GWP Grow out Husbandry WP20-21-22-23

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… DIVERSIFY will address the **main documented species specific bottlenecks in the production** of the selected species, in order to **develop adequate husbandry practices and technologies for the industry** to enable production (greater amberjack and wreckfish) or to optimize production (meagre, pikeperch, Atlantic halibut and grey mullet)…

cosmopolitan species….

- **large size and fast growth**, potential of rearing in sea cages -especially offshore (meagre, greater amberjack),
- **freshwater fish** of high demand for RAS culture (pikeperch),
- **cold-water** of the sub-arctic northern Europe (Atlantic halibut)
- **euryhaline warm-water** suitable for extensive aquaculture.

Structure of the GWP

- WP 20: Meagre
- WP 21: G. amberjack
- WP 22: Pike perch
- WP 23: Grey mullet

WP 20. Meagre

- Technologies and practices used for grow out, similar to those for gilthead sea bream and European sea bass
- Meagre is different in
  - growth rates
  - feeding and spatial behavior in the cage
- Species-specific husbandry practices and methods can improve the performance

- The objectives of this WP are
  - **the development of method**
    - **to avoid size variability in juveniles**
    - **for feeding respecting the specific behaviors of meagre**
  - **the modification of applied methodologies for cage culture to maximize the performance**

Task 20.1 **Size variability at juveniles**

Difference in growth depends on genetic origin?

Potential of low-growth fish for compensatory growth?

- Tank experiments at juvenile stage
  - Genetic characterization of juveniles for parental assignment
  - Growth studies
  - Economic analysis

- Result:
  - Identification of causes
  - Development of methodology

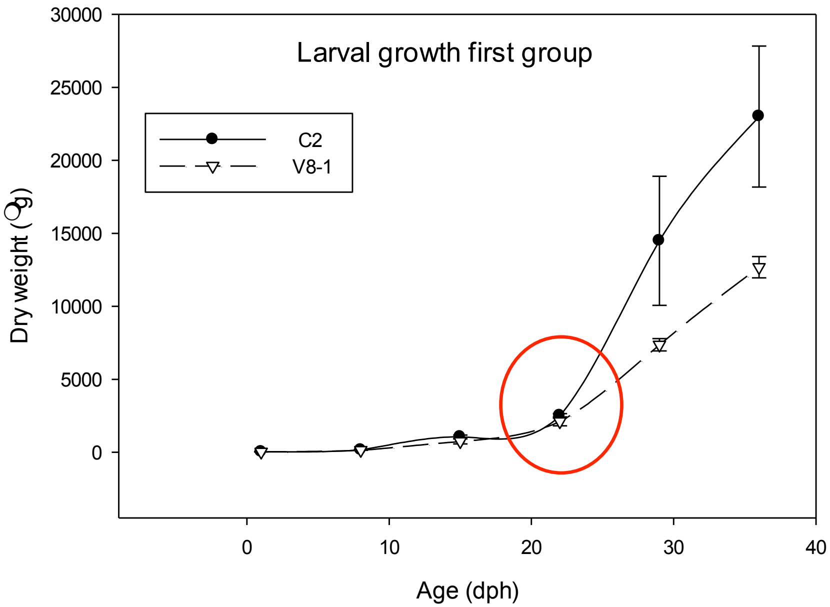
- Implementation: IRTA, HCMR

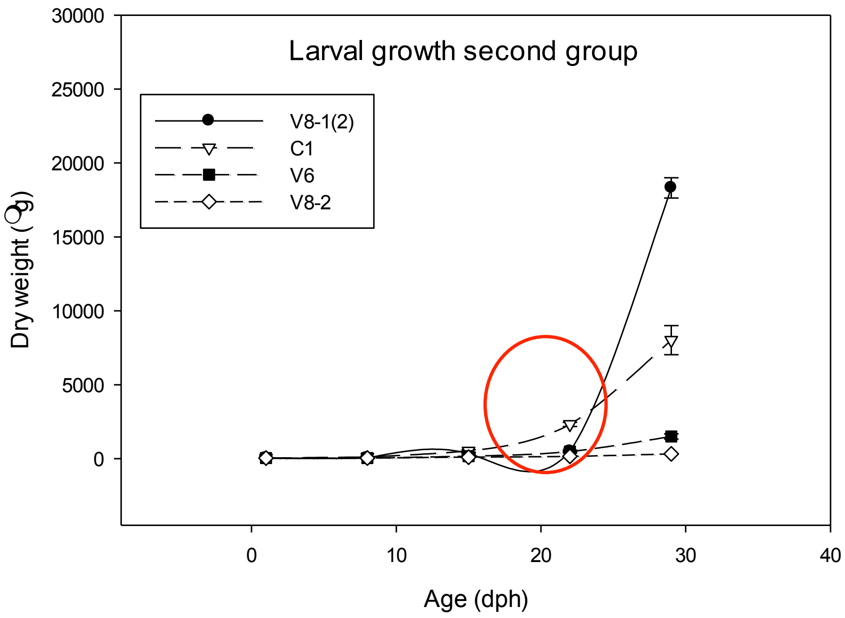
First experimental rearing

Family	Related half-sib family	Spawning Date (Tank)	Female	Male
1	2 and 3	24/04/2014 (V8-1)	5-wild	19-wild
2	1	01/05/2014 (V8-1(2))	5-wild	20-wild
3	1	01/05/2014 (V8-2)	1-wild	19-wild
4	-	24/04/2014 (C2)	16-cultured	21-wild
5	-	01/05/2014 (C1)	2-wild	22-wild
6	-	01/05/2014 (V6)	13-cultured	17-wild

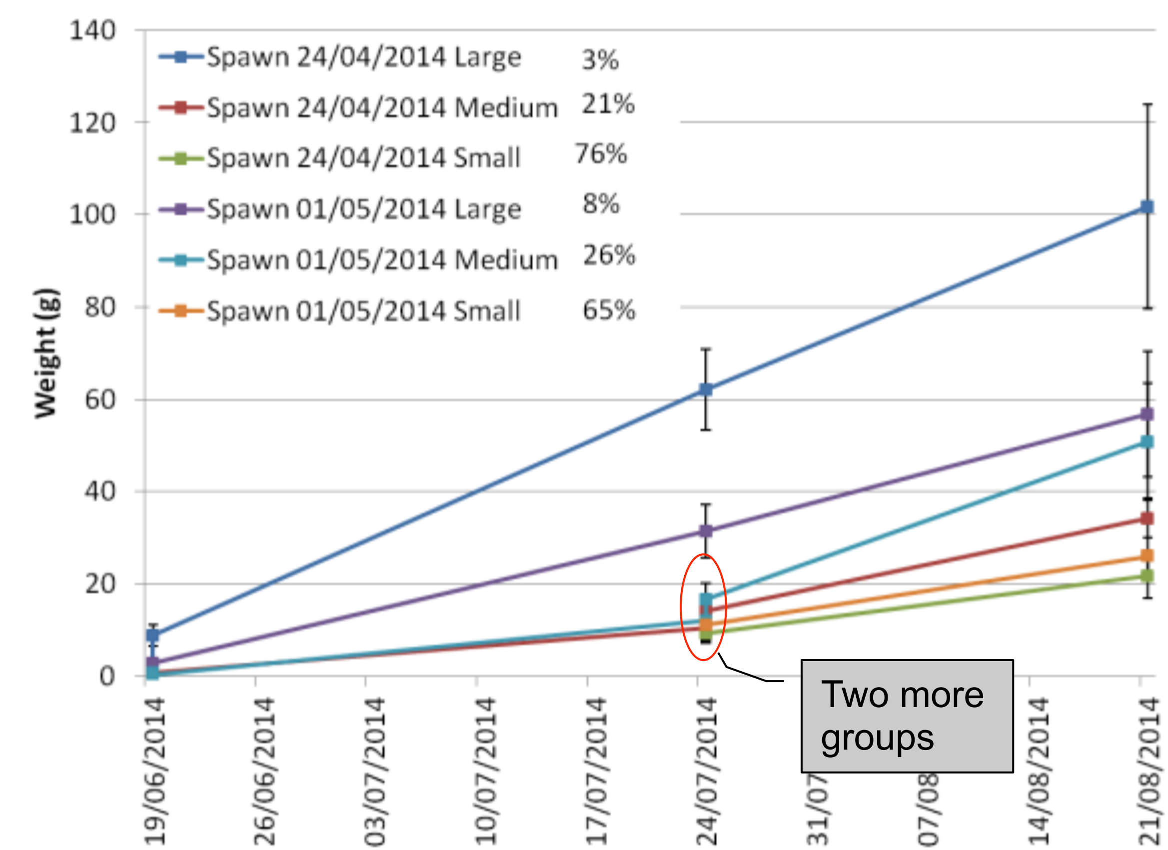
- Parents that contributed to each family or half-sib family and spawning date.
  - The female and male number refers to the breeders unique ID and wild or cultured indicates the origin of the breeder.

- Growth (DW, g) of the six groups of larvae during the first month

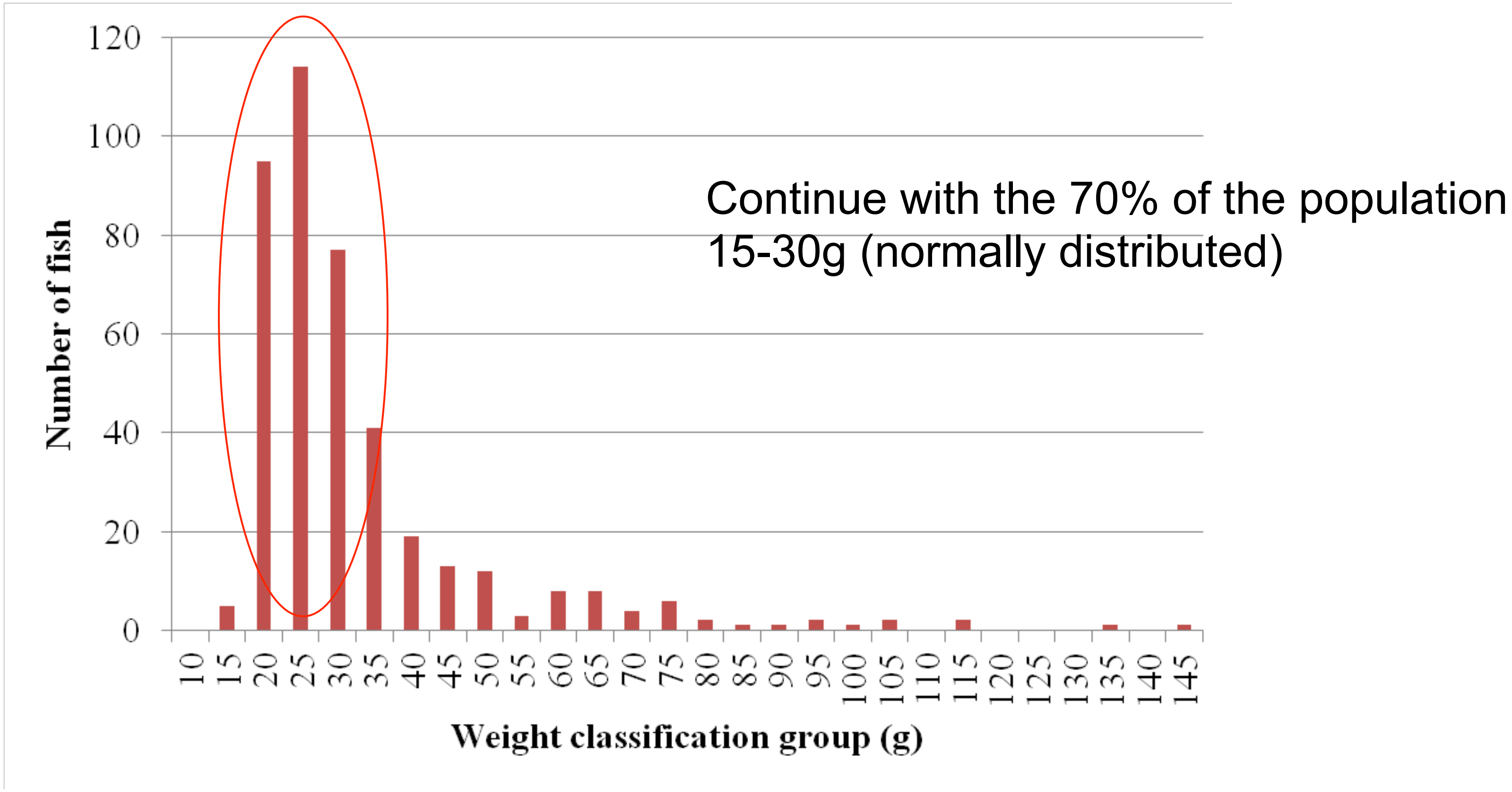




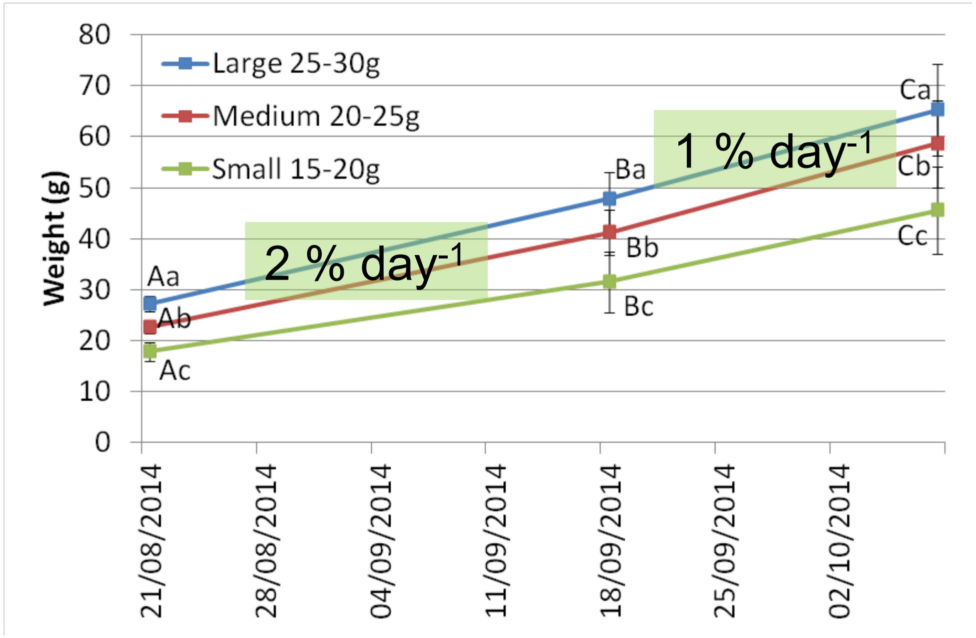
- Growth of different grades during first two months of nursery with percentages that each grade represents of the populations



- Weight frequency distribution after two months in nursery.
  - The population skewed to large fish,
  - 84% in the size range 15-40g and
  - 16% in the range 40-144g.



- Growth of grades of fish that represent 70% of the population.
  - To date there have been no significant differences in growth rates of the three grades.



- Trial to continue until December (low temperatures)
- Repeat trial next year considering the problems anticipated

Task 20.2 **Effect of rearing environment**

Which is proper environment for meagre rearing?

- Effect of cage depth (sT 20.2.1)
- Effect of light intensity (sT 20.2.2)

In preparation to start November 2014

  - Two size groups [(200 – 600g) and (800-1500g)]
  - Duration 8+8 months

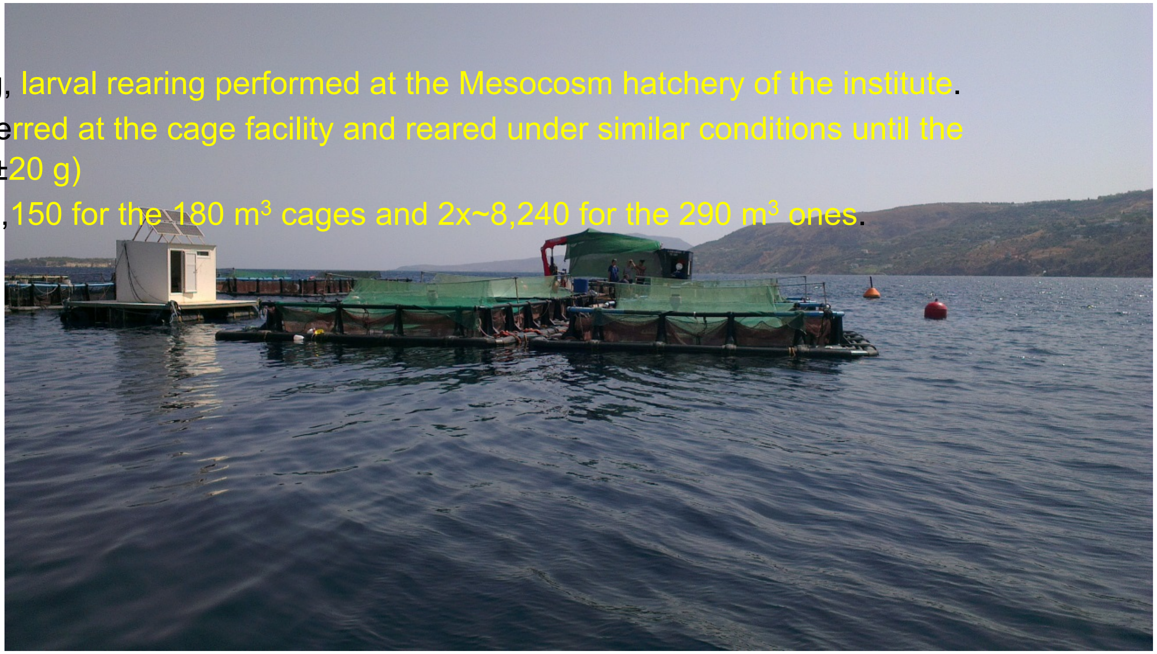
- Result:
  - Definition of optimal depth
  - Definition of optimal light intensity

- Implementation: HCMR, Argosaronikos SA

Task 20.2.1 **Effect of cage depth**

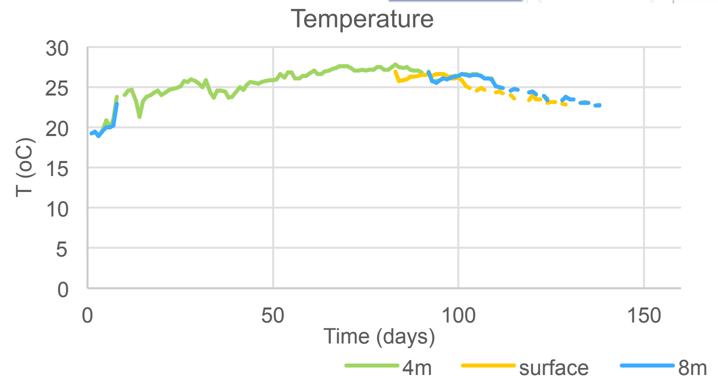
Test performance of meagre in cages of different depth (started May 2014)

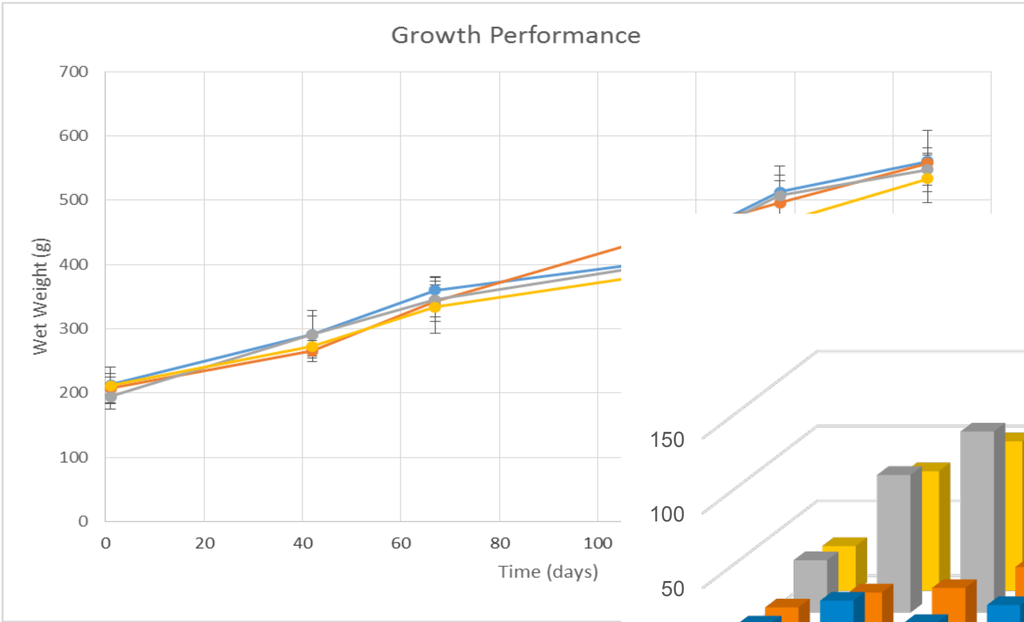
- Methodology
  - Cages of 180 (6x6x5-Shallow) and 290 (6x6x8-Deep) m^3 at the HCMR pilot farm in duplicates
  - Fish origin from HCMR.
    - Eggs form a single spawning, larval rearing performed at the Mesocosm hatchery of the institute.
    - Juveniles of 2 gr were transferred at the cage facility and reared under similar conditions until the beginning g of the trial (200 ±20 g)
    - 4 groups were created, 2x~5,150 for the 180 m^3 cages and 2x~8,240 for the 290 m^3 ones.
  - Duration of trial 8 months

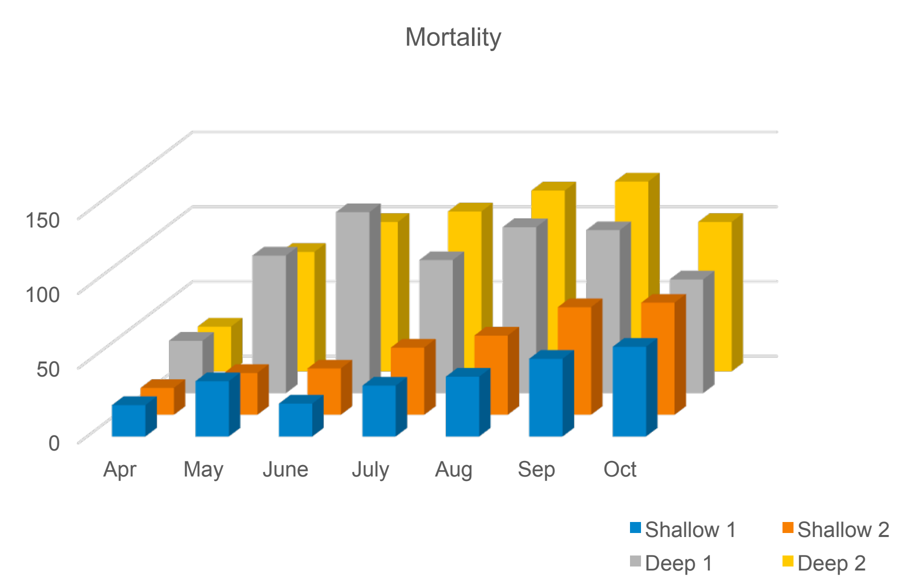


Results (so far)

- Similar growth rate (~2g d^{-1})

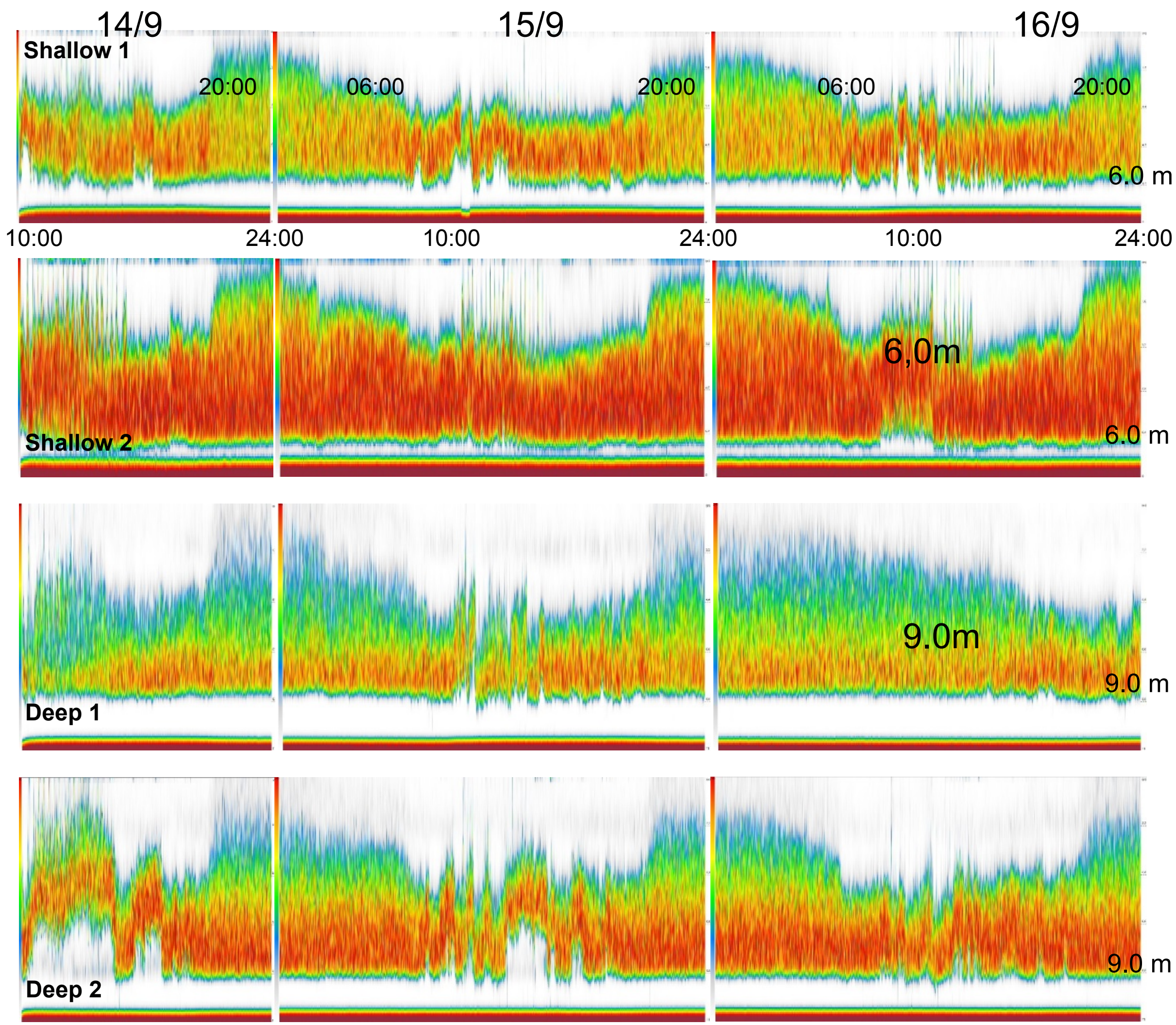






SGR: ~2g d^{-1}

Results (so far)



- Vertical distribution in cages
  - observation independent of the cage depth
  - correlated with the light and dark period of the day
  - repeated pattern during the experimental period
  - first time that such a behavior has been observed

Task 20.3 **Development of feeding methodology**

Is the feeding method applied adequate for meagre?

Can we develop an "industrial" feeding system?

- Test in tanks
  - 2 different size groups [(50 – 100g) and (700-900g)]
  - different feeding stimuli (mechanical, optical)
  - different feeding methods

To start November of 2014 with fish of 50 gr

- Test in cages
  - 2 feed distribution methods from the surface and from the bottom (HCMR)
  - Comparison hand feeding with demand type industrial (MAREMAR)
- Result: Development of feeding system for industrial application
- Implementation: HCMR, IRTA, Argosaronikos SA, CULMAREX SA

WP21. Greater amberjack

- Preliminary data for grow out of greater amberjack suggested that growth performance is high
- Further studies are required to develop
  - rearing method in cages
    - volume - depth and
    - test the application of submersible cages
  - feeding methods
  - appropriate husbandry practices
    - specific thermal ranges for optimal growth and health,
    - optimum rearing density

Task 21.1 **Development of rearing method in cages**

Which is the proper volume (depth) of cages? (sT21.1.1)

Can we use submerged cages? (sT21.1.2)

- Trials for 12 months in
  - commercial cages (10m and 6m depth)
  - commercial cages (20m diam; 10m depth)

To start in 2015

- Result
  - definition of optimal depth
  - definition of optimal technology
- Implementation: FORKYS, CanexMar, FCPCT, HCMR

Task 21.2 **Development of feeding methods**

Do we feed properly the greater amberjack?

Which is the feeding pattern

- Test in tanks for 4 months with fry (5g) and juveniles (200g)
  - different feeding methods (continuous vs fix ratios)
  - estimation of daily rhythm and frequency

Planned to start in early 2015 with juveniles already available

- Result: definition of optimal feeding method – feeding pattern
- Implementation: IEO , FCPCT

Task 21.3 **Development of appropriate husbandry practice**

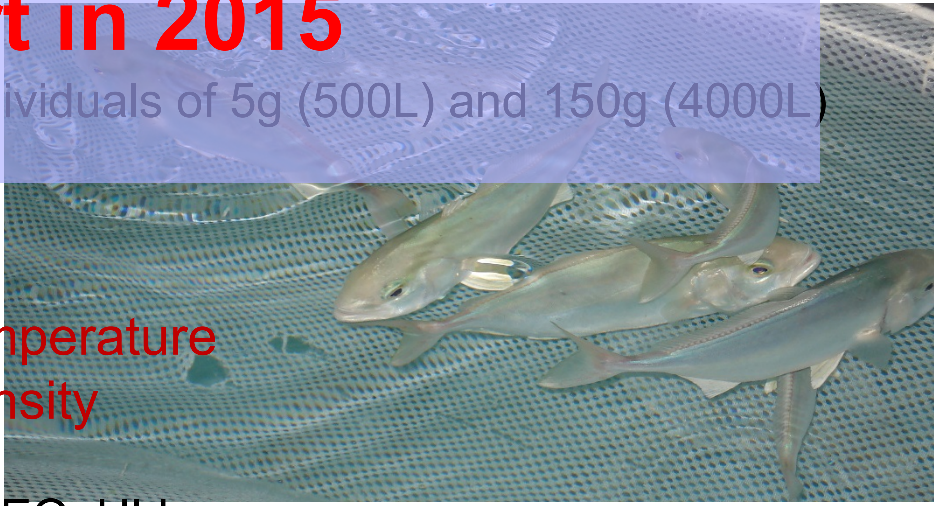
Which is the optimum temperature range?

Which stocking density is optimal?

- Test in tanks for 4 months with individuals of 5g and 200g
  - 2 different temperature ranges 14-17 ºC and 26-29 ºC

To start in 2015

- Test in tanks for 4 months with individuals of 5g (500L) and 150g (4000L)
  - 3 different stocking densities



Result:

- definition of optimal rearing temperature
- definition of optimal rearing density

- Implementation: FCPCT; HCMR, IEO, ULL

WP 22. Pike perch

- Bottlenecks (by SMEs)
  - unpredictable depression of growth
  - management manipulations are followed by high mortalities
- Reasons
  - high stress responsiveness to intensive culture conditions
  - use of pikeperch broodstock of various domestication levels, including wild populations
- Studies are required
  - effect of husbandry practices and environment
    - farm conditions
  - effect of domestication level and geographical origin

Task 22.1 **Effect of husbandry practices and environmental factors on pikeperch immune and physiological status**

Which are the main stressful factors for pikeperch?

How the fish respond to stress?

- Trial for 8-12 months with juveniles (80-100 g)
  - Expose to various husbandry practices and environmental conditions

- Result: identify an optimal combination of environmental and husbandry factors

- Implementation: FUNDP, DTU, UL, ASIALOR

First preliminary experiment

Specific objectives

- determine the sensitivity to single or repeated stressor
- estimate the time amplitude for stress response
- test whether dietary tryptophan mitigate primary stress response, and the overall effects

Fish and facilities:

- pikeperch juveniles of 10-12g 42 fish tank^{-1} (triplicate)
- June-September 2014

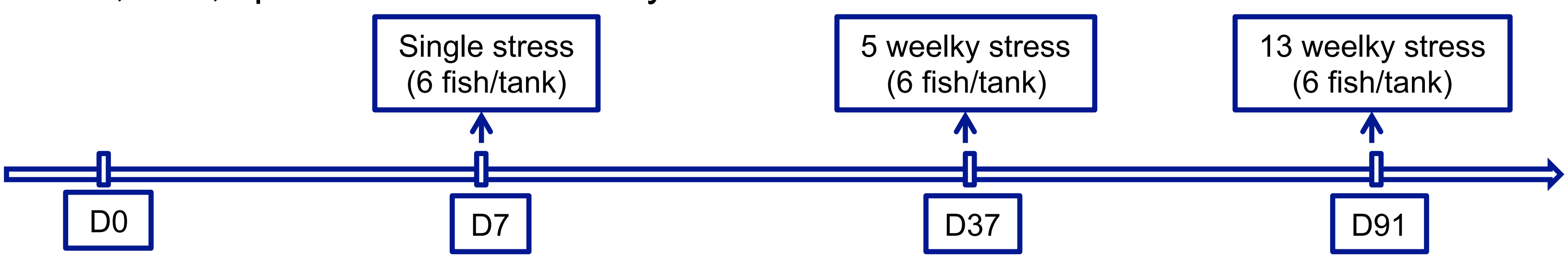
RAS tanks (100 L) for the stress experiment

Experimental treatments:

- control fish (CT)
- stressed fish (CTs) (one complete removal of tank water + 30 s-emersion per week)
- stressed - diet supplemented fish (xTRP) – (with 3 or 6 times of L-Tryptophan)

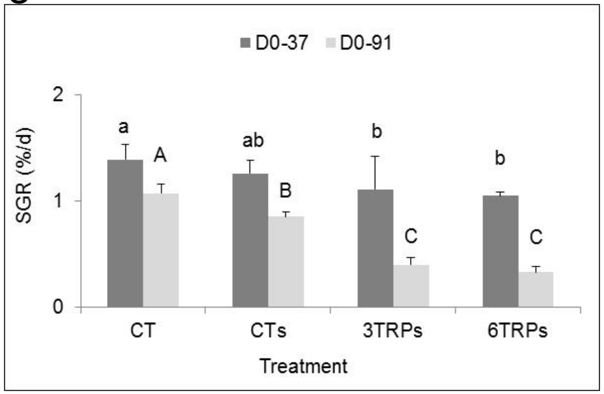
Sampling

- Blood, liver, spleen and head kidney



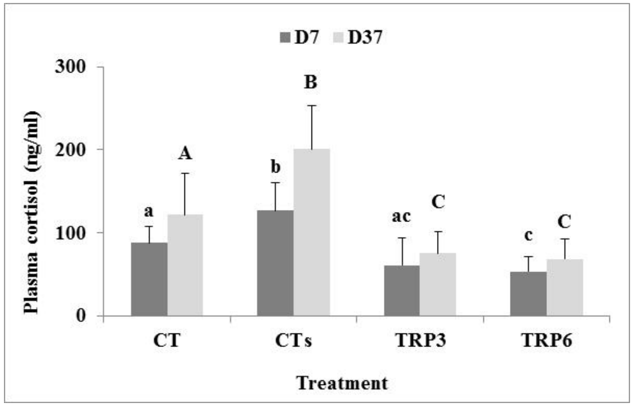
Results

❖growth



❖physiological response

- plasma cortisol, glucose, brain serotonin, cortisol conjugate in tank water



❖immune response

- Analysis ongoing (plasma lysozyme activity, plasma total Ig, ACH activity, immune genes)

❖Resilience response ***:***

- Planned for mid-November 2014
- 3 groups (CT, CTs, TRP) to determine the amplitude of stress response
- Serial samplings: 0, 0.5, 1, 3, 6, 24 h

Second preliminary experiment

- ***Specific objectives***
  - To determine the LC50 dose of *Aeromonas hydrophila* or *A. salmonicida*
  - To have a better control of the planned experiment concerning the disease resistance of stressed fish

- Planned for November -December 2014

RAS tanks for bacterial challenge (AL2)

The actual experiment

- Trial for 8-12 months with juveniles (80-100 g)
  - Expose to various husbandry practices and environmental conditions

To start in 2015

Factors	Modalities
1. Size grading	None vs each15 days
2. Rearing density	10 vs 50 kg/m^3
3. Hypoxia	4 vs 8 mg/L
4. Amonia	0.15-0.20 vs 0.8-1.2 mg TAN/L

Factors	Modalities
5. Lighting intensity	5-10 vs 80-100 Lux
6. Temperature	20-21 vs 26-27°C
7. Feeding conditions	Sinking vs floating
8. Light spectrum	White vs red light

- Monitoring
  - physiological stress responses, immune competence and global resistance to infectious diseases.
  - physiological and immune parameters and associated mortality,

Task 22.2 **Characterization of pikeperch immune and physiological status in farm conditions**

Are the results applicable in farm conditions?

- Comparative rearing of 2 or 3 batches (10 g to 1.5 kg) in farm conditions for 2 years

- Result: best practice for rearing of pikeperch
- Implementation UL, FUNDP, ASIALOR

Task 22.3 **Effect of pikeperch domestication level and geographical origin on stress sensitivity**

How the level of domestication affect the stress response?

- Investigate the effects of domestication (wild vs domesticated strains) and geographical origin (freshwater vs brackish water strains)

  - Different batches of juveniles from larval stage in similar conditions
    - 3 or 4 different geographical origins,
    - 1 or 2 populations of the same geographical origin with 2 levels of domestication

  - Monitoring the genetic variability

- Implementation: UL, FUNDP, DTU, ASIALOR

WP 23. Grey mullet

Evaluating the geographic range for grow-out of mullet in the Mediterranean basin

- Most **grey mullet** are reared extensively in polyculture systems
- Exists an established market (North Africa) and a growing one in the Med,
- Intensive monoculture has to be developed

  - Evaluating the geographic range for grow-out of grey mullet in the Mediterranean basin,
  - Determine the cost-benefit of different weaning diets on the performance and health status of juvenile grey mullet.

Task 23.1 **Determine the cost-benefit of different weaning diets on the performance and health status of wild juveniles**

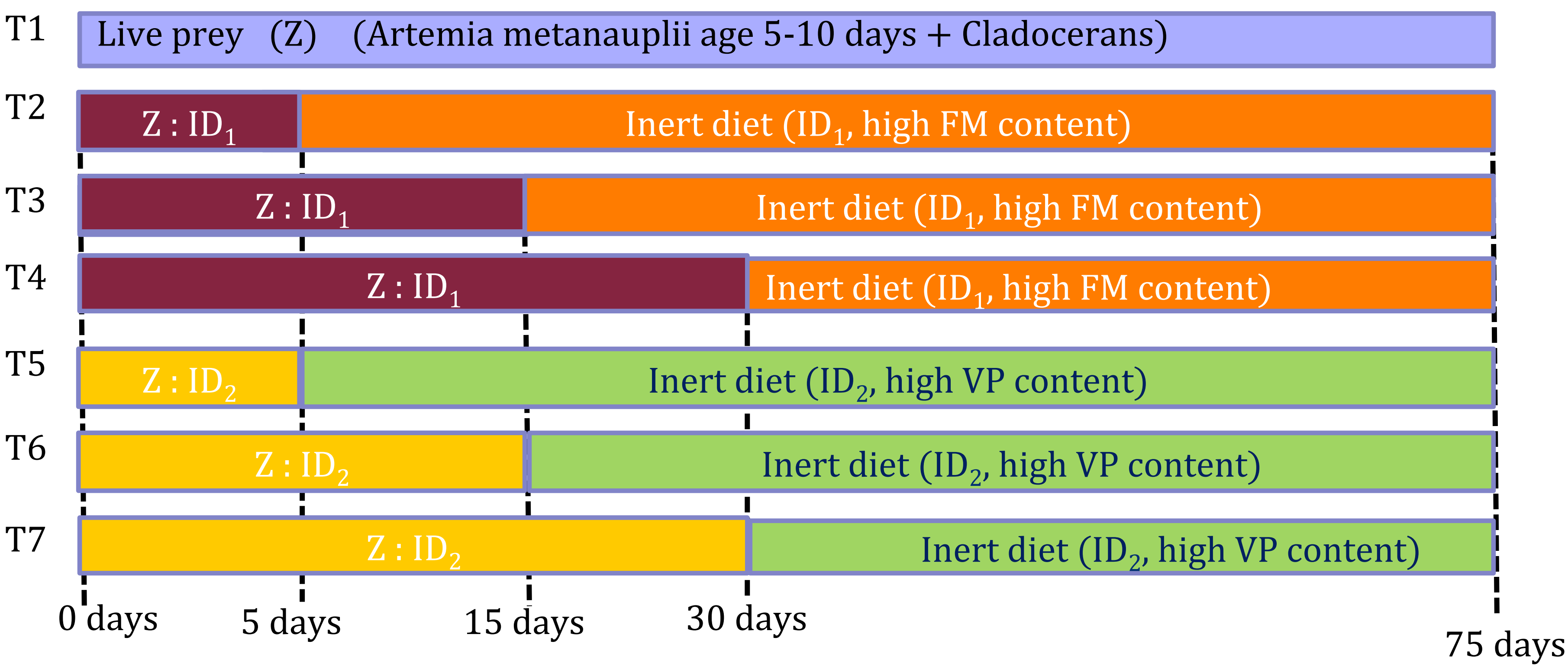
Which is the optimum weaning methodology?

- Test in tanks with wild juveniles following an adaptation period
  - the efficacy of different weaning diets in terms of
  - Different weaning strategies
- Monitoring
  - fish growth, survival maturation of digestive system, health status
  - economic efficiency.
- Result: recommendation of best weaning diet
- Implementation: IRTA

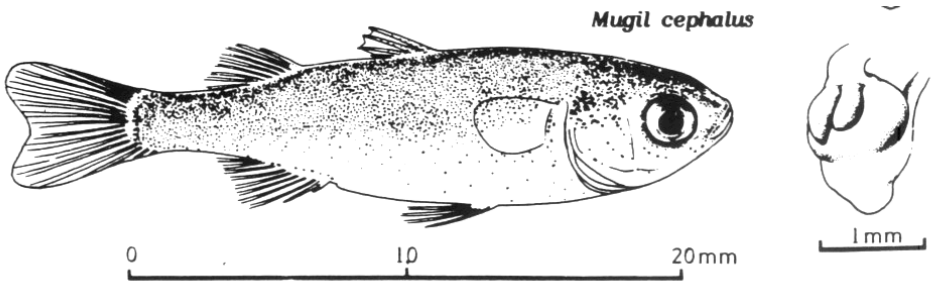
Optimization of weaning strategies in grey mullet

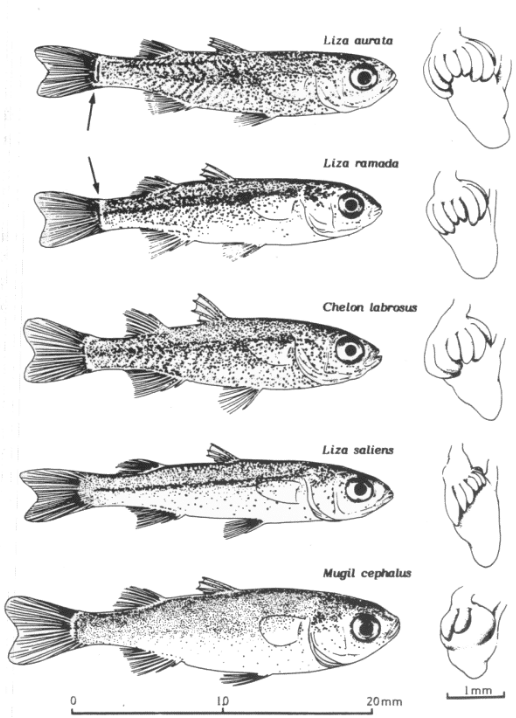
- Type of diet
  - rich in fish meal (FM)
  - rich in vegetal protein sources
- Co-feeding period

Experimental design (7 treatments/ 4 replicates each):



<u>Fish origin</u>:
Local fishery for exportation (Italy, Israel)





<u>Species Identification</u>:

- Body shape & Nb. of pyloric caeca
  - Cambrony (1984; Vie et Millieu 34, 221-227) (n = 2)

<u>Fishing / recruitment season</u>:

- October – December
  - (DOGC.Nº 2922 (02/07/1999)

Task 23.2,3,4 **Feeding an improved diet in monoculture**

Which are the appropriate conditions of rearing?

- Test in cement (IL, GR), and earthen (IS, SP) ponds
  - Two stocking densities
  - Using wild (GR, SP) or F1 (IL) juveniles
  - Monitoring
- Result: best grow out management practice
- Implementation: IOLR, IRTA, HCMR, CTAQUA, DOR, GEI, IRIDA

Thank you for your attention!

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