Ongrowing in cages: Optimizing the feeding conditions

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Workshop on meagre (*Argyrosomus regius*) aquaculture:
Results from the DIVERSIFY project.
9th October 2018, Palau Macaya, Barcelona (Spain)

- Cage rearing is essential for the industrial application
- Technologies and practices used for grow out, similar to those for seabream and seabass

But meagre is different!!

- Species-specific husbandry practices are needed
- The objectives of this work was **to develop / modify applied methods for ongrowing in cages to maximize performance**

Which is the proper environment for meagre rearing?

- Effect of cage depth
- Light intensity (cage shading)

How we should feed meagre in cages?

- Submerged feeding
- Night feeding

The rearing environment

- Cage volume
- Cage shading

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Methodology (1)

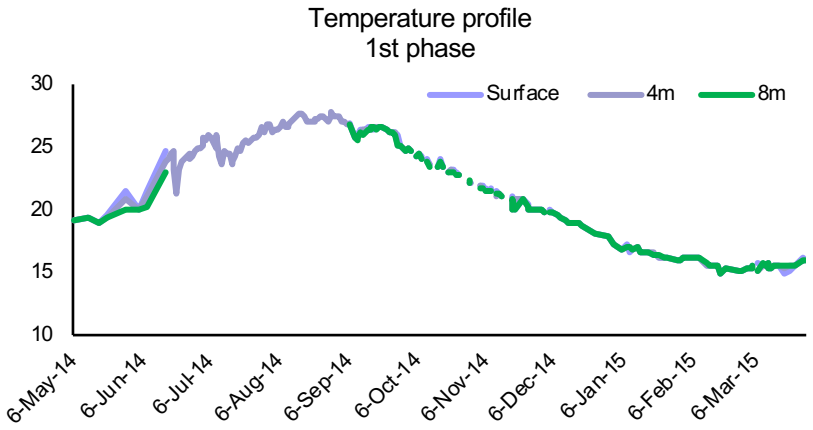
Cage volume

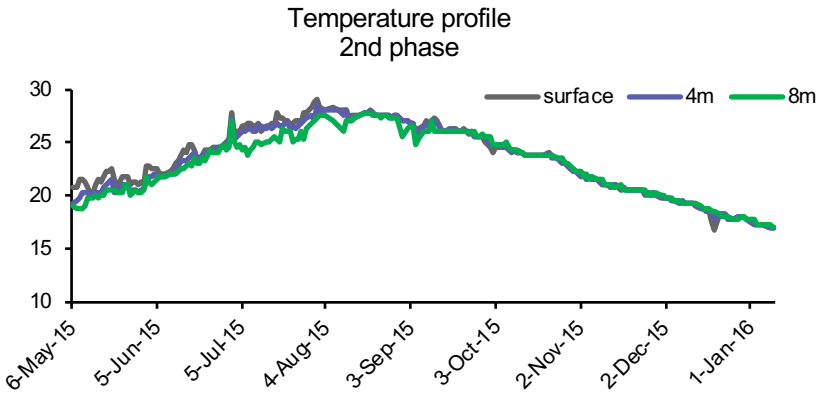
- Cages of 180 (6x6x5-**Shallow**) and 290 (6x6x8-**Deep**) m^3 at the HCMR pilot farm in duplicates

- Two successive trials
  - 1st trial: Size >200 g
  - 2nd trial: Size >800g
- Duration of each trial 8 months
  - Feeding with feeders during light phase
  - Weight samples periodically
  - Physiological/ immunological monitoring
  - Fish distribution monitored with echo sounders

Methodology (2)

Cage volume





- 1st phase: Initial body weight 200±20 g
  - 5,150 fish (n=2) for the **shallow** cages and
  - 8,240 fish (n=2) for the **deep** cages ones

- 2nd phase: Initial body weight 870±20 g,
  - 2,000 fish (n=2) for the **shallow** cages and
  - 3,200 fish (n=2) for the **deep** cages ones

Methodology (3)

Cage shading

- Two cages at Argosaronikos farm in 2 rearing periods
  - One covered with net of 90-95% shading;
  - One covered only with a bird protecting net.
- Duration of each trial 8 months
- Groups were fed by hand, to apparent satiation
- Weight samples periodically and fish distribution with echo sounders

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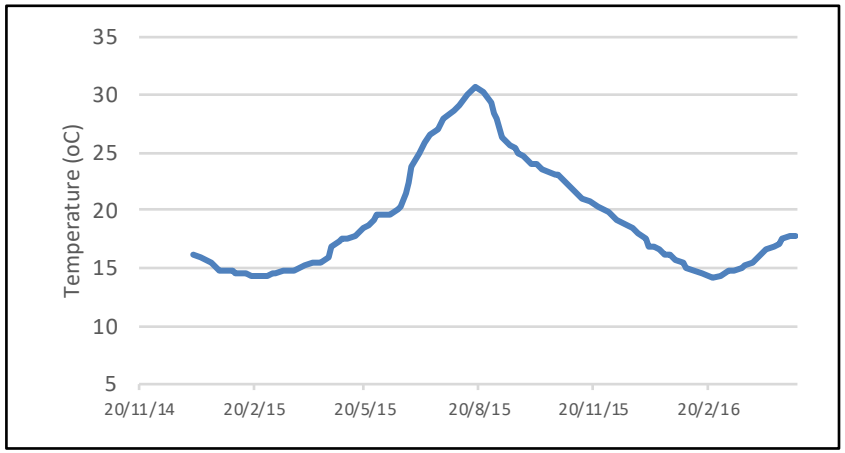
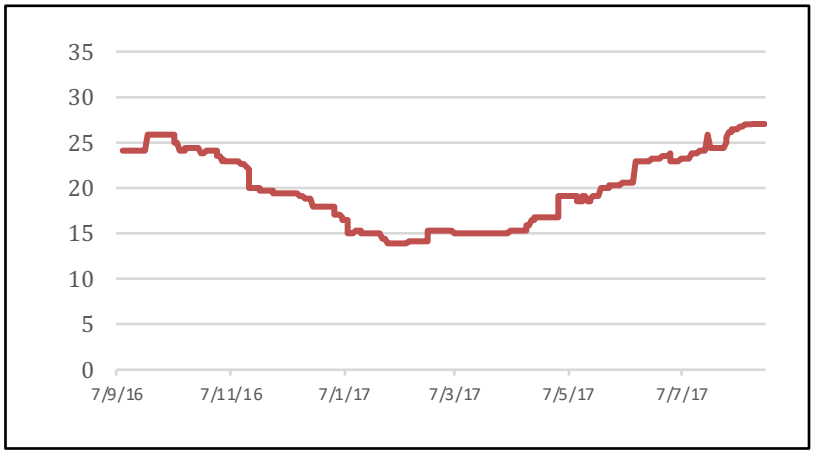
Methodology (4)

Cage shading





1st trial

Cages of 1000 m^3

11.000 individuals in each

weight of 135±25 g.

2nd trial

Cages of 800 m^3

11.000 individuals in each

weight of 255±100 g.

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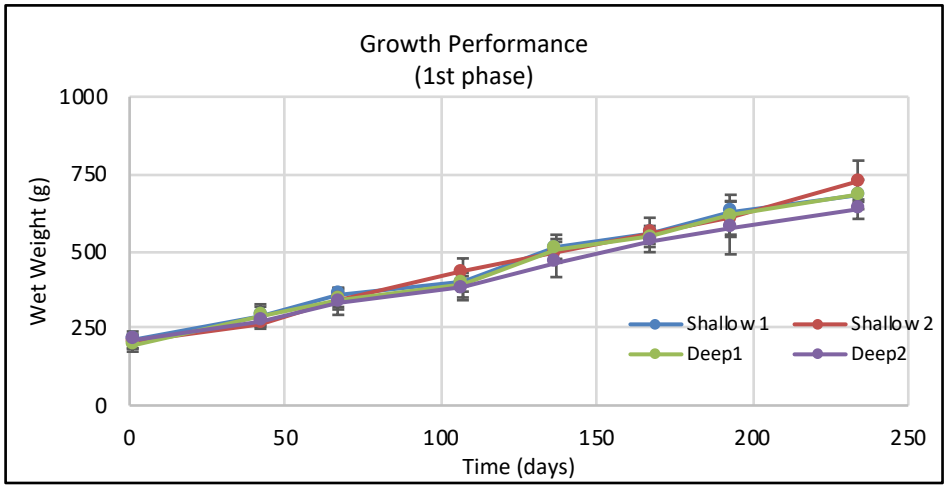
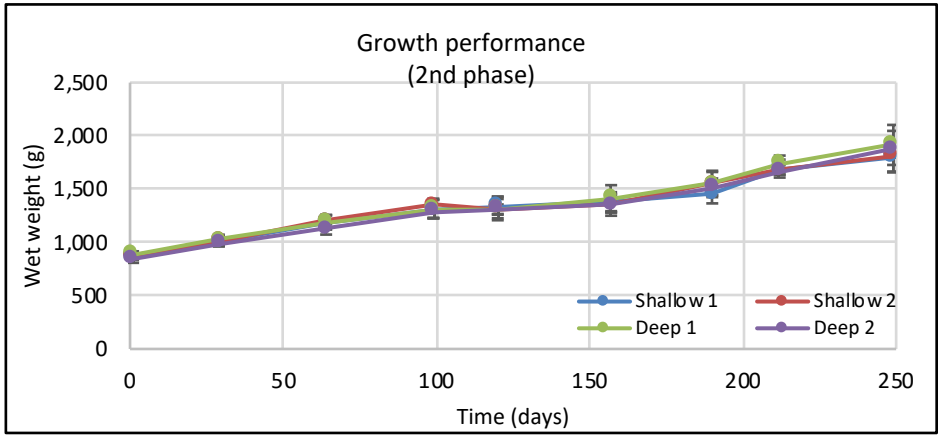
Results

Cage volume



SGR: ~2g d^{-1}
No significant difference

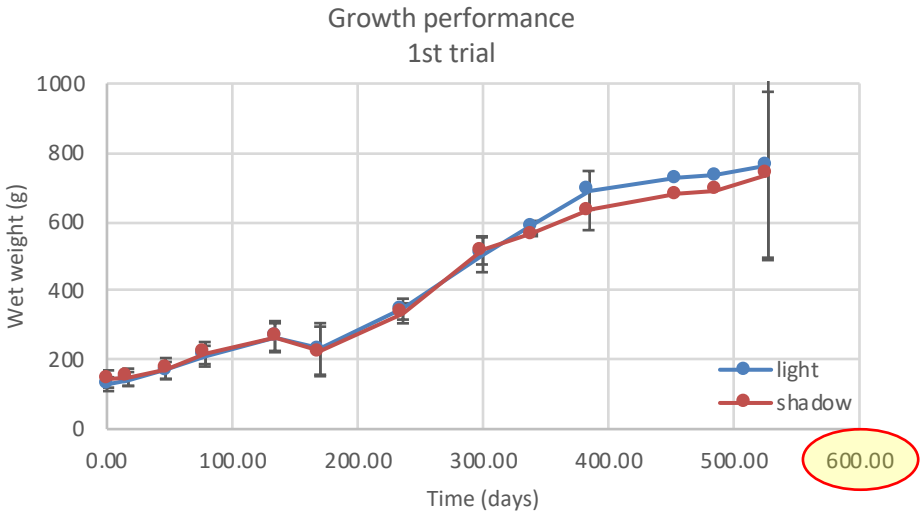


SGR: ~3.5g d^{-1}
No significant difference

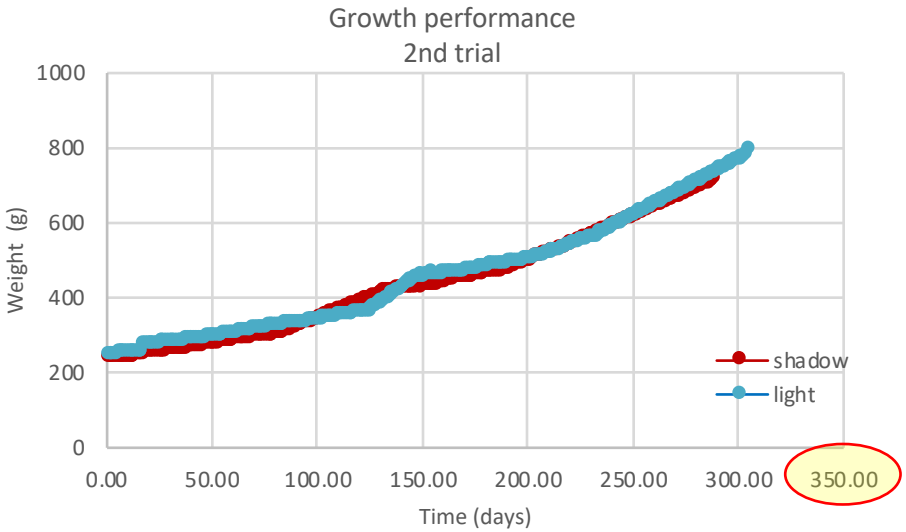
		Shallow 1	Shallow 2	Deep 1	Deep 2
1st phase	Survival (%)	76.5	75.8	87.9	86.1
	FCR_{econ}	1,92	1,92	1,58	1,60
2nd phase	Survival (%)	89.2	90.3	92.1	91.9
	FCR_{econ}	1.67	1.70	1.50	1.47

Results

Cage shading



SGR: 1.25 g d^{-1}
No significant difference



SGR: 1.66 g d^{-1}
No significant difference

	Trial 1		Trial 2	
	Shadow	Light	Shadow	Light
FCR_{econ}	3.0	2.9	2.0	1.8
Survival (%)	91.4	92.7	98.3	93.3

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Results

- Significantly better performance in the deep nets during the 1st phase, but not during the 2nd phase

- No difference between shaded and non-shaded cages

Results

Behavior

- Monitor the vertical distribution of the populations in cages with an echo integrator

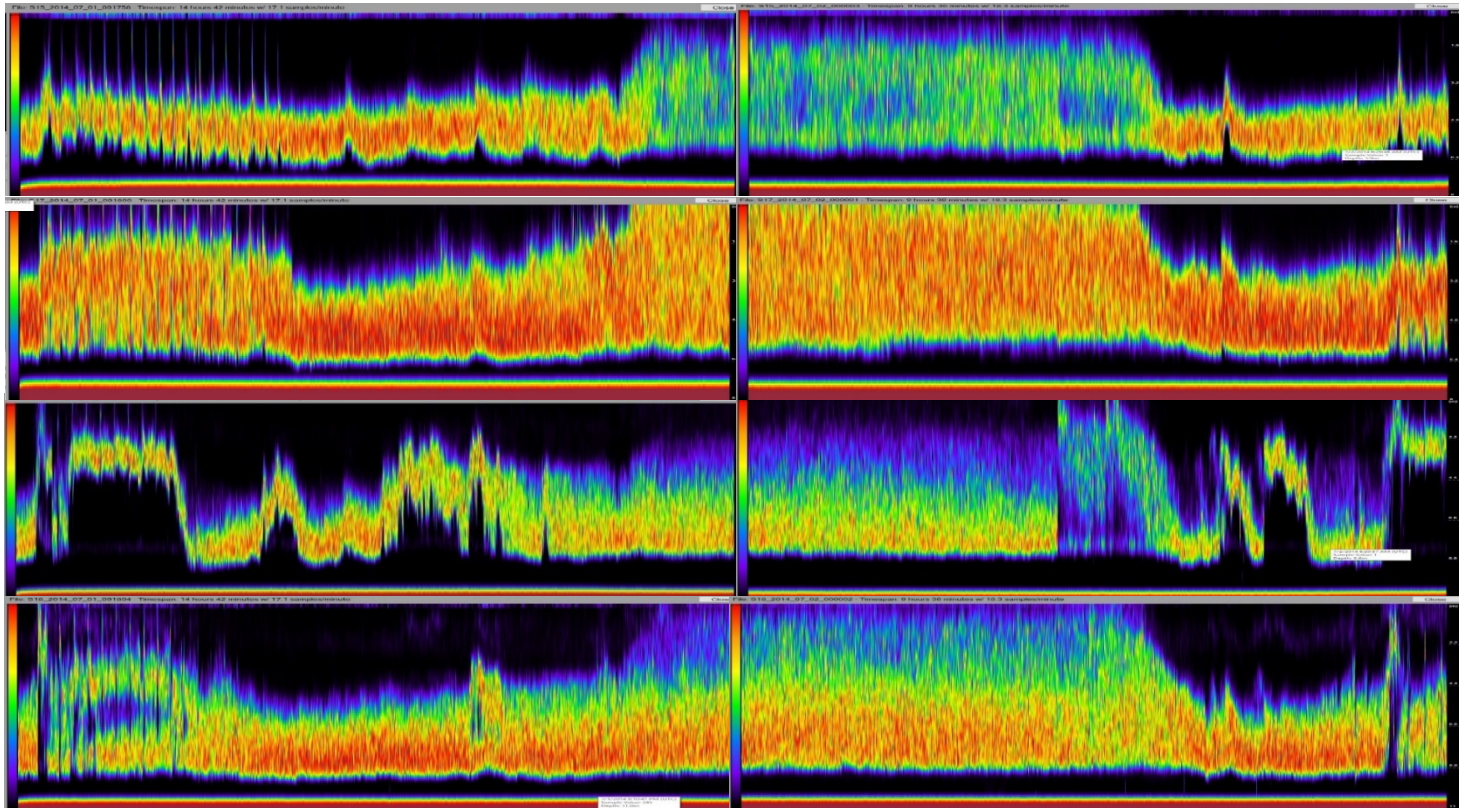
01-02 Jul 2014

Shallow (1)

Shallow (2)

Deep (1)

Deep (2)



Results

- No differences in spatial distribution among different rearing conditions
- In the echograms the feeding periods are clearly recognizable
  - vertical movements towards feed; return to lower layers of the cage
- Stress period during high temperature (late August – September)
  - individuals of ~1,5 Kg were sluggish and with limited appetite (not the case for groups of ~500g)
- Meagre behavior in general different from the observed in salmon or European seabass
- Meagre exhibited high tolerance to variable conditions and a very conserved spatial distribution pattern
  - nocturnal behavioral pattern documented for the first time
  - a potential for alternative feeding approach

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Results

- 1st Phase
  - Glucose and Lactate: showed differences between the two net depths but statistical interactions make interpretation difficult
  - Cortisol: only seasonal fluctuation
    - higher levels in March may reflect stress due to crowding or lower temperature
- 2nd Phase
  - Cortisol and Lactate: Significantly higher values in fish reared in the SHALLOW net than in the DEEP net at the end of the trial

Lesson learned

- Depth of nets has a significant effect on the performance of meagre between 200-800 g
  - better performance in deep nets
- No difference for fish between 800-1600 g
- No effect of shading

The feeding methodology

- Night feeding
- Submerged feed distribution

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Methodology (1) Nigh feeding

- Cages of 290 (6x6x8) m^3 at the HCMR pilot farm in duplicates
- Duration of trial 8 months
- 4x~1,820 individuals
- Initial body weight 500±50 g
  - Feeding with feeders during light phase
  - Weight samples periodically
  - Physiological/ immunological monitoring
  - Fish distribution with echo sounders

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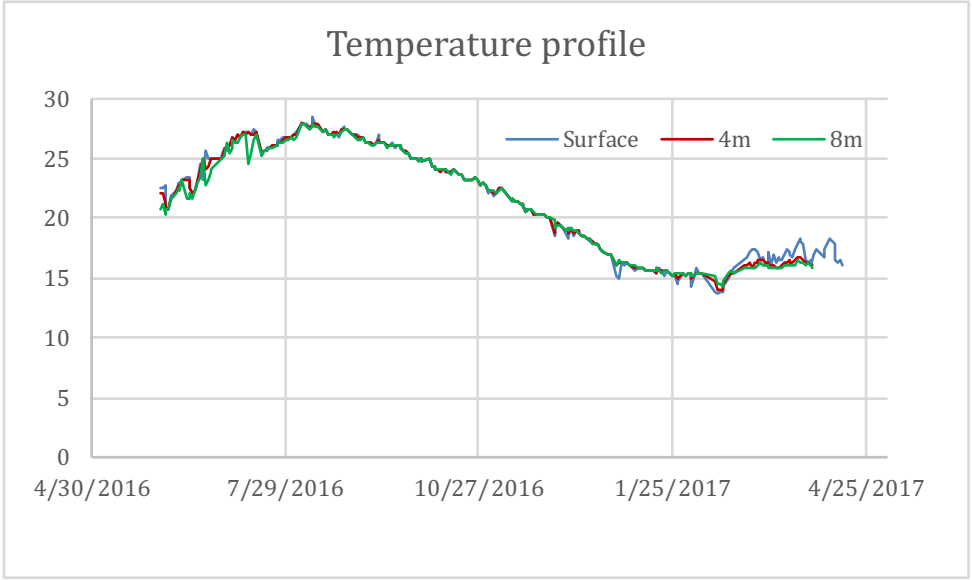
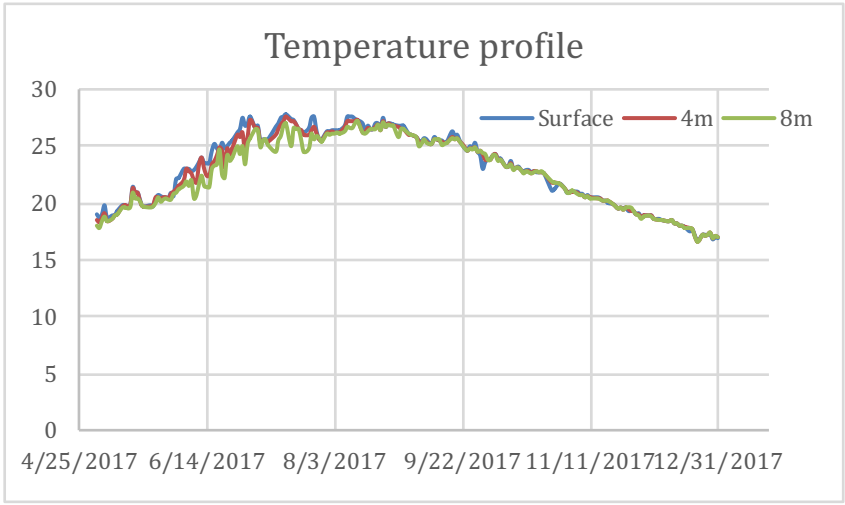
Methodology (2) Nigh feeding



	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00
Day feeding																								
+1 week																								
+2 weeks																								
+3 weeks																								
+4 weeks																								
Night feeding																								

Methodology (3) Submerged feeding

- Cages of 290 (6x6x8) m^3 at the HCMR pilot farm in duplicates
- Duration of trial 8 months
- 4x~2,720 individuals
- Initial body weight 290±30g



- Feeding with feeders during light phase
- Weight samples periodically
- Physiological/ immunological monitoring
- Fish distribution with echo sounders

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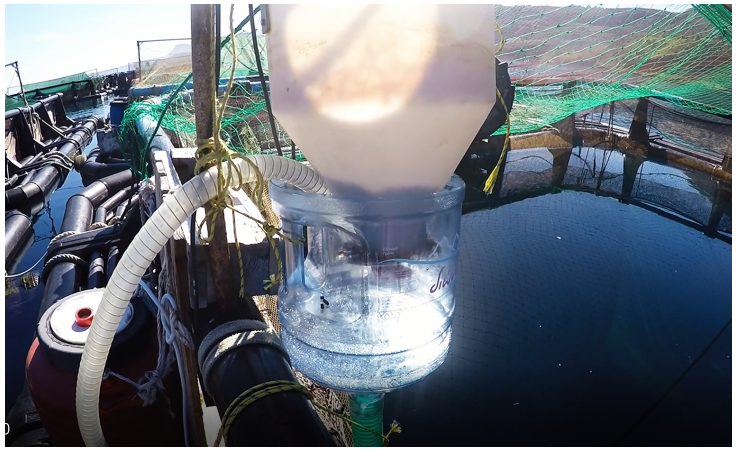
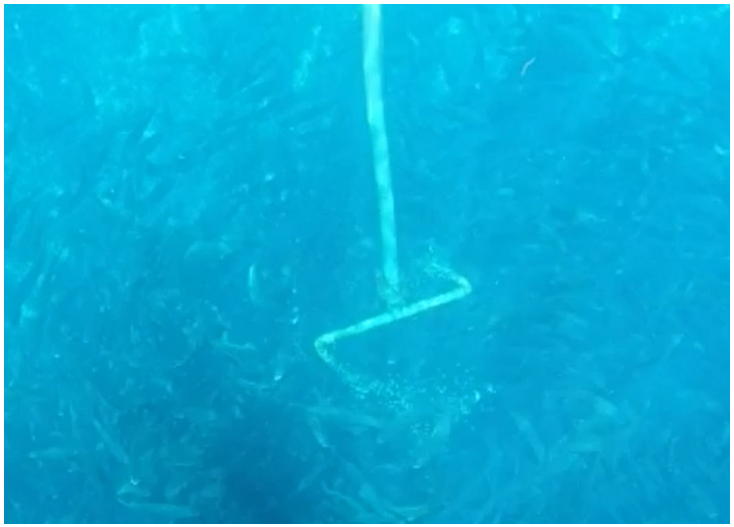
Methodology (4) Submerged feeding

- Standard feeding with feeders on the surface
- Submersible feeding
  - transfer feed together with sea water through a flexible tube from the surface using an electric pump
  - an electric dosing mechanism delivered the required feed quantity
  - a rotating distributor at 4 m depth





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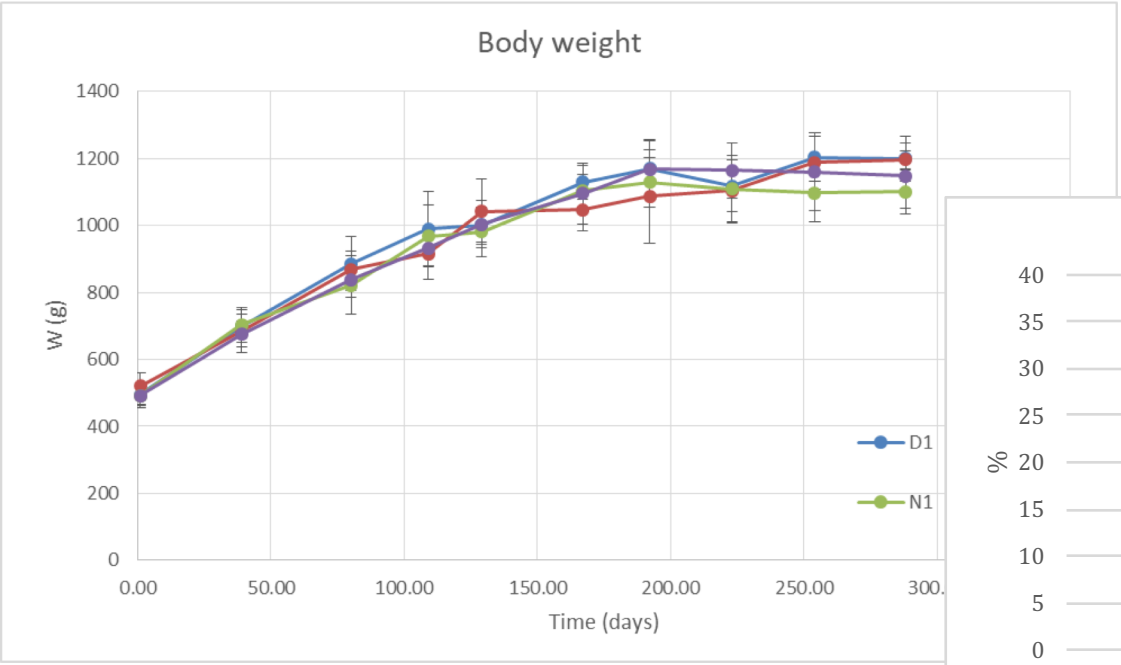
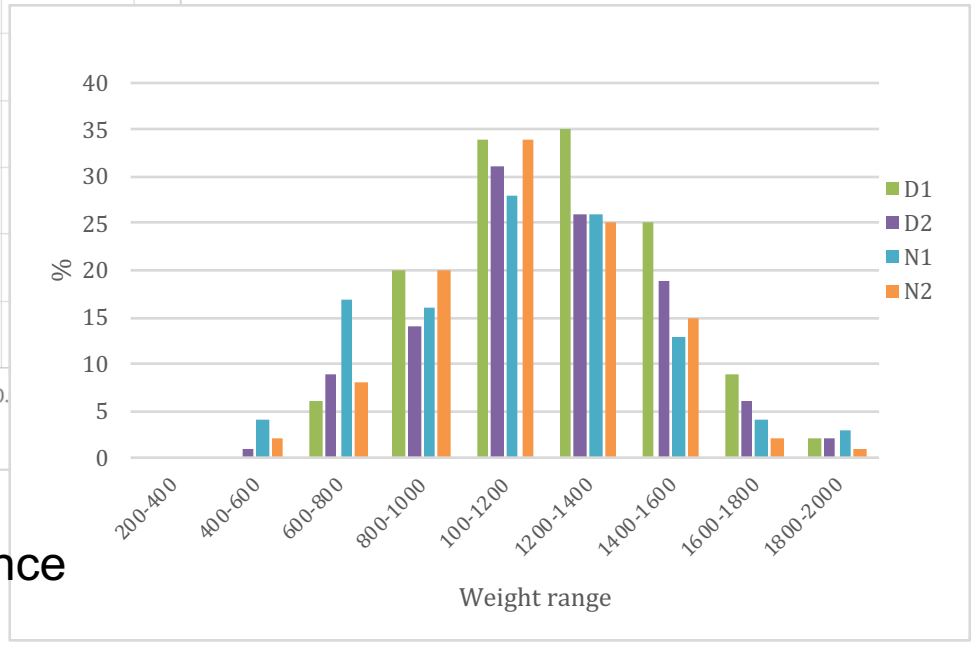
Results

Night feeding



Physiological parameters:
No differences



SGR 2.5 g d^{-1} with no significant difference

	D1	D2	N1	N2
Mortality (%)	4.8	3.5	5.4	2.6
FCR	2,6	2,6	3,0	2,7

Coefficient of variation
- between 21.3 - 29.2%
- night-fed groups higher

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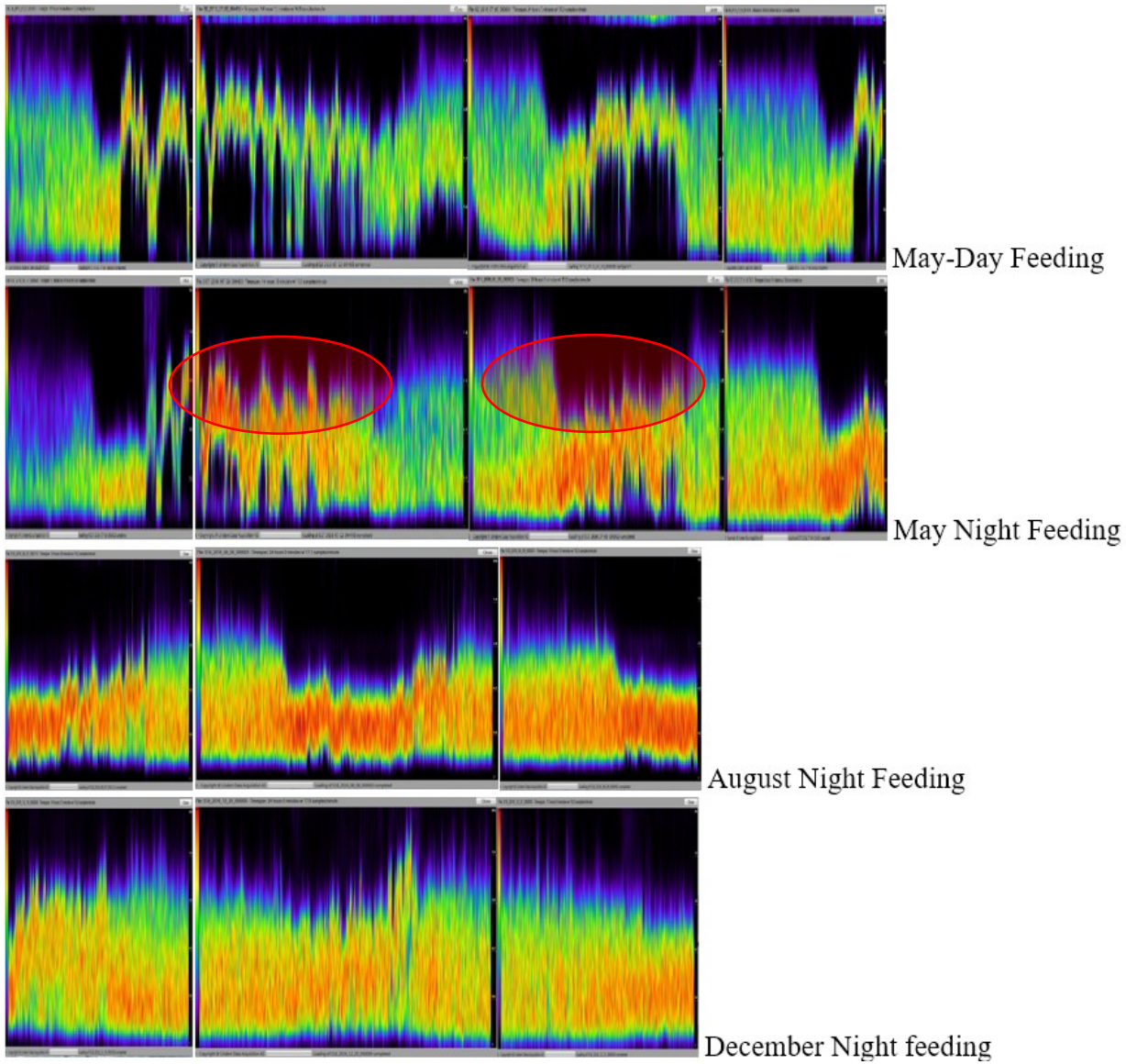
Results

- Night-fed groups with two distinct behaviors
- The first 2-3 months were searching for feed during the day
- The behavior may express the capacity of the individuals to feed during the whole day period

Night feeding



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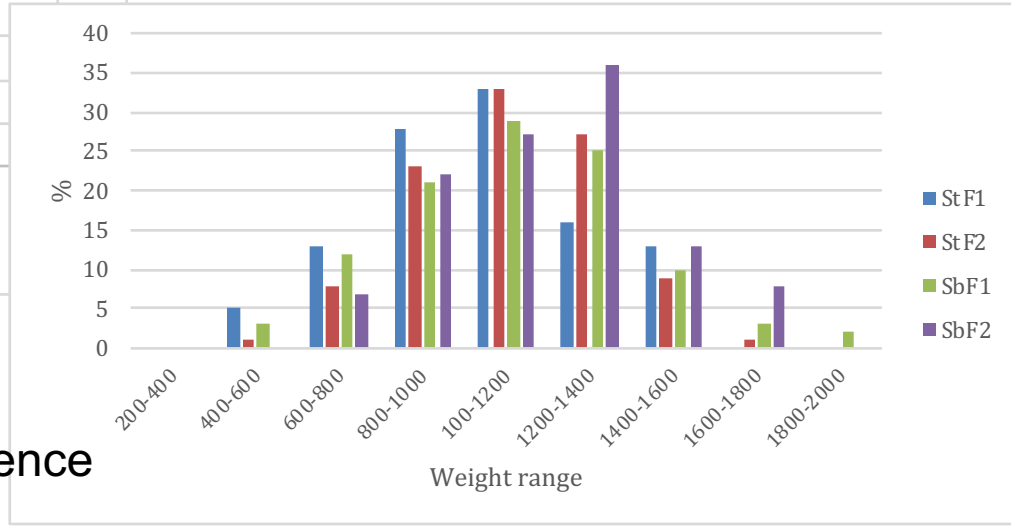
Results

Submerged feeding

Behavior: No differences



SGR 3.8 g d^{-1} with no significant difference

	StF1	StF2	SbF1	SbF2
Mortality (%)	3.2	3.8	3.4	2.3
FCR	1.7	1.5	1.8	1.6

Coefficient of variation

- between 20.6 – 25.7%
- Bigger sizes for submerged feeding

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Lesson learned

- Night vs day feeding had no effect on performance
  - Night-fed population exhibited higher size variability
- Submerged vs surface had no effect on performance
  - bigger sizes for submerged feeding
  - submerged feeding resulted in a better immune status

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Thank you for your attention!