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Developing shrimp larval rearing techniques for application in Europe

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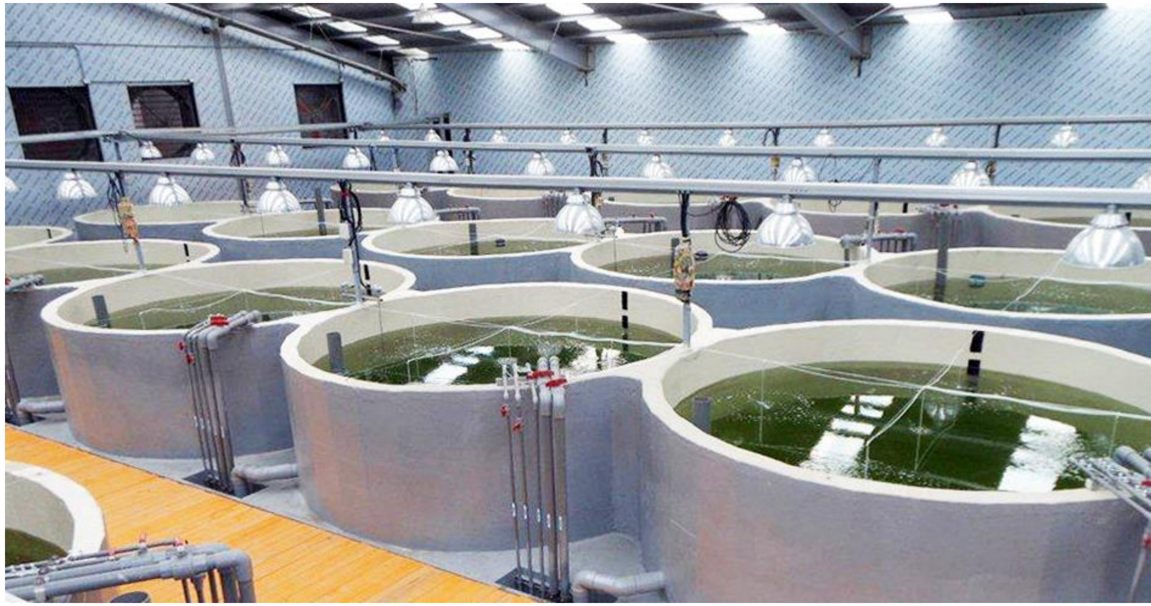
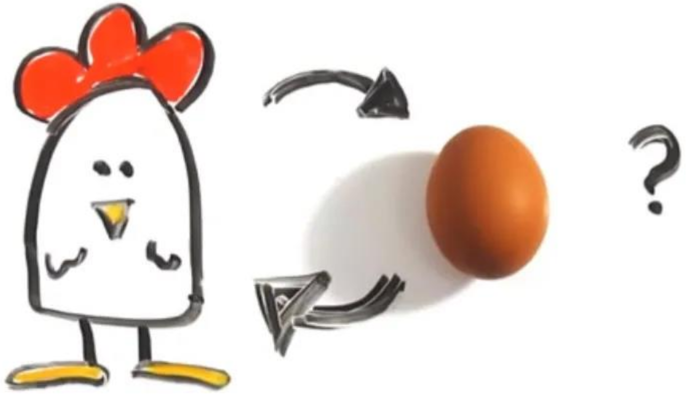
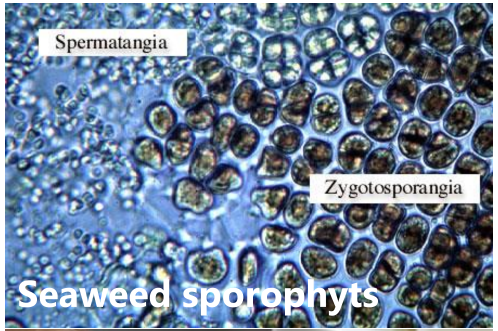


BLAUWE CLUSTER
AGENTSCHAP INNOVEREN & ONDERNEMEN
Vlaanderen
is ondernemen

Context

- Growing interest in aquaculture/restoration
  - Roadmap/desk top studies: Aquavalue, SeaConomy, …
  - Nearshore / offshore projects: Value@sea, Edulis, Coastbusters, Symapa, United, Wier en Wind,…
  - Onland: shrimp, seaweed, …
- Common problem: suitable starting material?
  - No marine hatchery in Belgium
  - Import often problematic:
    - Availability
    - Mortality during transport
    - Bio-security (SPF)
- Lots of expertise, but lack of concerted approach





General objectives

- Expand knowledge on hatchery techniques for 3 species groups
  - Adapt to local conditions (e.g. availability of water, energy, labour cost)
  - Specific local needs (species, genetic, disease status,…)
  - Increase ecological and economical sustainability
  - Taking advantage of specific activities of consortium partners
- No simple duplication, but also innovation
- Set up a (multispecies) hatchery pilot as an incubator / accelerator

Specific goals

WP2: Seaweed

- Hatchery-facilities
- Collection of local strains
- Life cycle control
- Genetic map / strain selection Ulva
- Provide starting material
- Bio-degradable substrate + seeding technique

WP3: Mollusks

- Hatchery- and nursery-protocol for local conditions
- RAS /automation
- Functional algae-based feeds
- Disease control
- Spuikom as nursery

WP4: Shrimp

- Species selection
- Indigenous species
- Hatcheryprotocol for local conditions
- Functional algae-based feeds
- RAS / automation
- New disease testing tools

WP1: Synergies and integration?

WP5: Ecological and economical gain

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Blueprint for a viable hatchery of 3 marine commercially attractive species groups

- Flemish innovation and Entrepreneurship (Vlaio) - Blue Cluster - ICON-type project
  - Combination basic research / industrial research
  - Start: October 1, 2019; 39 months

Availability of shrimp (vannamei) postlarvae

- Research at UGent (+others)
  - Thailand → Brazil → Thailand → US
- Imaqua BVBA
- Shrimp farming initiatives in Europe

→Not reliable, quality?

→Local production of Pls?

First project results - shrimp

- ✓ Hatchery protocol *L. vannamei*
- ✓ Functional algae-based feeds

Larval rearing system

- **RAS set-up**
  - 12 tanks of 100 L
  - Biofilter + protein skimmer
  - Upflow - Flow rate adjustable
  - Controled room
    - 29 °C
    - 12L/12D
- **Nauplii from IMAQUA BVBA**

Broodstock holding system and conditions

- 6 cylindrical tanks of 1.2 m^3
- Biofilter, drumfilter, skimmer and UV
- Automatic feeding
- Inverted photoperiod
- Temp. 27°C, Salinity 32 ppt
- Demineralised water + commercial sea salt-mix
- Diet: IMAQUA broodstock dry feed (IM42), polychaetes and squid

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Broodstock

- Origin: USA
- First broodstock raised and matured from postlarvae in a nursery systeem at IMAQUA
- Currently preparing F2 broodstock generation

Artificial insemination of females

- Allows to use smaller tanks and increase density of animals
- Most cost-effective option
- Best for European conditions
- Chosen as standard procedure at IMAQUA

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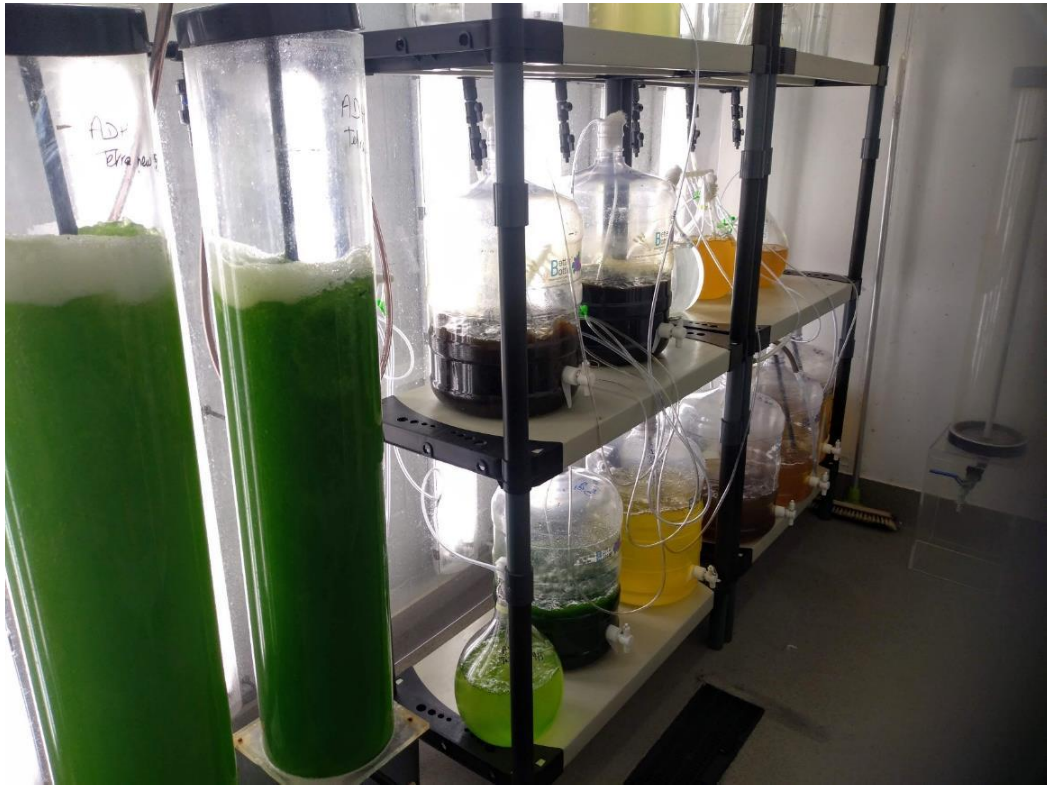
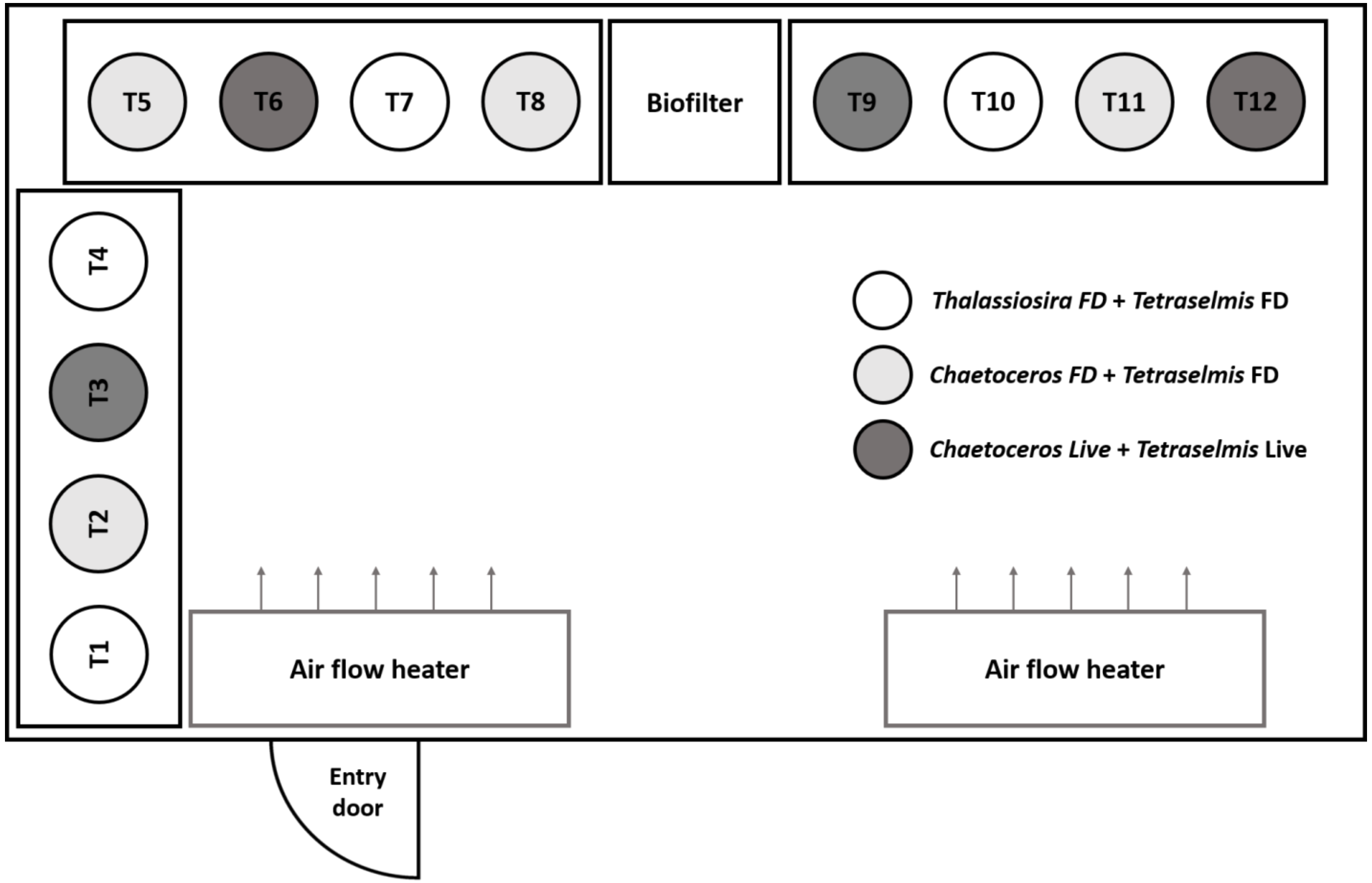
Microalgae



- "In house" batch algae
- High-density photobioreactor algae (Proviron)

proviron
chemistry between us

Larval rearing protocol



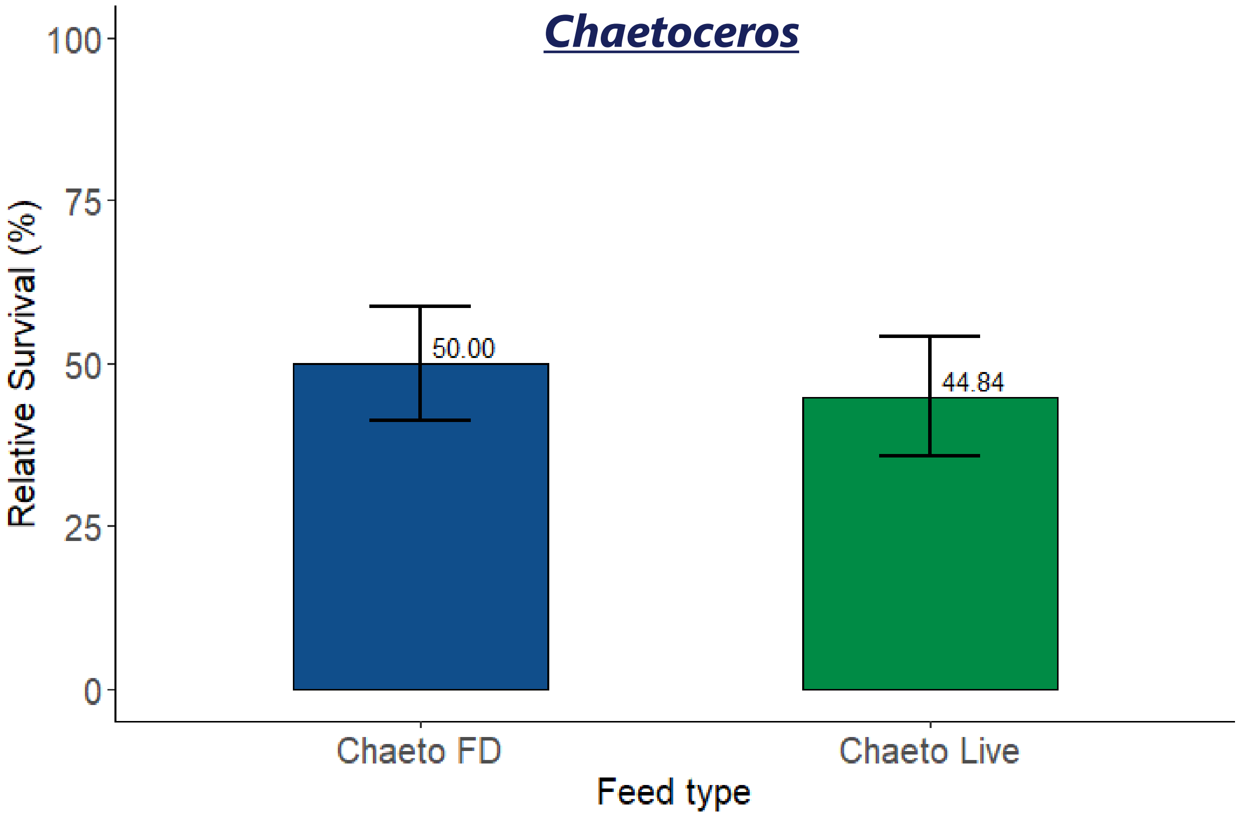
- **Standard feeding schedule**
  - Algae ~10^5 cells/ml
  - Artemia from Z3 onwards
- **Water regime**
  - Natural seawater
  - No exchange: N and Z stages, RAS from M
- **Parameters**
  - Residual algae → flow cytometry
  - Water quality parameters
  - Development and performance (activitity, digestion and fouling)
  - Survival to PL stage
  - (Bacterial load)

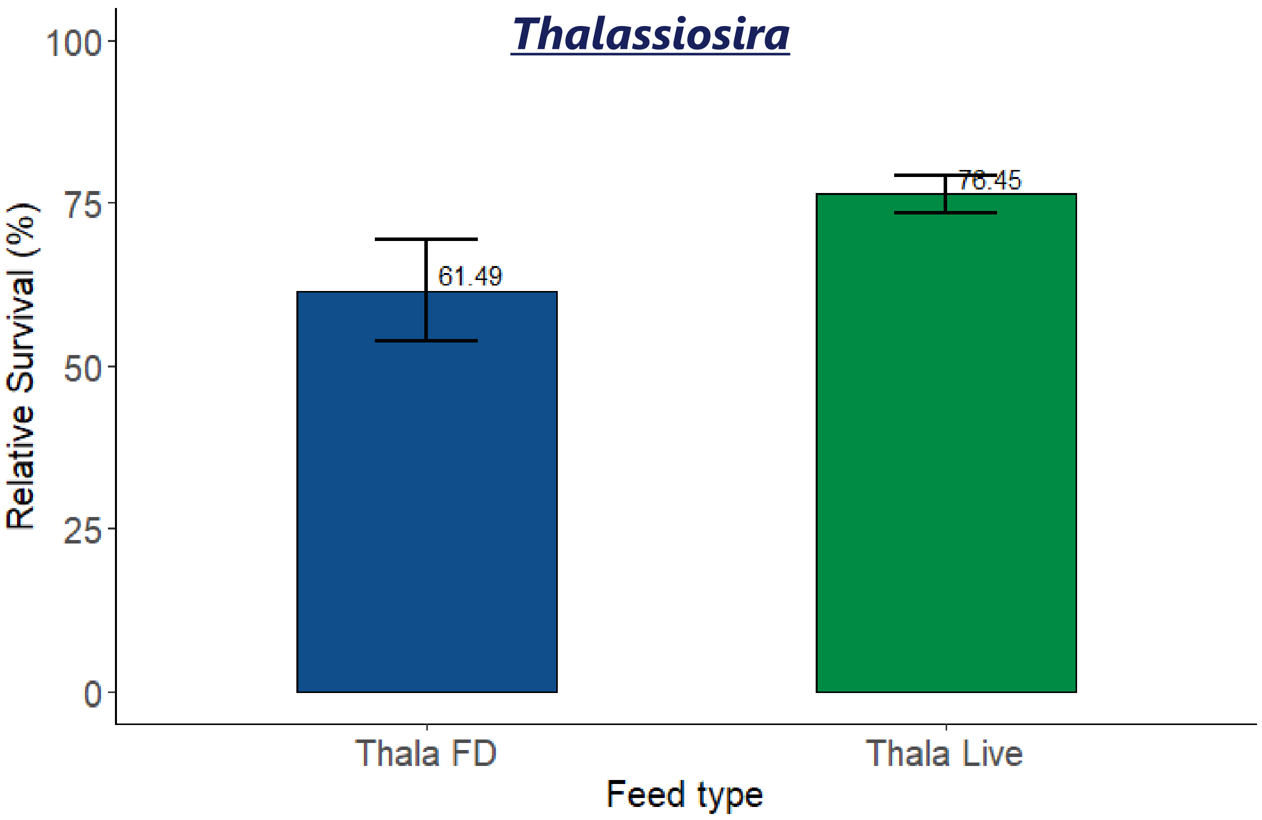
Larval rearing experiments

- **Several factors tested**
  - Different mono- and mixed-species diets → **suitable algae species?**
  - Batch- versus PBR algae → **effect culture technology algae?**
  - Freeze-dried versus live algae → **effect processing algae?**
  - Addition of probiotics grown on exudates of freeze-dried algae→ **effect microflora?**

- **Set-up/procedure systematically improved**
  - Fine-tuning aeration, turbulence, temperature and salinity control
  - Biofilter efficiency
  - …

Freeze-dried vs. live algae: Survival





Freeze-dried vs. live algae: Larval development

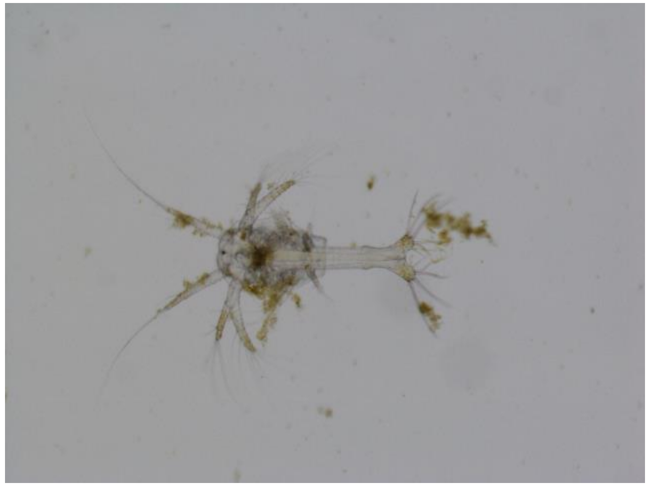
Delay in development (1-1,5d) with freeze-dried algae

Day	CL	CLP	CFD	CFDP
0	N2-N3	N2-N3	N2-N3	N2-N3
1	N4-N5	N4-N5	N4-N5	N4-N5
2	Z1	Z1	Z1*	Z1*
3	Z2	Z2	Z2*	Z2*
4	Z2	Z2	Z2*	Z2*
5	**Z3**	**Z3**	**Z2*-Z3***	**Z2*-Z3***
6	M1	M1	Z3*-M1	Z3*-M1
7	M1-M2	M1-M2	M1-M2	M1
8	M2-M3	M2-M3	M2	M1-M2
9	M3-**PL1**	M3-**PL1**	M2-M3	M2-M3
10	PL1+	M3-PL1+	M3-**PL1**	M3-**PL1**
11	PL1+	PL1+	PL1+	PL1+

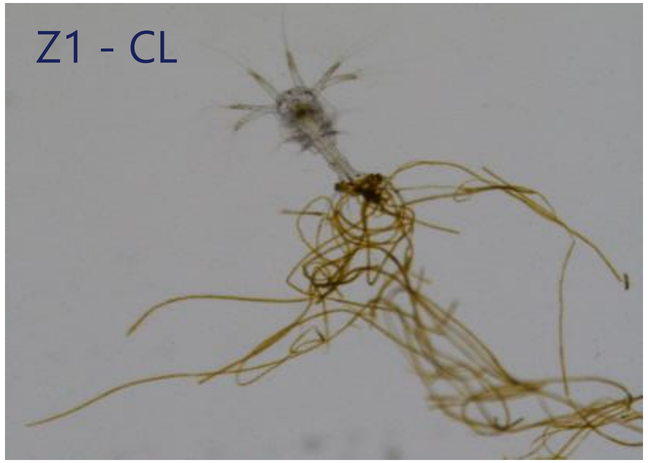
Day	TL	TFD
0	N2-N3	N2-N3
1	N4-N5	N4-N5
2	Z1	Z1*
3	Z2	Z2*
4	Z2	Z2*
5	**Z3**	**Z2*-Z3***
6	Z3-M1	Z3*
7	M1-M2	Z3*-M1
8	M2-M3	M1-M2
9	M3-**PL1**	M2-M3
10	M3-PL1	M3-**PL1**
11	PL1+	M3-PL1

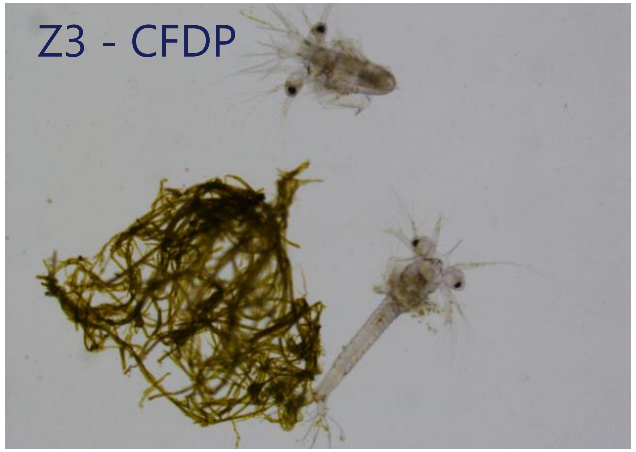
Freeze-dried vs. live algae: Fouling and digestion

- Fouling: Freeze-dried algae



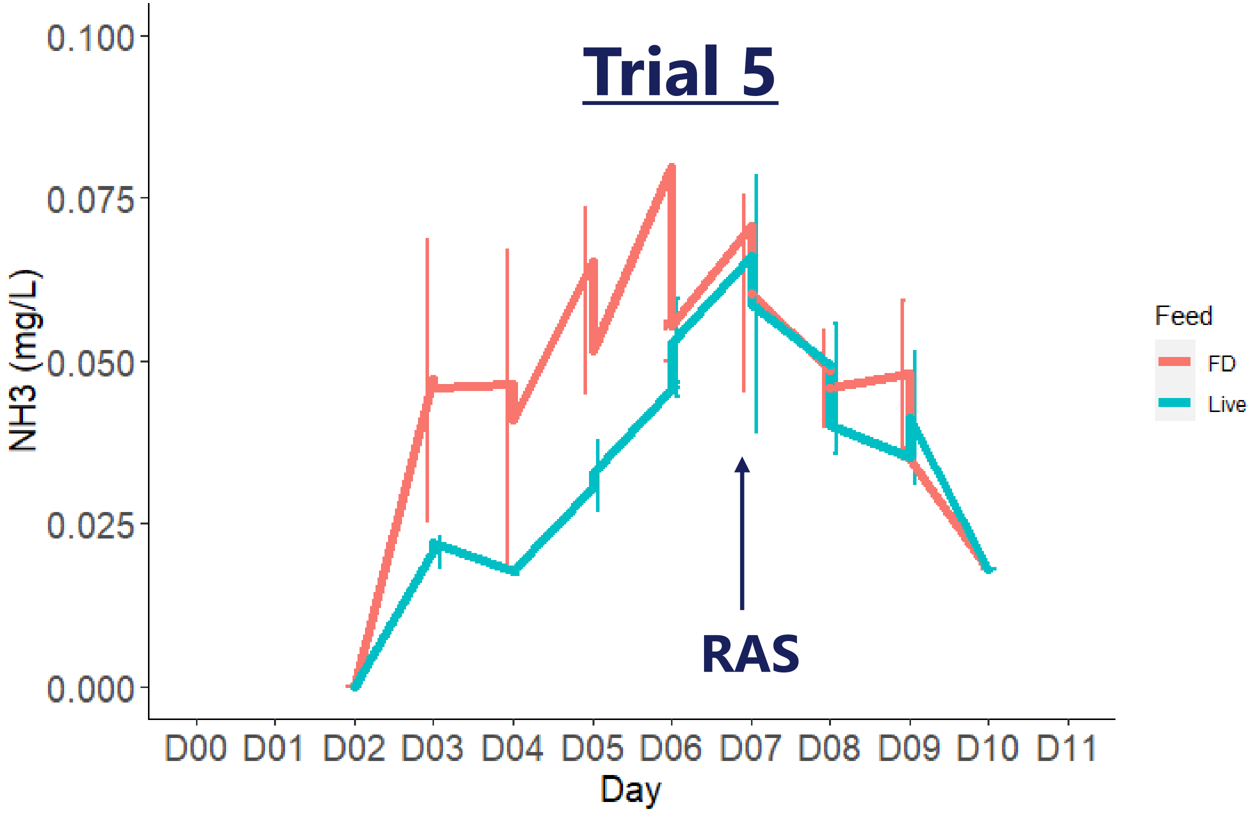
- “Lange faeces”: both

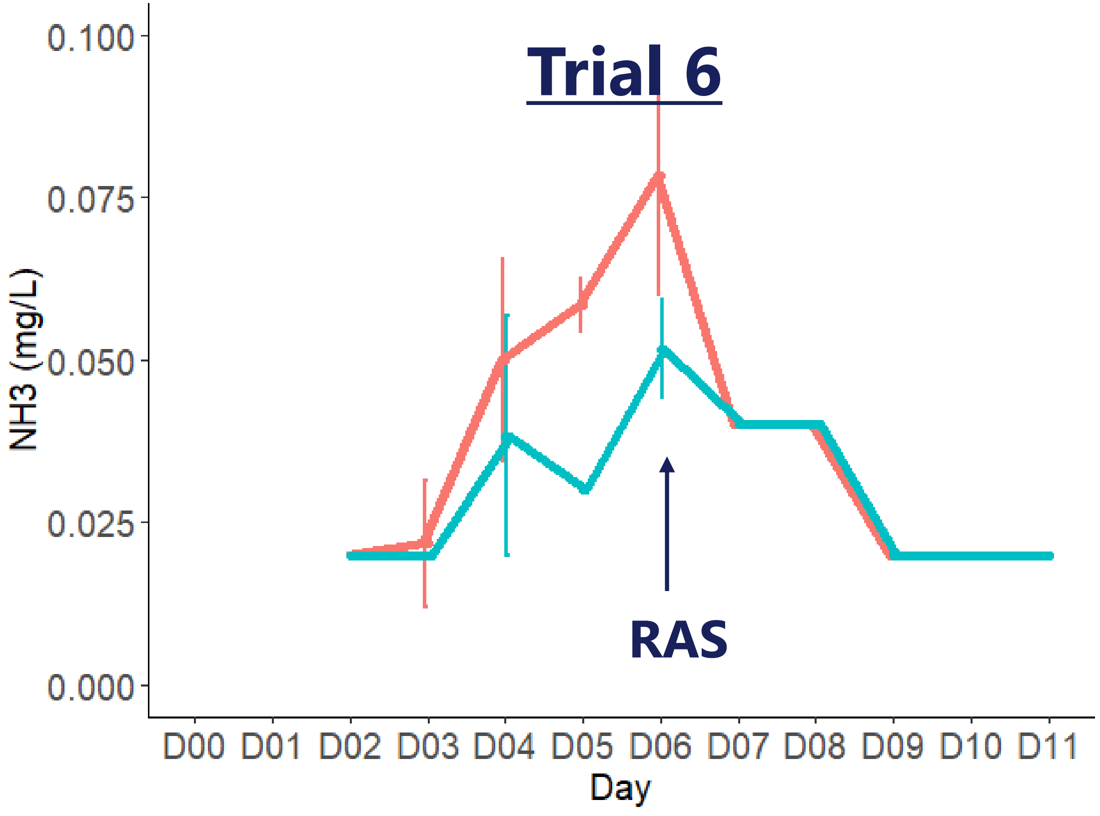




Freeze-dried vs. live algae: Water quality

- Temperature, salinity, DO → very stable
- NH_3 concentrations





Conclusions hatchery protocol *L. vannamei*

- **Good baseline**
  - Reliable and reproducible with live and freeze-dried algae
  - Very low water consumption (± 20L per day / 100,000 postlarvae)

- **Next steps**
  - RAS from early stages (zoea): solution for water quality/fouling (with FD algae)?
    - Adjust feeding levels to compensate for losses in RAS
  - Automatic algae feeding system: solution for overfeeding?
  - Test alternative sea water sources (artificial, diluted brine): more widely applicable
  - In parallel: probiotics grown on algae-exudates (C:N ratio)

Thank You!

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COLRUYT GROUP

DEME
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