DIVERSIFY meeting 2nd February 2016

European eel breeding, larval culture and first-feeding attempts

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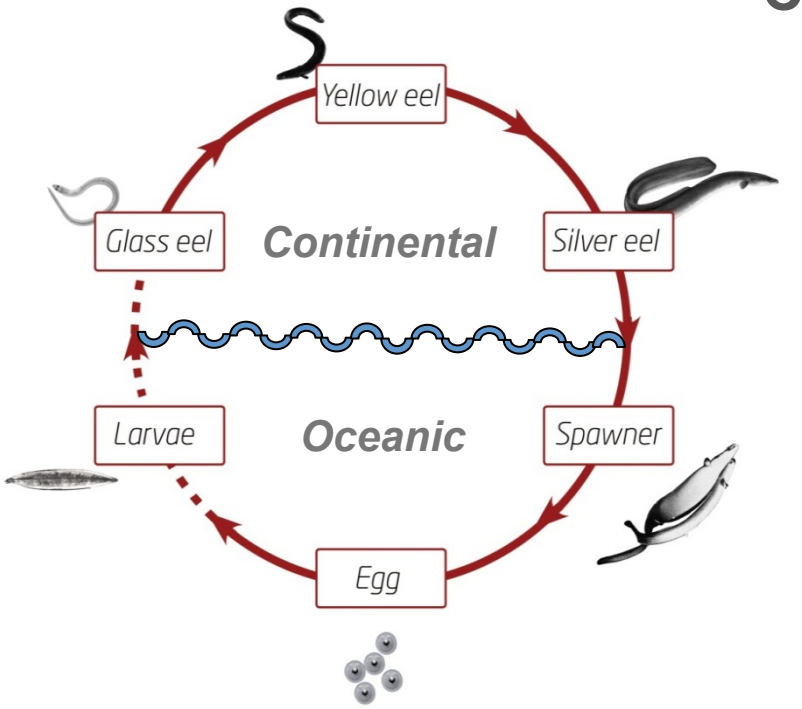
PRESENTATION OUTLINE

- European eel obstacles and research approach
- Breeding: gamete production and fertilisation
- Incubation and larval culture technology
  - Ontogeny
  - Bio-physical culture conditions & physiological requirements
- Tailoring suited first feed – physiology, morphology and behaviour
- Challenges and perspectives

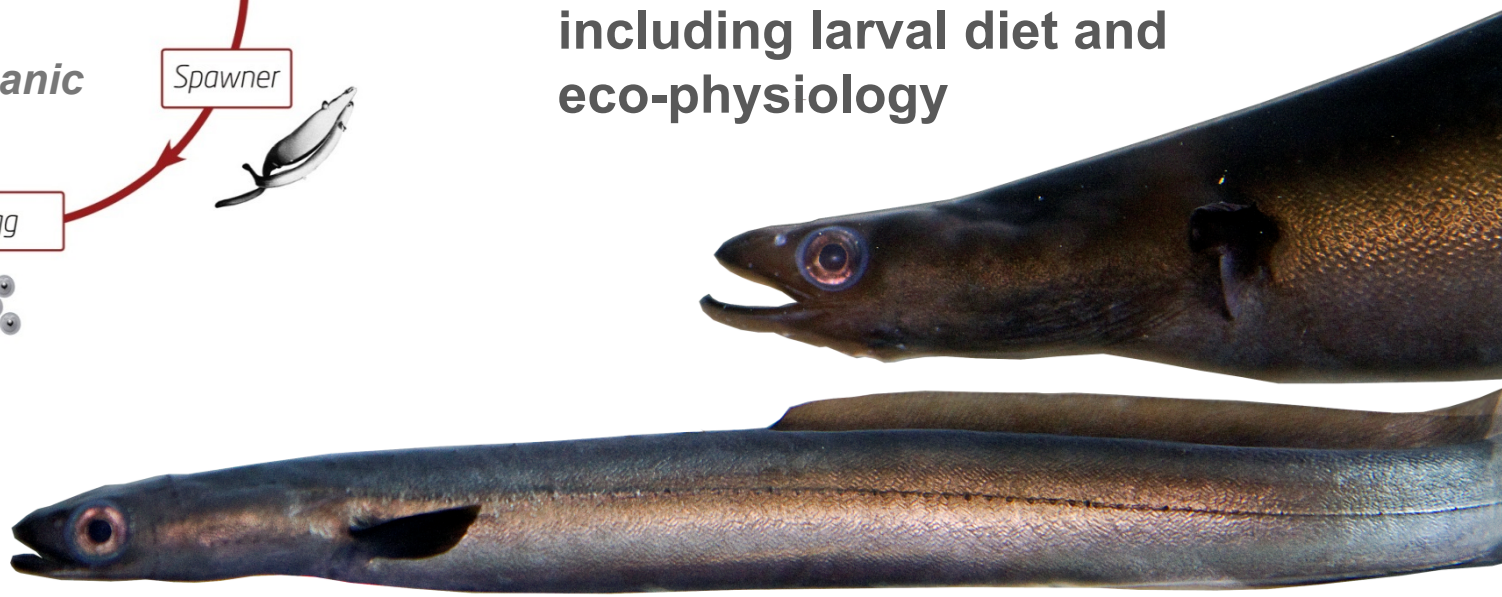
EEL BREEDING AND HATCHERY RESEARCH

European eel stock decline drives the need for a shift from to captive breeding of glass eels



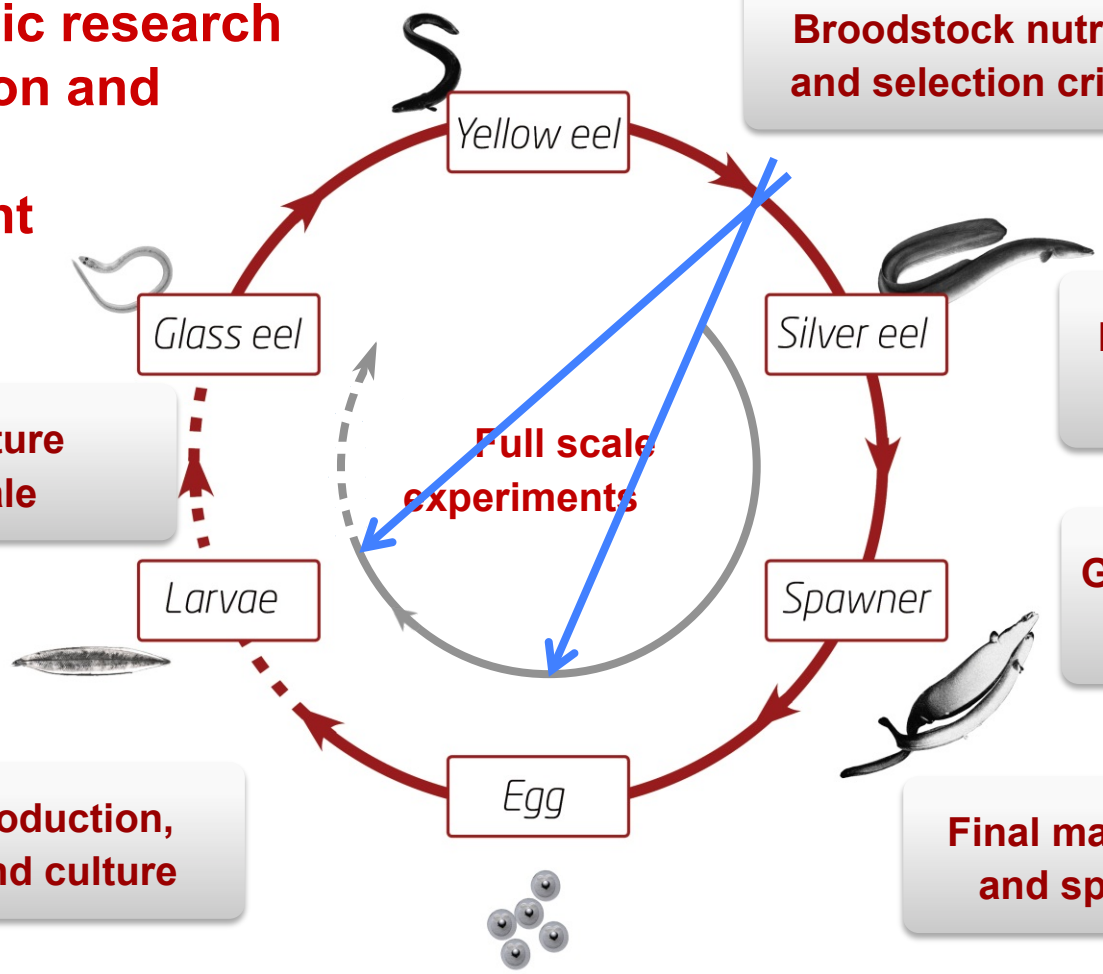
Challenges for glass eel production:

- Complex hormonal control and inhibition of maturation
- Lack of knowledge about wild eel reproduction and early life stages including larval diet and eco-physiology



RESEARCH APPROACH

Linking basic research to application and technology development



Broodstock nutrition and selection criteria

Hormonal control and treatments

Gamete development of females and males

Final maturation, egg and sperm quality

Fertilisation and embryonic developmental competence

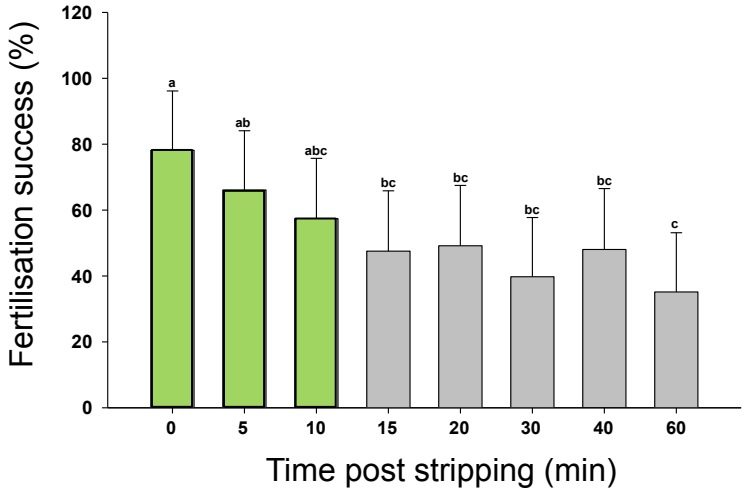
Larval production, quality and culture

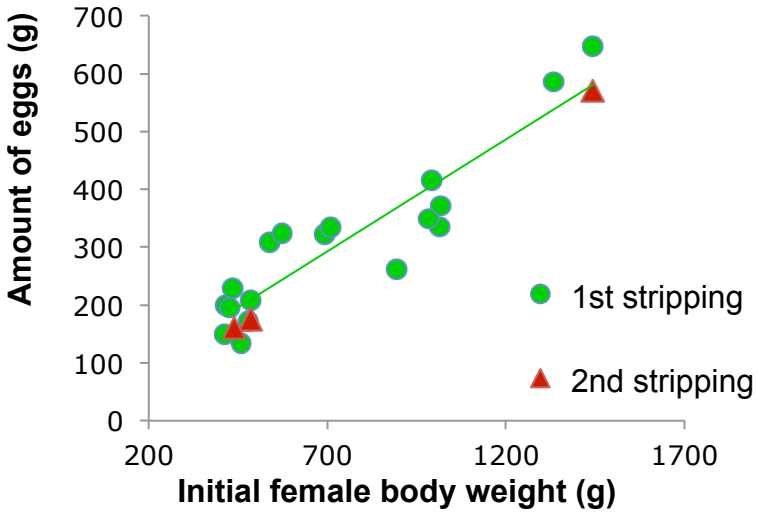
Larval culture large scale

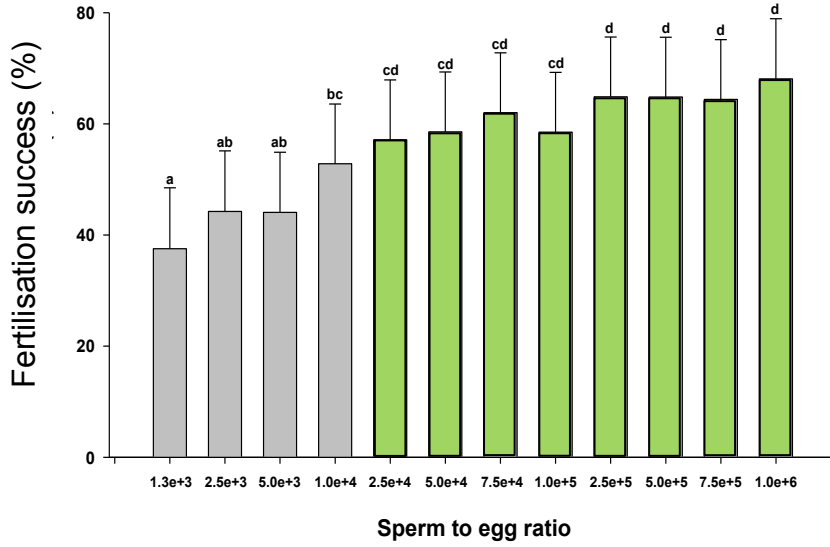
Strategy: Incremental progress through controlled experiment

BREEDING: GAMETE PRODUCTION AND FERTILISATION

- ✓ **Enhanced broodstock feeds for improved quality eggs**
- ✓ **Assisted reproduction protocols**
- ✓ **Stable egg production: wild and farmed broodstock**
- ✓ **Fertilisation standardised protocols**







High fecundity: 1 g of eggs ~2000 eggs

Butts et al., Aquaculture 2014

Incubation and larval culture: ontogeny

Embryonic development

Duration ~48 h at 20 ºC

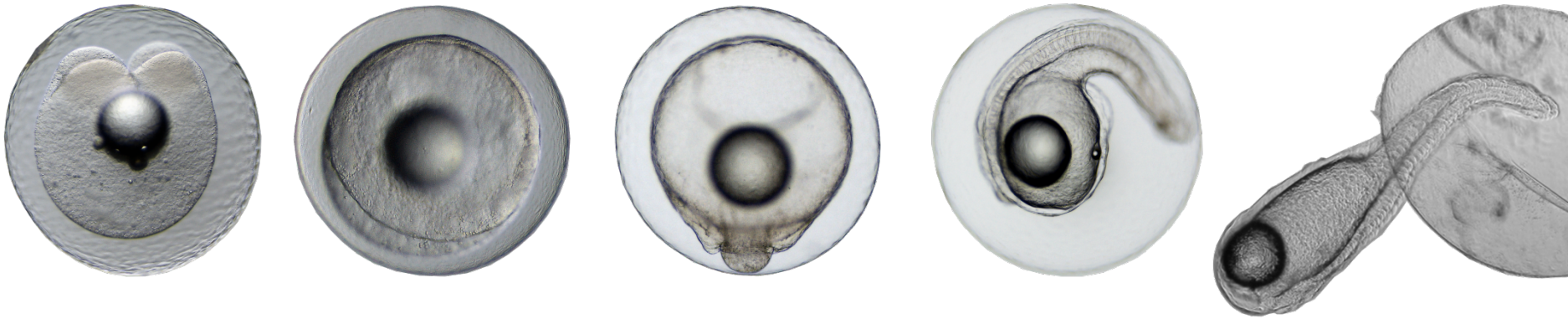
First cleavages
~ 3 h

Cells over yolk-mass
~ 14 h

Evident embryo
~ 24 h

Segments & tail free
~ 40 h

Time of hatch
~ 48 h



1 mm

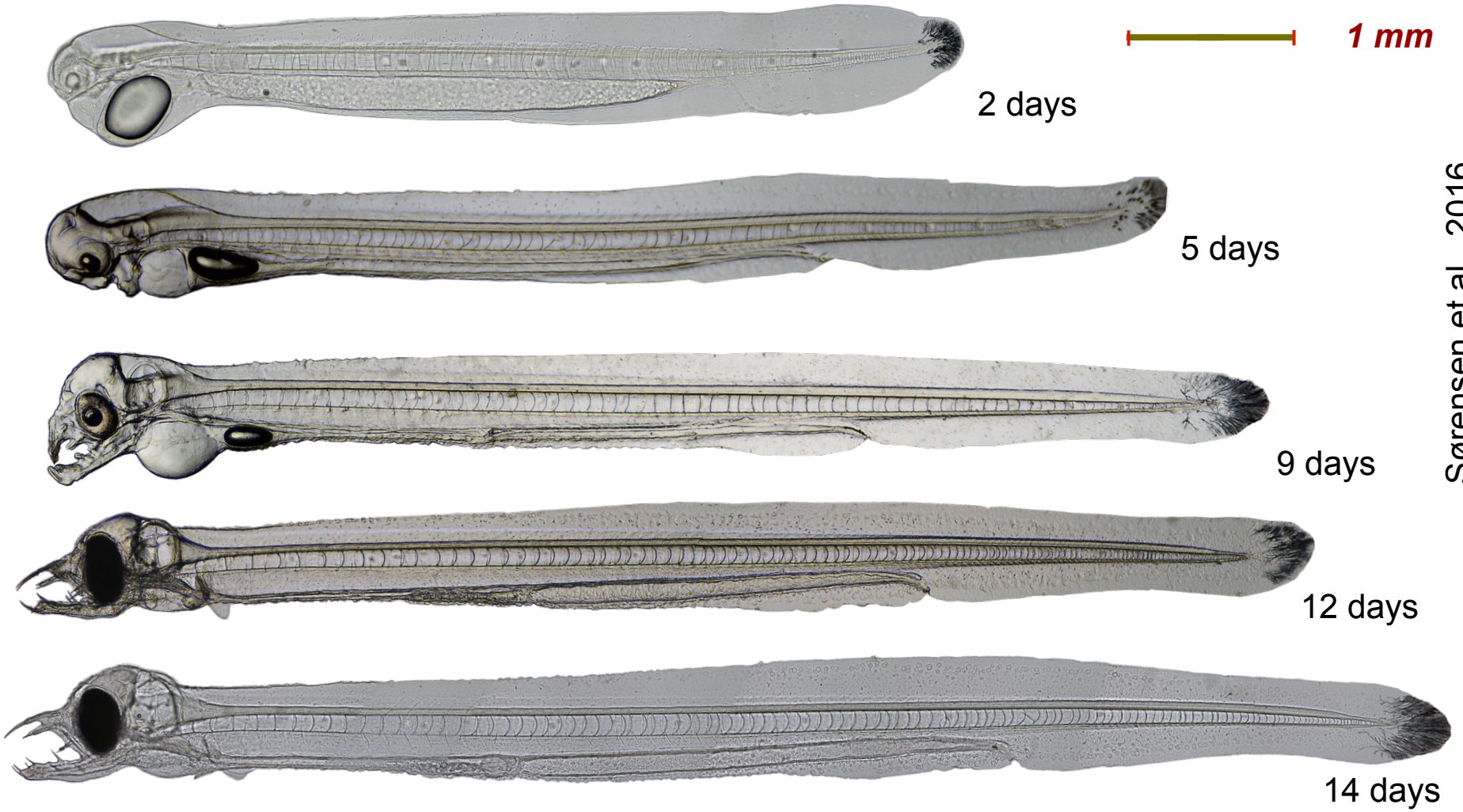
Sørensen et al., Aquaculture 2016

LARVAL DEVELOPMENT

Sørensen et al., 2016

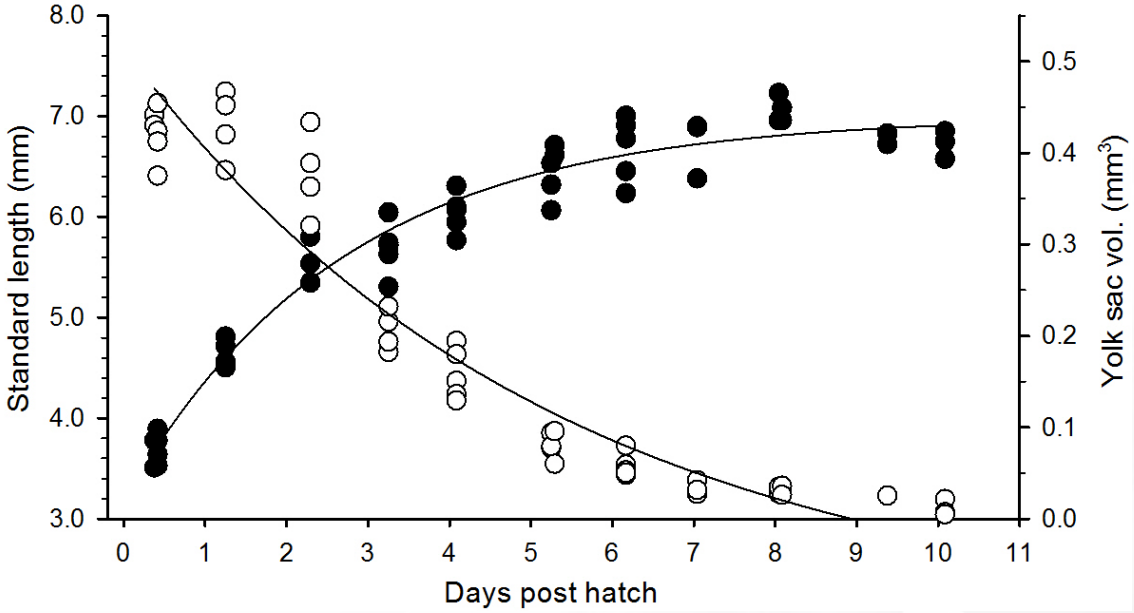
LARVAL DEVELOPMENT

Duration to larval feeding stage ~12 days at 20 ºC



LARVAL DEVELOPMENT

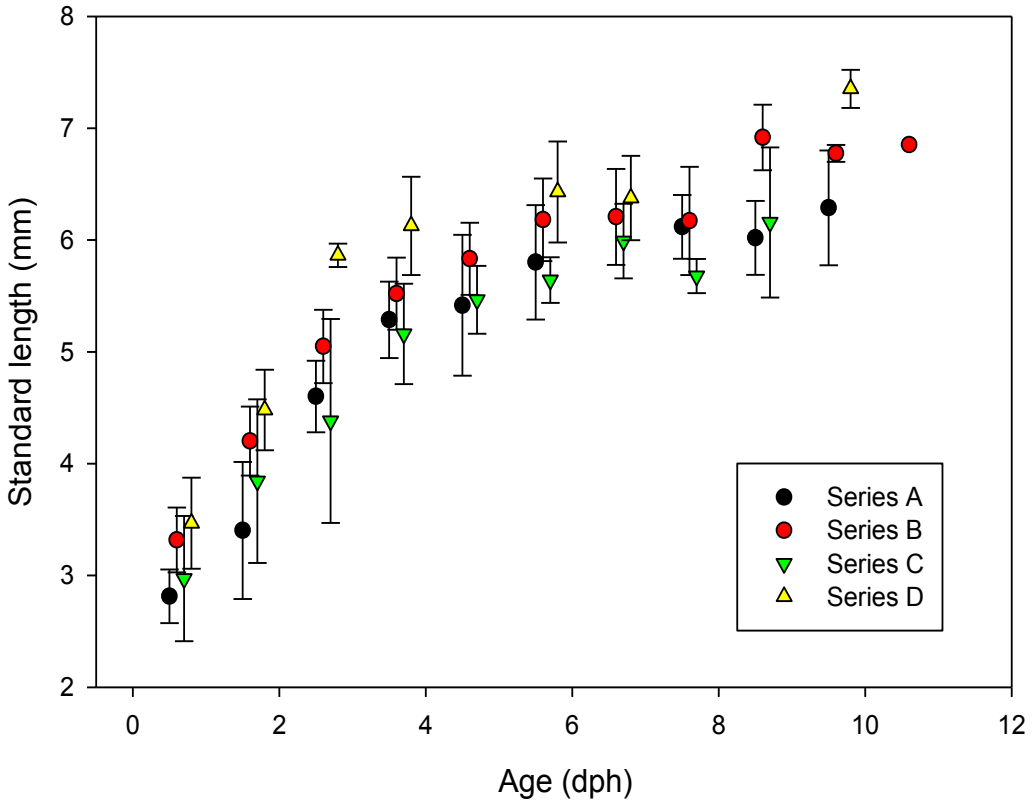
Max. size of yolk sac larvae ~ 8 mm



Larval size increase and yolk resorption at 20 ºC

LARVAL QUALITY – LENGTH INCREASE

Difference in egg and larval quality between farmed & wild broodstock apparent from hatch



Differences in larval size

Farmed:

- A
- C

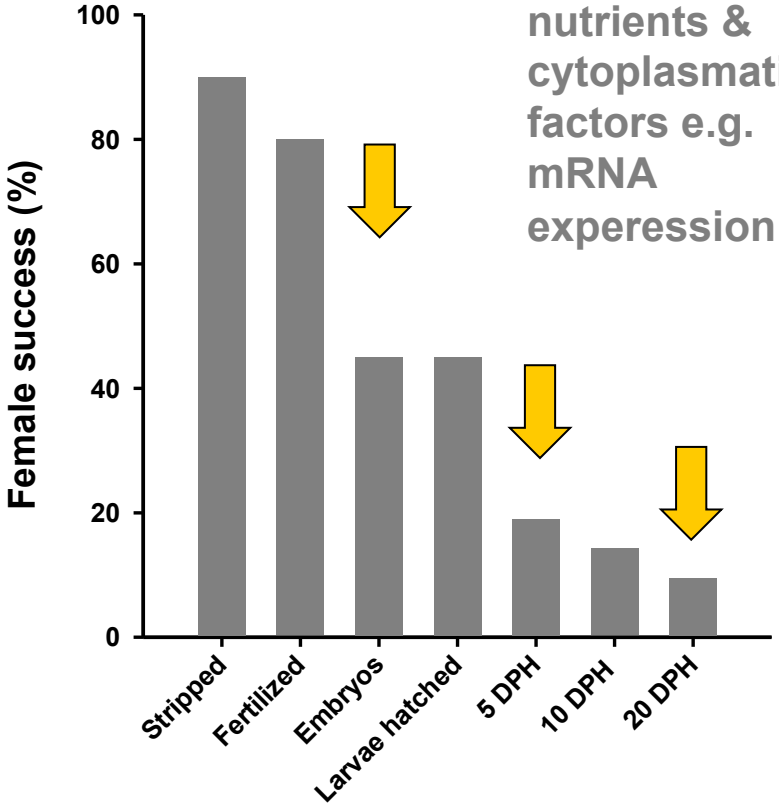
Wild:

- B
- D

Tomkiewicz et al., unpubl. data.

MAJOR BOTTLENECKS IN OFFSPRING CULTURE

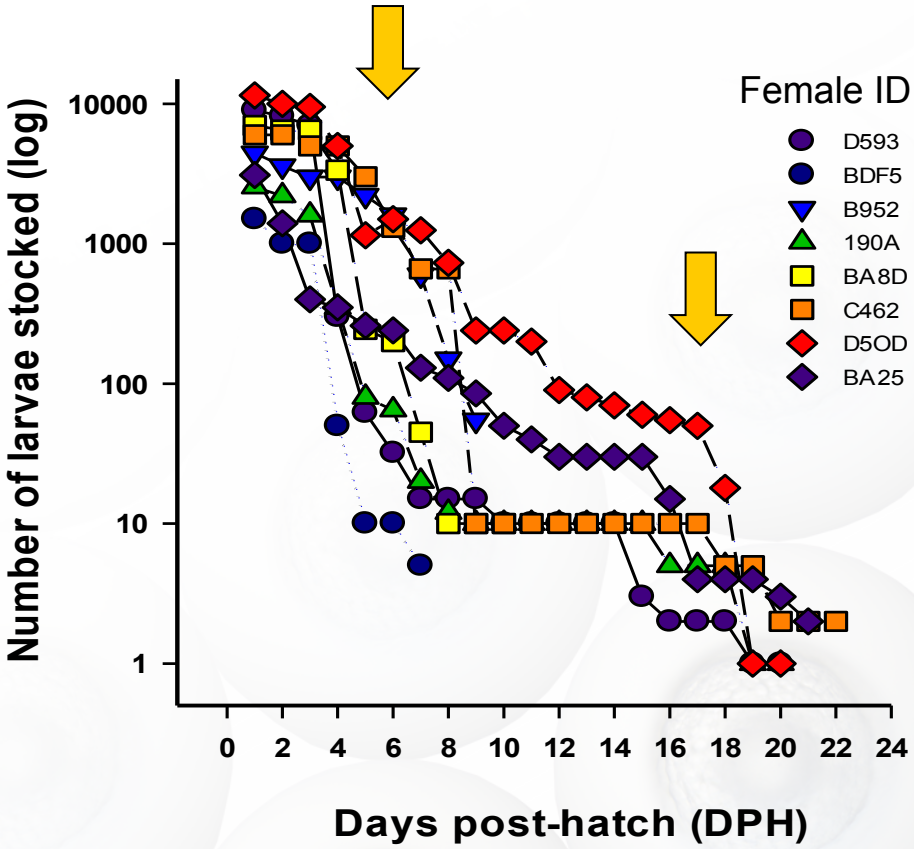
Mortality during embryonic development



Egg quality e.g. nutrients & cytoplasmatic factors e.g. mRNA experession

Tomkiewicz et al., in prep.

Mortality Day 3 to 8 Starvation Day 15+

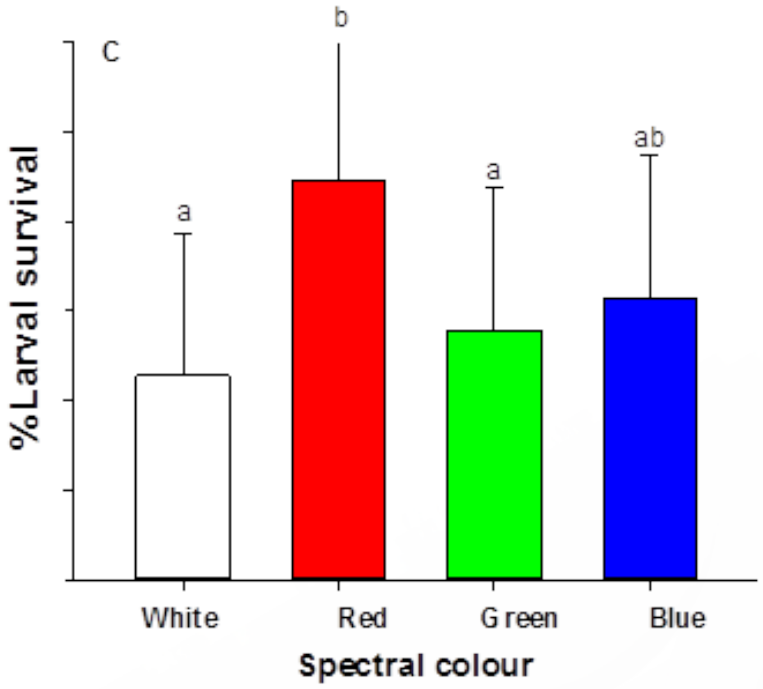


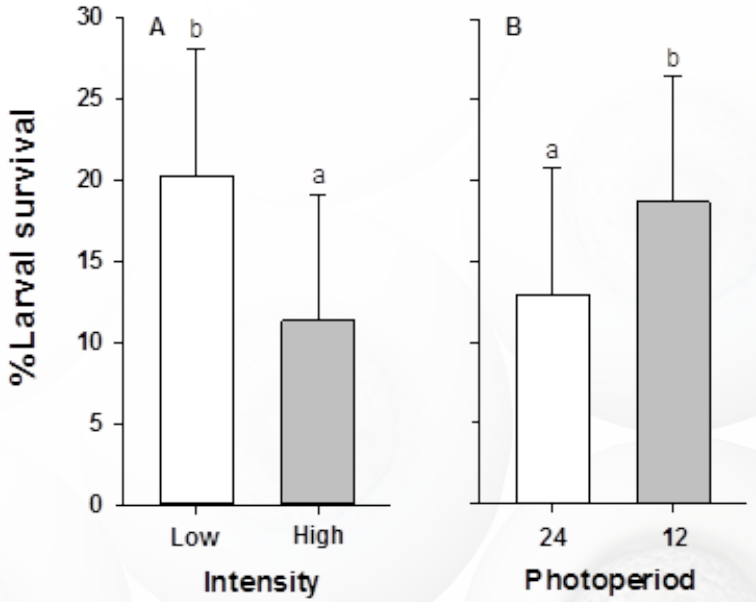
Stocking 3000 larvae per 100 l aquaria - aquaculture recirculation systems (RAS)

LARVAL CULTURE TECHNOLOGY AND FEEDING TRIALS

- Incubation and larval culture technology
  - Studies of ontogeny
  - Bio-physical culture conditions
    - Light regime, temperature, salinity
    - Microbial control
    - Rearing systems
- Tailoring suited first feed and feeding trials
  - Physiology & morphology
  - Feeding behaviour & ingestion

Impact of light regime on survival of yolk sac larvae

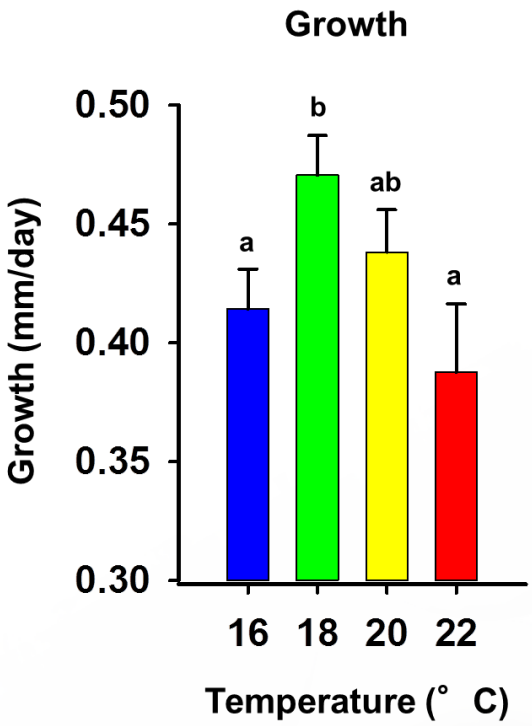


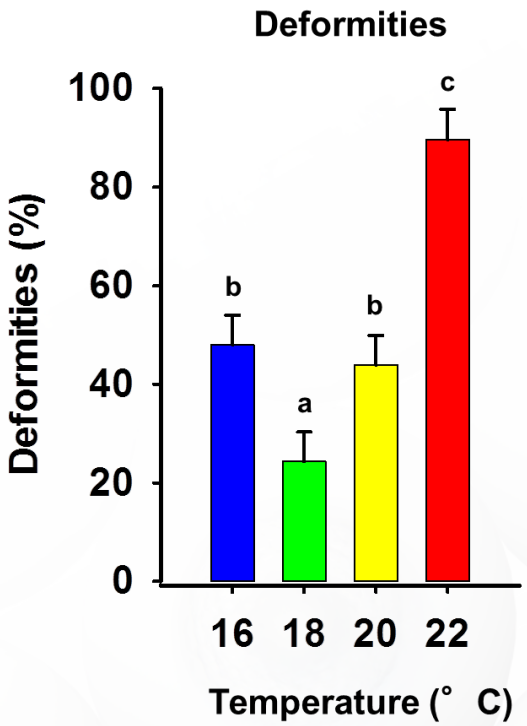


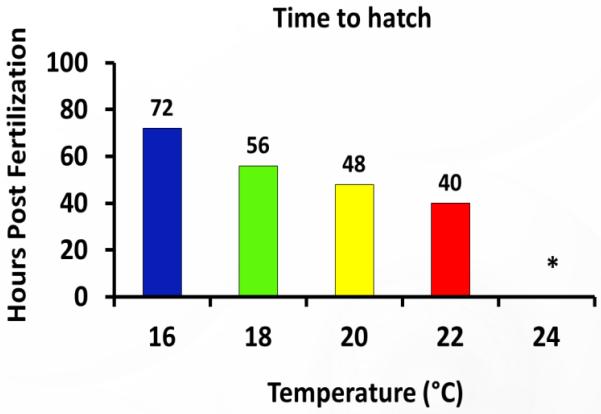
Politis et al., J. Exp. Mar. Biol. Ecol., 2014

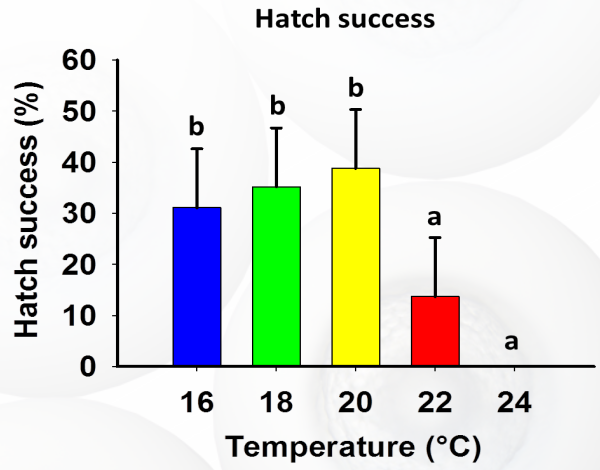
Impact of temperature on larval hatch and survival

~ 18 ºC appears optimal





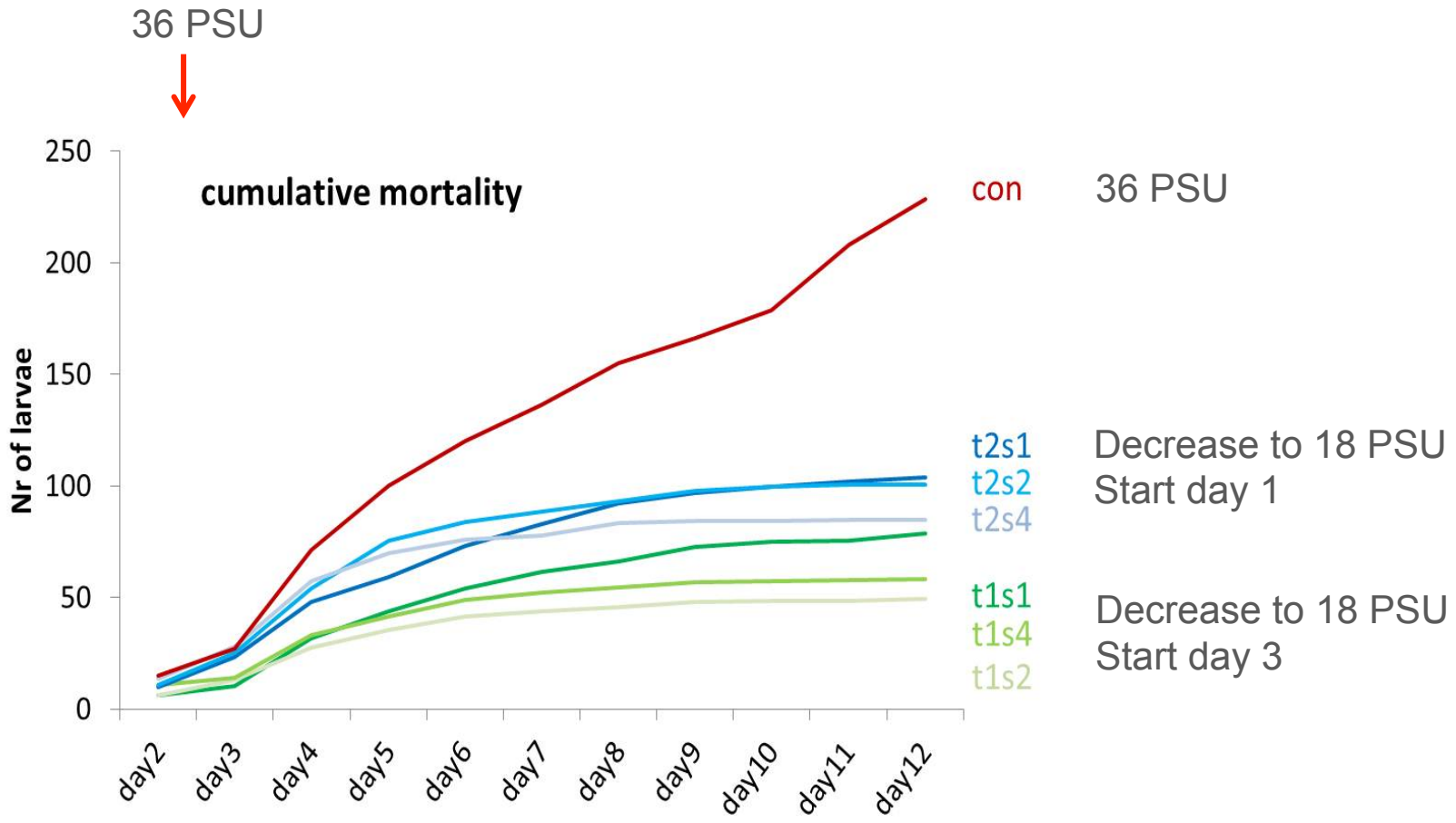




Molecular analyses ongoing

Politis et al., in prep.

Salinity experiment preliminary results

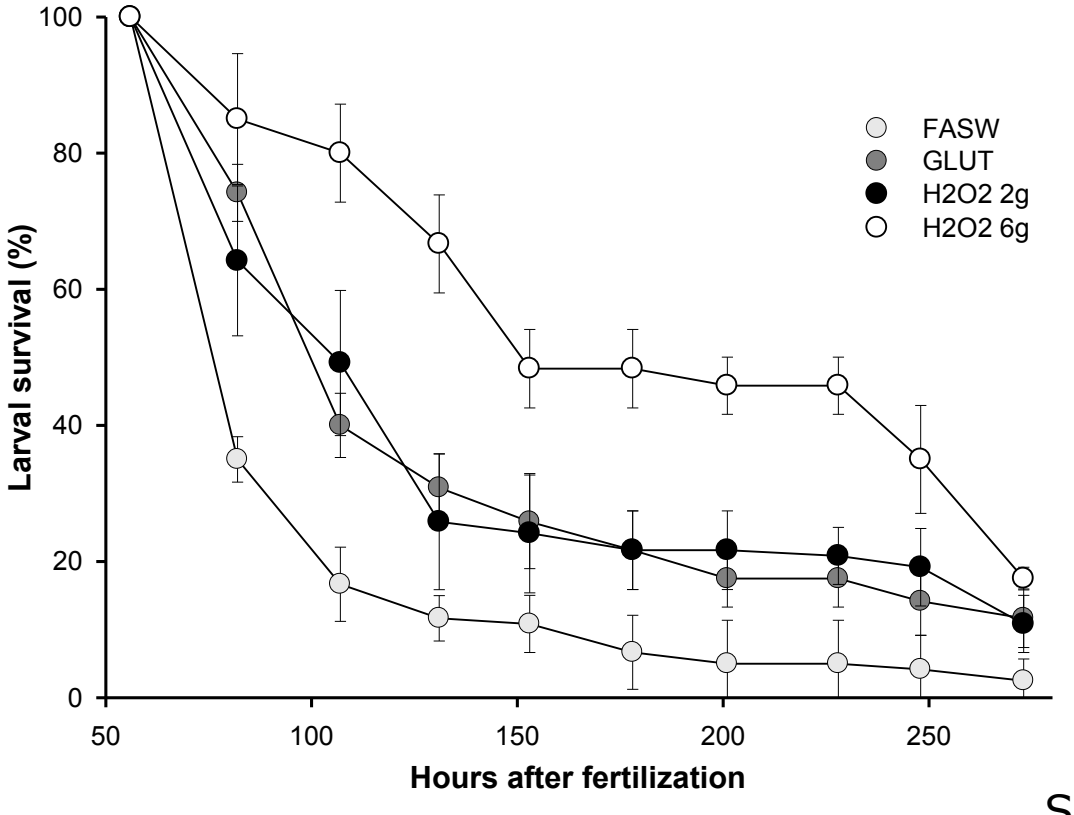


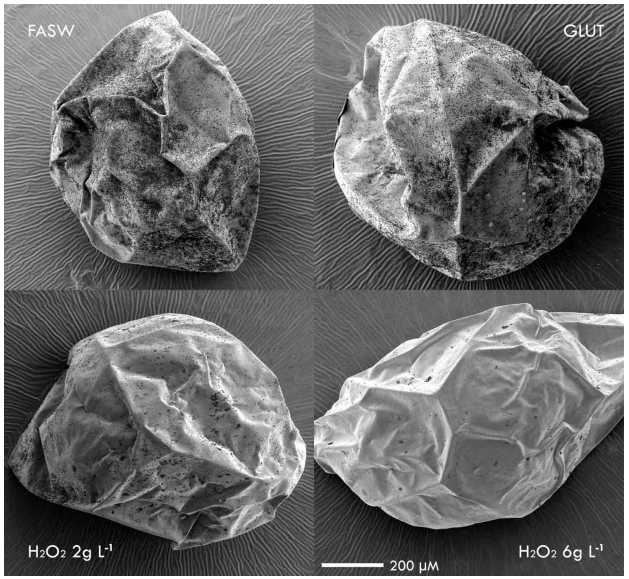
Politis et al., unpublished data

EGG DISINFECTION AND MICROBIAL CONTROL

Embryonic survival is not enhanced

Larval survival using disinfection treatment increased



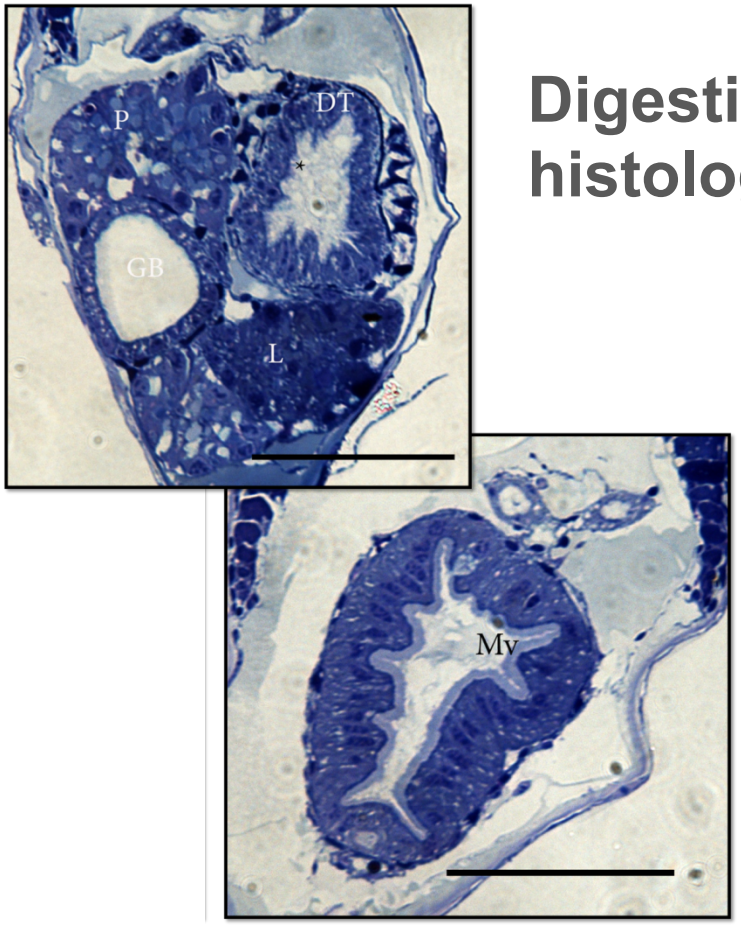


Ongoing: Combination with matured water technology

Sørensen et al., Aquaculture, 2014

ONTOGENY OF LARVAL DIGESTIVE SYSTEM

What can larvae digest?

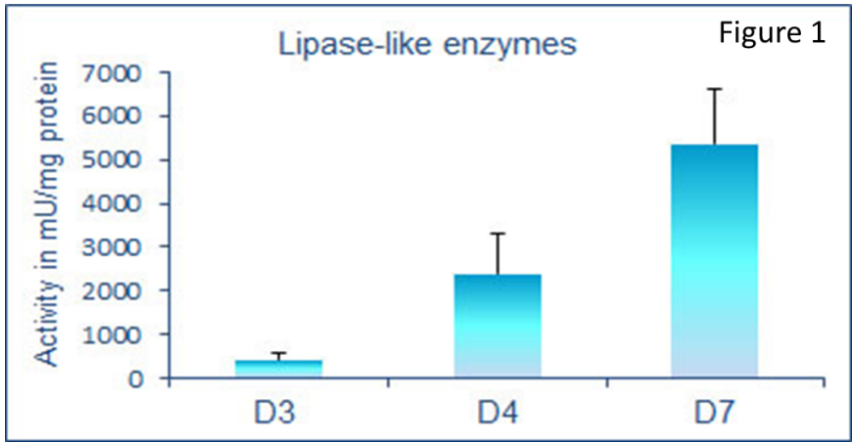


Digestive histology

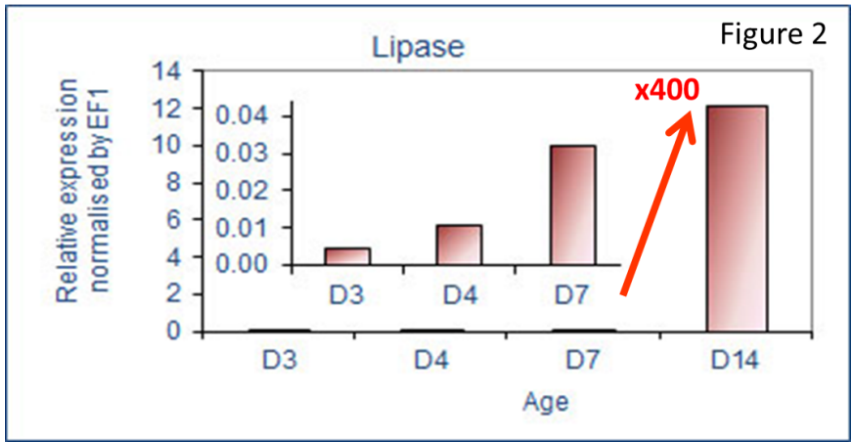
Kjørsvik et al. (in prep.)

Relatively immature liver/pancreas at 12 DPH

Digestive enzymes day 3-14



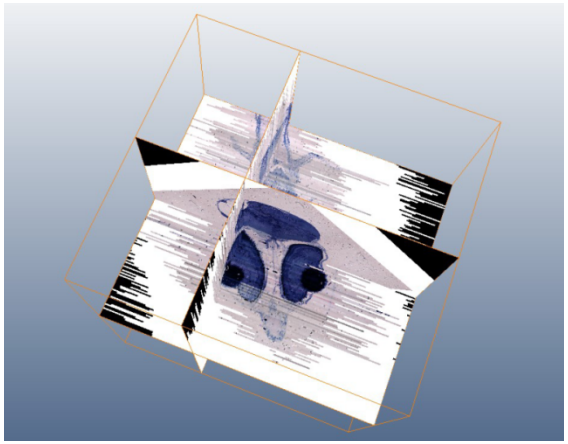
Enzyme activity (biochemical study)



Enzyme gene expression

Mazurais et al. unpubl. data

LARVAL FEEDING CAPABILITIES

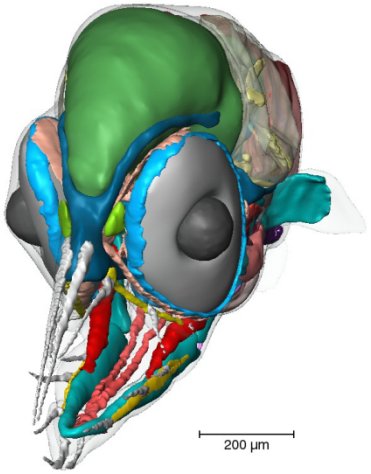


Analysis of larval head morphology

What can they ingest?

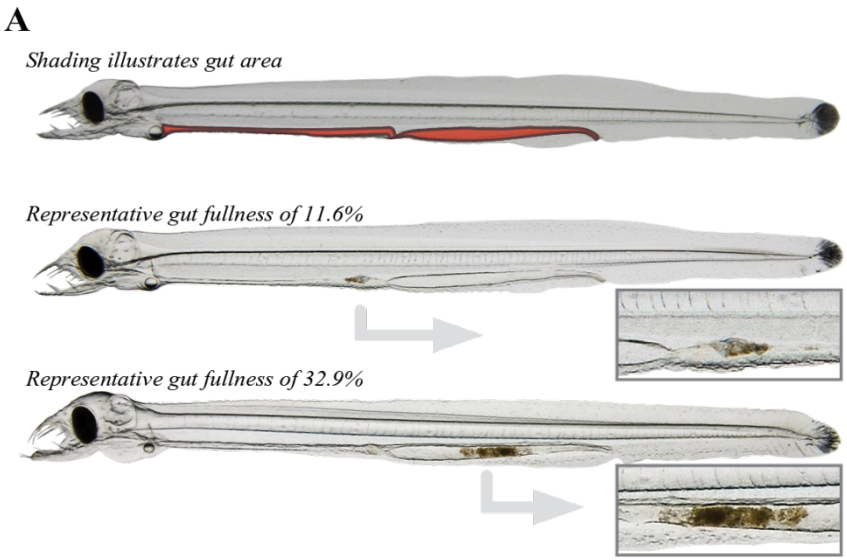
Study of larval behaviour

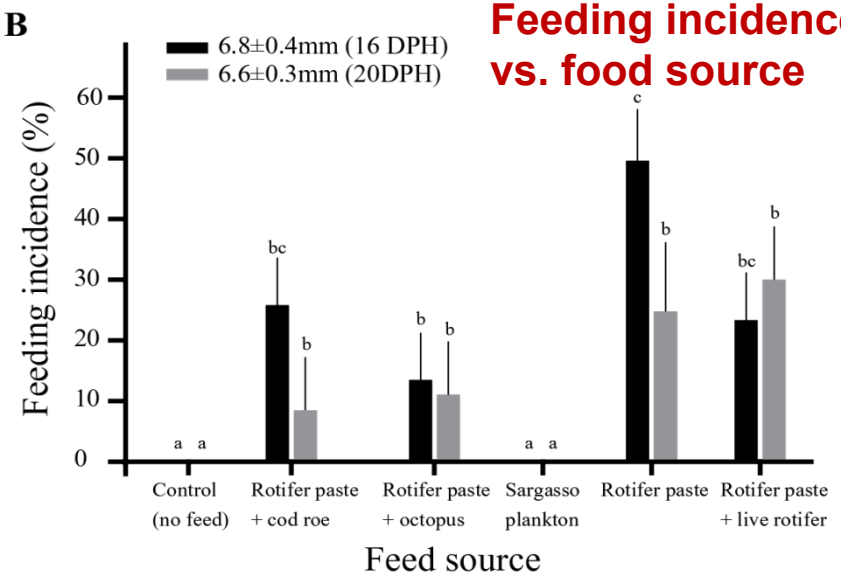
European eel larvae 14-15 DPH

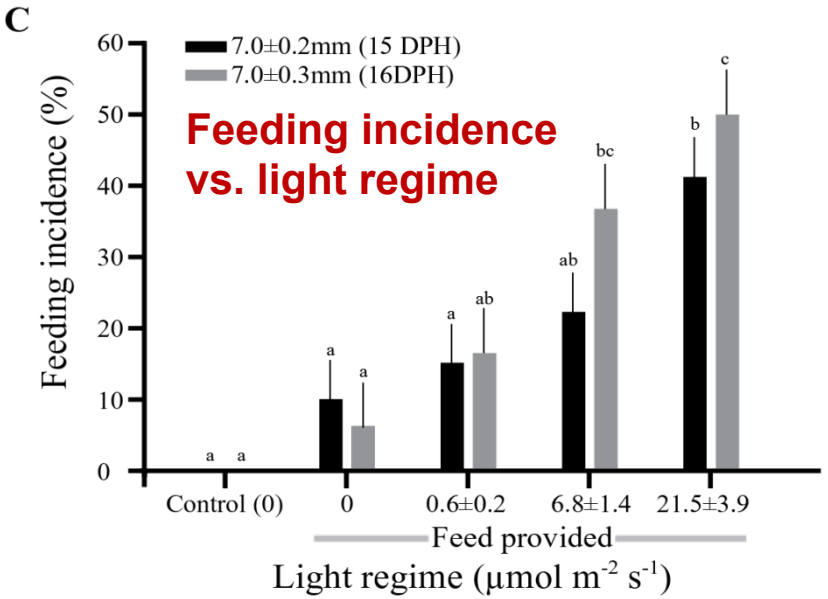


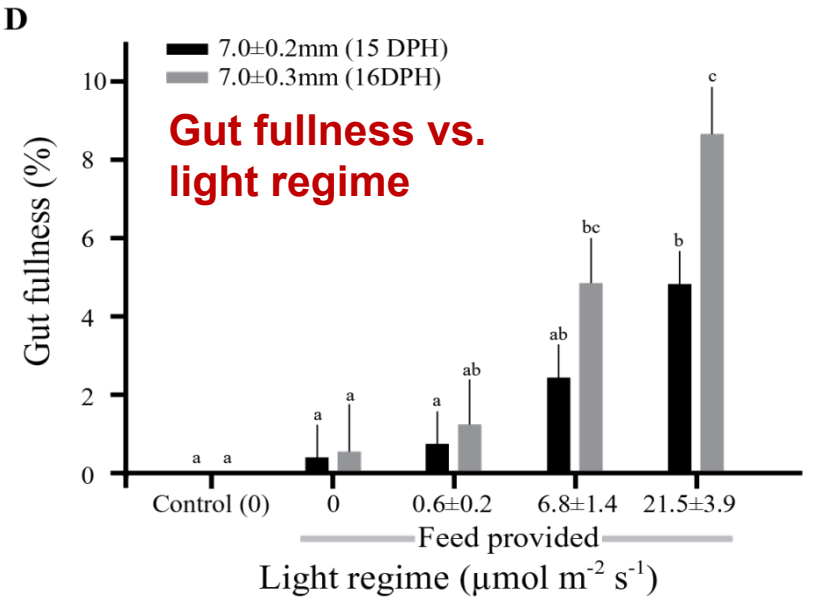
Bouillart et al., J. Anat.,2015

LARVAL FEEDING AND BEHAVIOUR EXPERIMENTS







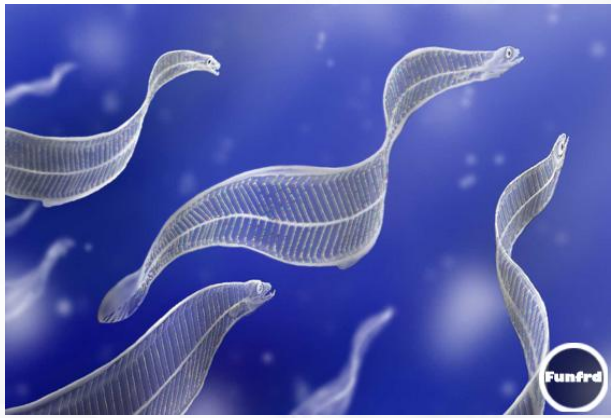


Butts et al. (in prep.)

Main challenges and present focus

- **Culture conditions and ontogeny**
  - Temperature & salinity (incl. molecular study)
  - Egg disinfection, matured water, systems & density
  - Immune system development (molecular study)
  - Vision and olfaction (TEM)
- **Insight into larval nutritional requirements**
  - Molecular studies
  - Force feeding study (C14-labelling)
- **Feeding trials medium scale**
  - Behavioural studies (+light)
  - Algae, peptides etc.
  - Diets, enrichments & attractants
  - Ontogeny during ongrowing

http://funfrd.com



Leptocephalus larvae – unpreceeded in hatchery technology

ACKNOWLEDGMENTS

PRO-EEL 2010 -2015 Partners

www.pro-eel.eu

DTU	Technical University of Denmark
IMARES	Institute for Marine Research and Ecosystem
LU	University of Leiden
CNRS	National Center for Scientific Research
ICTA UPV	Institute for Animal Science and Technology, Polytechnic University of Valencia
NOFIMA	Nofima Akvaforsk – Fiskeriforskning A/S
UGENT	Ghent University
KU	University of Copenhagen
INRA	National Institute for Agronomic Research
BA	Billund Aquaculture Service Aps.
WU	Wageningen University
INSTM	National Institute of Sciences and Technologies of the Sea
IMR	Institute for Marine Research
NTNU	Norwegian University of Science and Technology
BIOMAR	BioMar A/S

ACKNOWLEDGMENTS

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

www.eel-hatch.dk

EEL HATCH

EEL-HATCH Consortium 2010-2017

- Technical University of Denmark
- Billund Aquaculture Service
- BioMar
- Bioneer
- Danish Aquaculture Organisation
- North Sea Science Park
- STMI

DTU

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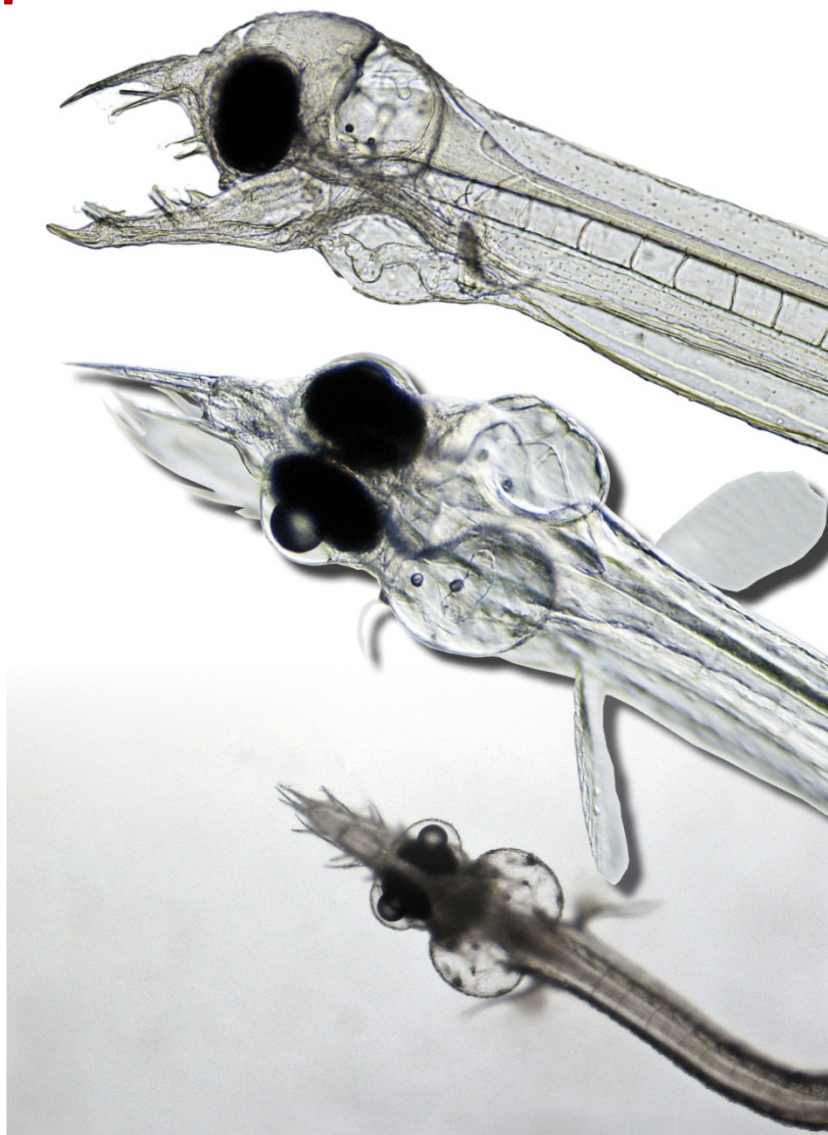
STMI
AQUA SYSTEMS

NORDSØEN
FORSKERPARK



THANK YOU FOR YOUR ATTENTION!