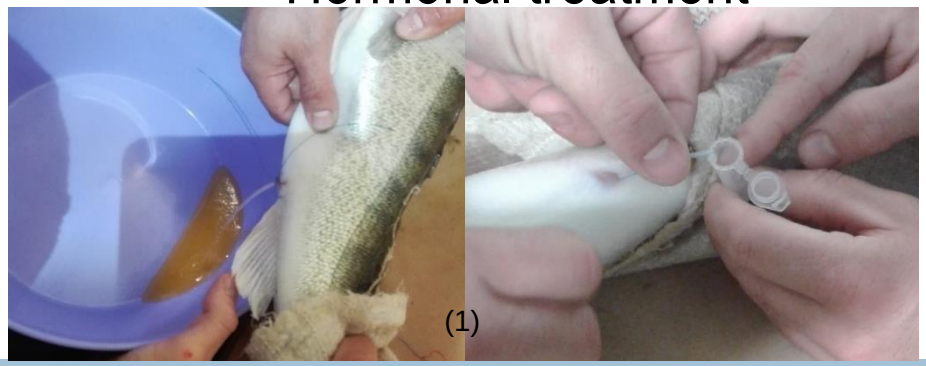
Temperature

hCG, GnRHa, CPE

Stripping (3-4/1)

Artificial spawning

Hormonal treatment



(1)

1. Uros Ljubobratovic u.ljubobratovic@gmail.com
2. https://www.fischlexikon.eu/images/fischlexikon/galerie/zander-01.jpg

Broodstock management

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- 3 strains + recruited fish
- Light regime: 50 lx, 17:7 (L:D)
- Feed: 44 % protein, 16 % lipid

Cooling chamber (season)

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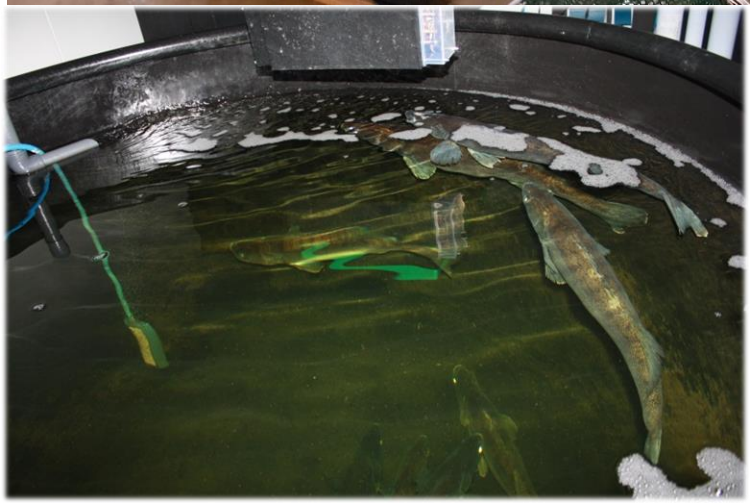
Landwirtschaft und Fischerei

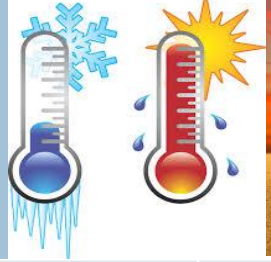
- 3 chambers
- Cooling aggregate
- UV – desinfection, trickling, mechanical filtration

Spawners

- Min. 24 month
- Mixed stocking
- Fitness, growth performance



Protocol for induction



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Landwirtschaft und Fischerei

	Temperature [°C]	Light regime	Feed intensity [%/d]	Duration [w/d]
„Adaption“	23 – 21	• 16 : 8 (L/D) • 50 lx	0.5	2 / 14
„Autumn“	21 – 10	• 8 : 16 • 10 lx	0.5 – 0.15	8 / 56
„Winter“	< 10	• 6 : 18 • < 8 lx	0.1	8 / 56
„Spring“	8 – 15	• 14 : 10 • 20 lx	0.15 – 0.5	8 / 56
„Spawning“	10 – 16	• 16 : 8 • 30 lx	no feed	4 / 28
„Complete cycle“				30 / 210

Temperature regime

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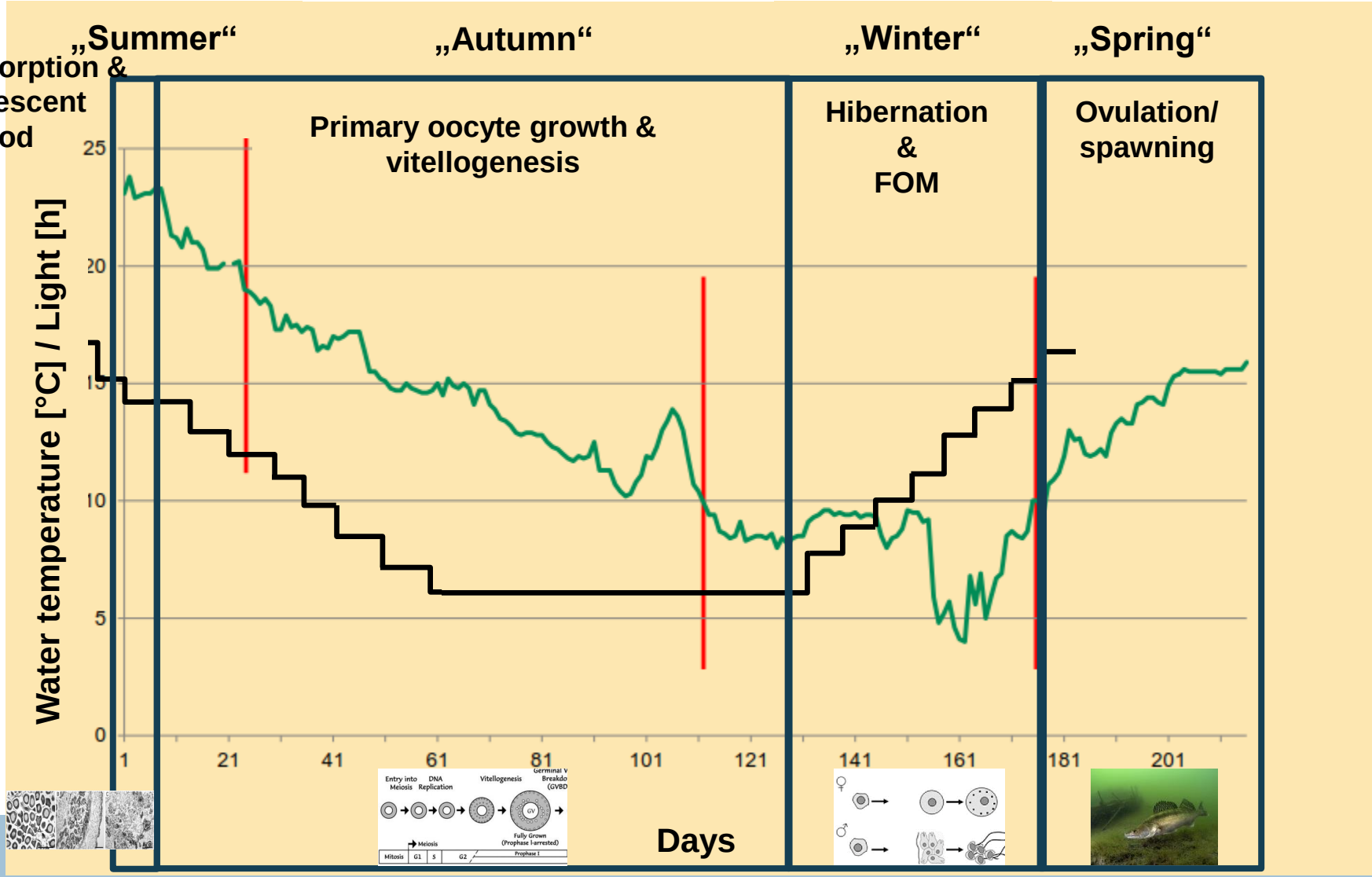

Oocyte size in trials

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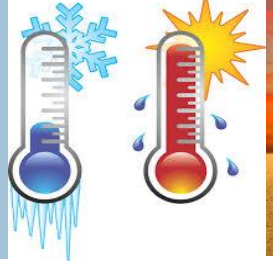
	Fish ID of virgins	Oocyte size* [µm]		Fish ID of second spawners	Oocyte size* [µm]	
		18 weeks/ 6°C	20 weeks/ 6°C		18 weeks/ 6°C	20 weeks/ 6°C
	D40C	895.50 ± 109.6	905.75 ± 48.24	D302	1056.89 ± 24.26	1066.09 ± 20.66
	278B	944.73 ± 68.14	976.60 ± 59.09	D2E6	951.88 ± 16.15	1007.40 ± 28.59
	D410	848.64 ± 48.66	932.30 ± 31.21	D335	941.79 ± 27.58	984.10 ± 28.33
	D409	575.50 ± 50.16	775.70 ± 60.25	D348	927.16 ± 36.38	984.41 ± 23.66
	275A	752.53 ± 115.96	828.25 ± 59.02	D2F0	952.27 ± 22.02	978.67 ± 46.47
	274C	805.31 ± 59.27	928.20 ± 78.56	D337	1049.34 ± 32.93	1071.90 ± 27.14
Sex ratio M/F	9/31			12/28		
Fertilization rate **[%]	0.5			3.0		
Amount of clutch	18			23		

*average size of ten measured oocytes per female
**average of whole propagation

Summary



- Year-round reproduction (up to six times)
- 7 months
- > 90 % gonad maturation
- 60 % fertilised clutch (n = 30)
- Ovulation within 4 weeks
- No mortality

RAS

Wild

Problems & outlook

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- Evaluation of egg/ sperm quality variable egg/ sperm quality
- Low fertilization rate
- Individual quality - large broodstock
- Better synchronization of males and females
- Egg treatment (desinfection)
- Differences in strains/ traits management

Thanks for the attention!

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Reproduction in nature

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1. The reproductive cycle in pp can be divided into four main chapters. With regard to the oocyte size pp have a purpose to reach.
2. This is a certain size around 900µm by the end of decreasing temperature.
3. Quality of gonad development is driven by both endogenous mechanisms and exogenous inputs, the most important of which are temperature and photoperiod.
4. Male gonads start to develop in fall and are fully developed by the mid-winter months, able to sustain spermiation for up to 6 months until spawning in early spring.
5. PP in general need extended winter period of 3-5 months with temperature below 15°C for proper gonad development
6. Gametogenesis and primary oocyte growth takes place already in August and secondary oocyte growth, known as vitellogenesis, begins in oocytes in November and continues until just before spawning.
7. In between of decreasing temperature and increasing temperature only the maturation takes place starting at the end of voitellogenesis without any growth in size/ volume.
8. Final hydration and maturation of oocytes occurs just before spawning.
9. 1-3 month quiescent period after spawning with resorption of non spawned oocytes.
10. Interaction of photoperiod and temperature is vitally important to the proper maturation, photoperiod initiates the process

Reproduction in nature

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- Gonadal development throughout the year preceding spawning in spring *Malison et al.1994, Henderson et al. 2000
- 1-3 month quiescent period after spawning *Henderson et al. 2000
- Male gonads start to develop in fall and are fully developed by the mid-winter months, able to sustain spermiation for up to 6 months until spawning in early spring *Shewmon et al. 2007
- Vitellogenesis begins in oocytes in November continues until just before spawning *Hermelink et al.2011
- Final hydration and maturation of oocytes occurs just before spawning *Sandström et al. 1995
- Quality of gonad development is driven by both endogenous mechanisms and exogenous inputs, the most important of which are temperature and photoperiod *Ciereszko et al. 1997
- PP need extended winter period of 3-5 months with temperature below 15°C for proper gonad development *Hermelink et al.2011
- Interaction of photoperiod and temperature is vitally important to the proper maturation, photoperiod initiates the process

- Prefer warmer temperatures between 4.5 – 26°C *Hokanson 1977)
- Preferred 8 – 18°C *Lappalainen et al. 2003, Hermelink et al. 2011)
- Males appear first, aggressively defend until hatching and swim up
- Nesting sites -16m * Schlumberger and Proteau 1996
- Females deposit a clutch of highly adhesive eggs
- Incubation 11.5 – 20°C *Muntyan 1977. Lappalainen et al. 2003