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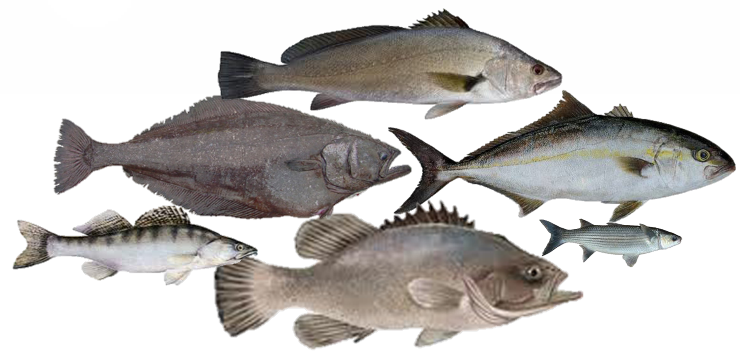
DIVERSIFY



GWP NUTRITION

GWP Nutrition Overall work

- Objectives of the GWP
- Structure of Nutrition GWP
- Progress and achievements during 2014 in Nutrition GWP

GWP Nutrition Objectives

- (a) develop adequate **first feeding regimes**
- (b) identify the optimum dietary nutrient levels required for **weaning**
- (c) build the knowledge on nutritional requirements to develop **sustainable and cost-effective grow out diets** for the candidate species.
- (d) requirements or feeding regimes to **optimize reproductive success** in some of the species.

GWP Nutrition Expected Impact

- Improved **larval rearing**
- Improved **health and fillet quality**
- Improved **cost efficiency** of diets for meagre and halibut
- Information to **develop diets** for greater amberjack, pikeperch and mullet
- Improved **reproduction success**

GWP Nutrition WPs

- WP 8 Meagre (**FCPCT**, ULL, SARC, DTU)
- WP 9 Greater Amberjack (HCMR, **FCPCT**, IEO, ULL, SARC, CANEXMAR)
- WP10 Pikeperch (FCPCT, ULL,FUNDP, **DTU**, ASIALOR)
- WP11 Atlantic Halibut (IMR, ULL, **NIFES**, SARC)
- WP12 Wreckfish (FCPCT, IEO, **CMRM**)
- WP13 Grey Mullet (FCPCT, IRTA, **IOLR**, UNIBA, CTAQUA)

WP8 Leader FCPCT

GWP Nutrition WP8 Meagre 2014 Action Plan

- Task 8.1 Improvement of larval weaning feeds (led by FCPCT).

Start in 2014

3	6	9	12		18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

- Task 8.2 Determination of nutritional requirements to promote feed utilization, consistent growth rates and fish welfare (Led by FCPCT).

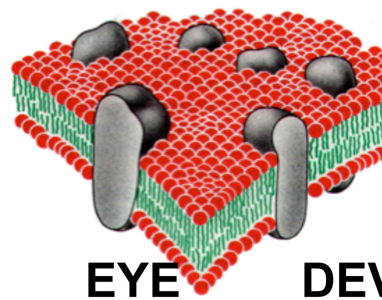
Fish being produced to start in 2015

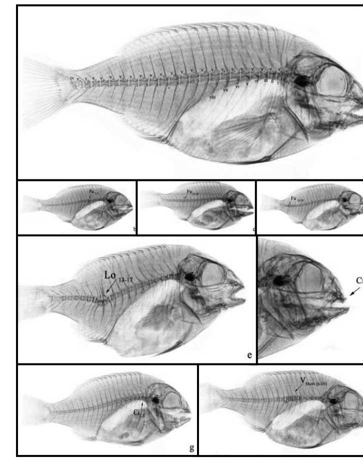
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

Task 8.1

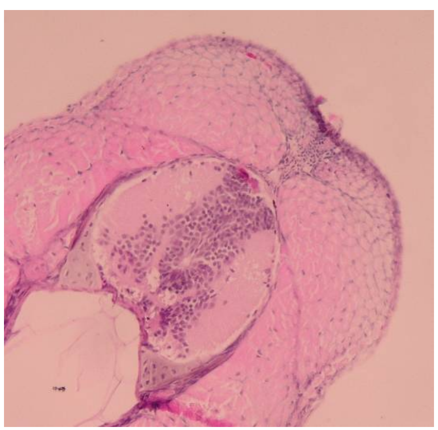
Nutritional requirements in first weanning diets unknown for meagre

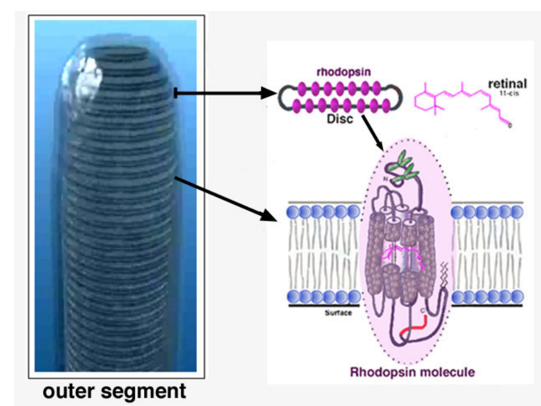
N-3 HUFA MOST IMPORTANT FOR LARVAE



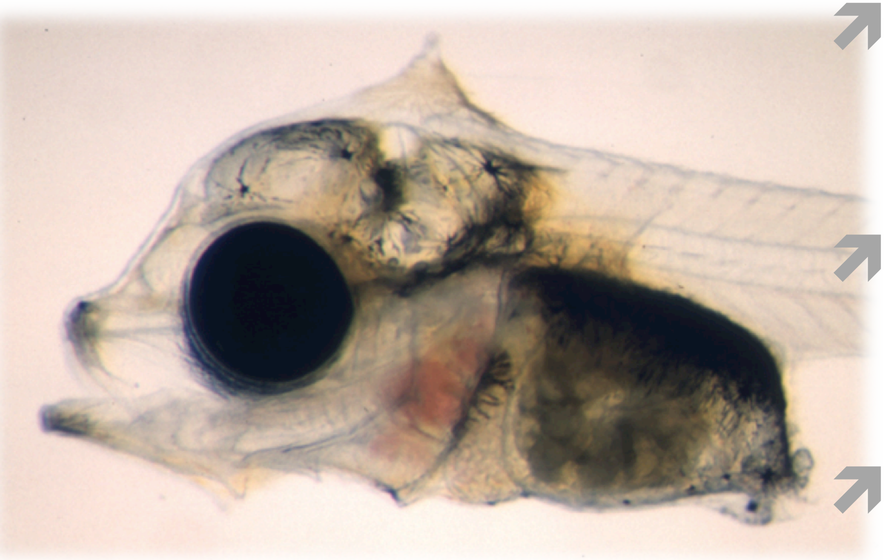


GROWTH BRAIN SURVIVAL EYE DEVELOPMENT SKELETON

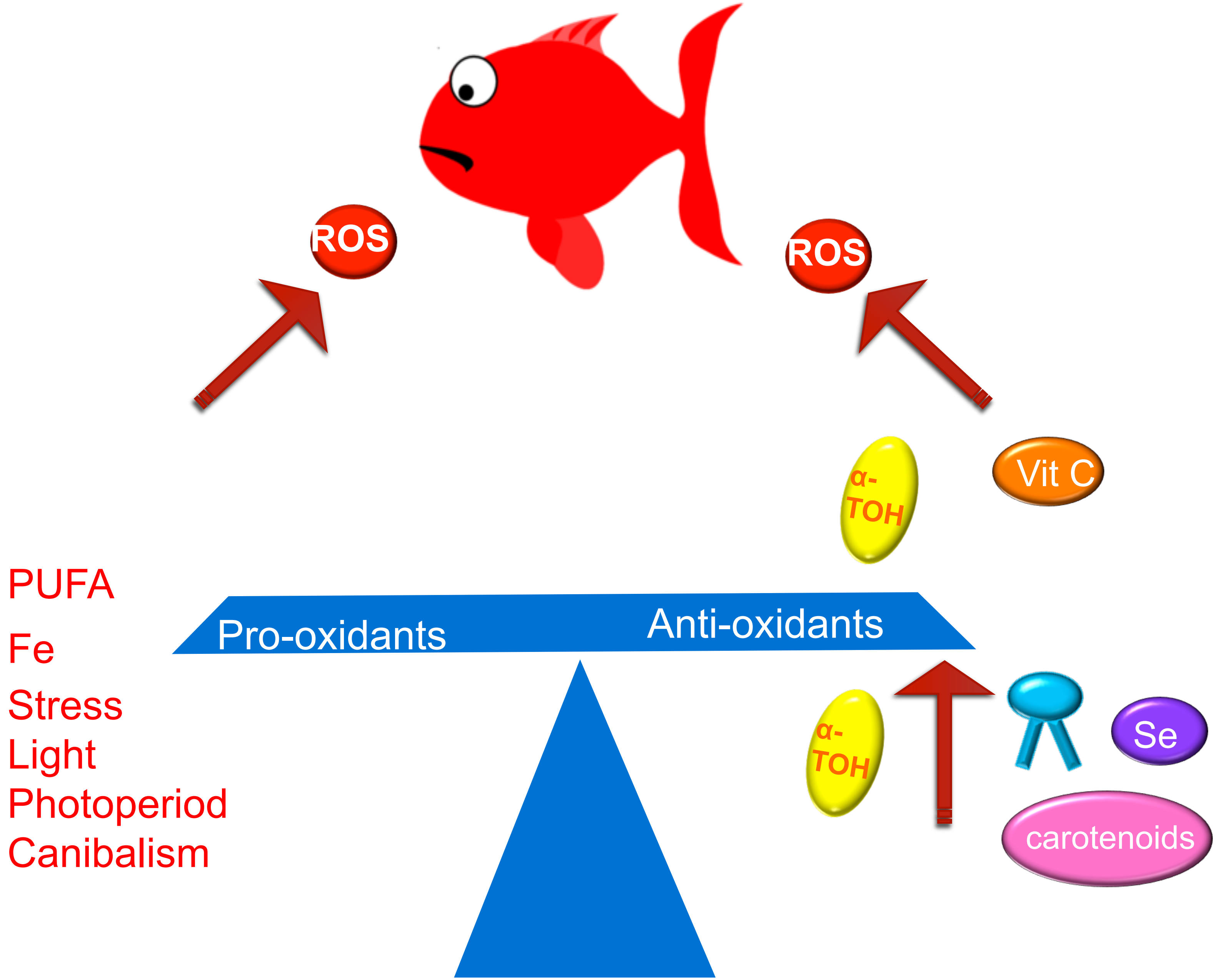




Marine fish larvae are under a high oxidation risk



- High metabolic rate & oxygen requirements
- High water content and water reabsorption at metamorphosis
- High PUFA requirements
- Lipid content and lipid mobilization from yolk sac
- Feed with high surface/volume
- Long water exposure of feed…


ROS
ROS
α-TOH
Vit C
PUFA
Fe
Stress
Light
Photoperiod
Canibalism
Pro-oxidants
Anti-oxidants
α-TOH
Se
carotenoids

Task 8.1

	0.5/150/ 180	0.5/300/ 180	0.5/300/ 360
Basal ingredients	90.00	69.00	69.00
Fish oil	0.00	0.00	0.00
Oleic acid	10.00	10.00	10.00
VIT E (mg/kg)	150.00	300.00	300.00
VIT C (mg/kg)	180.00	180.00	360.00

The optimum levels of essential fatty acids and related micronutrients. Task 8.1

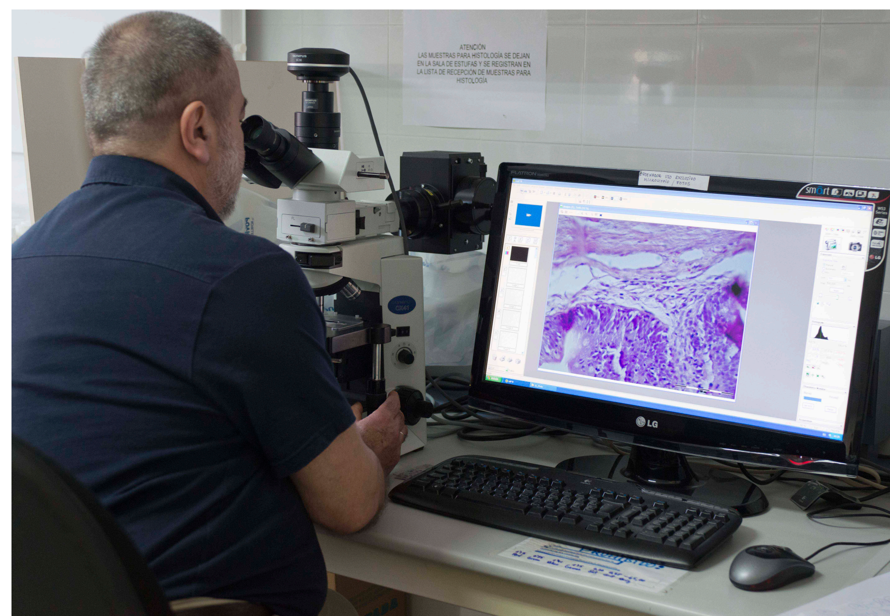
The importance of dietary HUFA for meager larvae and its relation with antioxidant vitamins (started May 2014)

- Fish origin: induced spawning broodstock (FCPCT-GIA)
- Six weaning diets different n-3 HUFA/vit E/Vit C. Triplicates. 18 tanks.
- Weaning conditions: Tanks 200L, Water temperature 23.21±0.20 °C, flowing rate rate of 8%/ h, aeration 125 ml min-1. DO2 5.26±0.28 mg. Photoperiod 12 h light. Manual feeding 14 times/day. Daily feed 1.5-2 g/tank
- Duration of trial: until significant differences 15 days

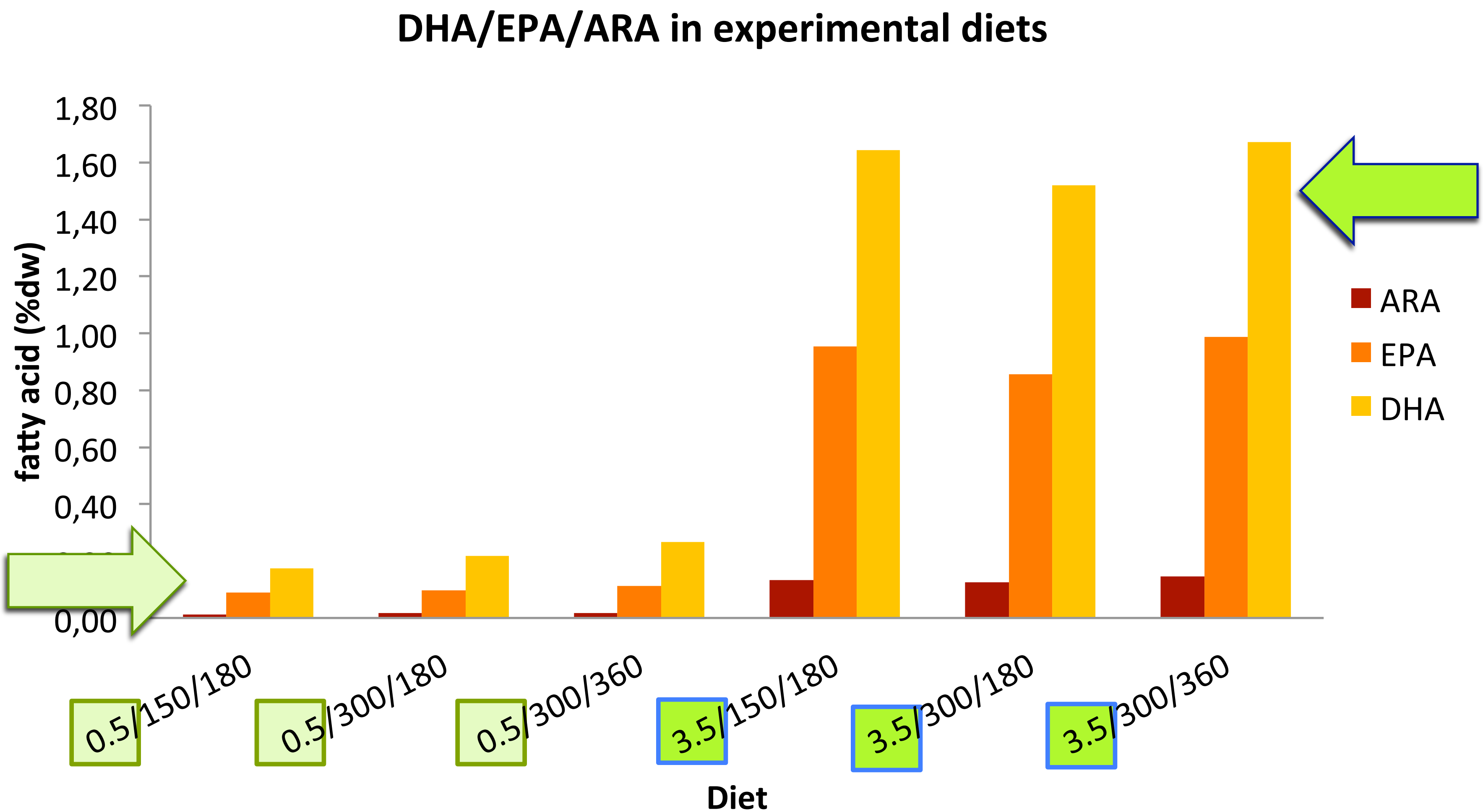
The optimum levels of essential fatty acids and related micronutrients. Task 8.1

The importance of dietary HUFA for meager larvae and its relation with antioxidant vitamins (started May 2014)

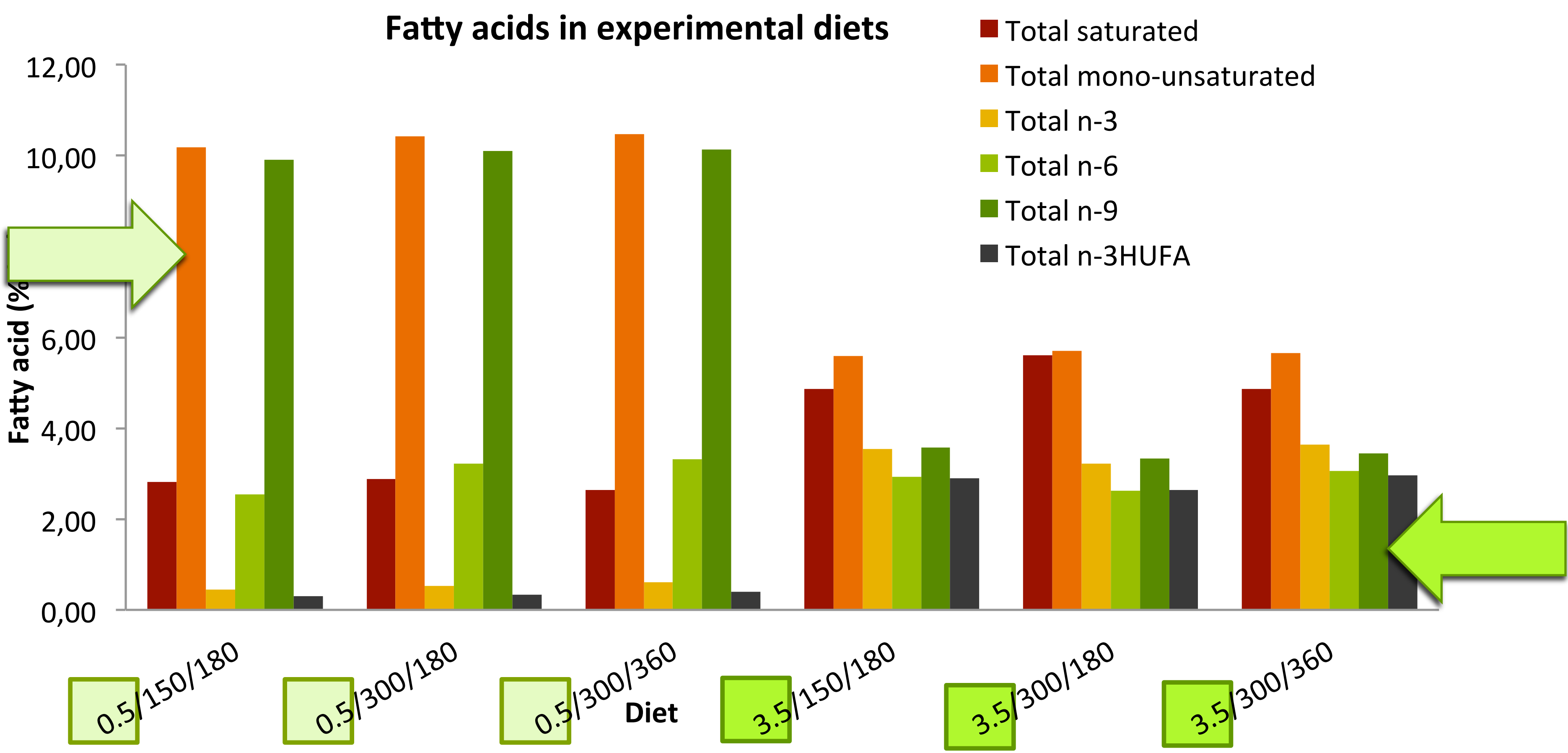
- Culture performance (Survival, weight), morphometric parameters (Total length), gut occupancy, larval organ (haematoxilin-eosine) and skeleton development (Alizarine red), and biochemical composition (FCPCT).
- Welfare status (FCPCT), specific fish behaviour (DTU) and digestive enzymes (ULL) will be studied.



Diet composition showed two n-3 HUFA levels Task 8.1

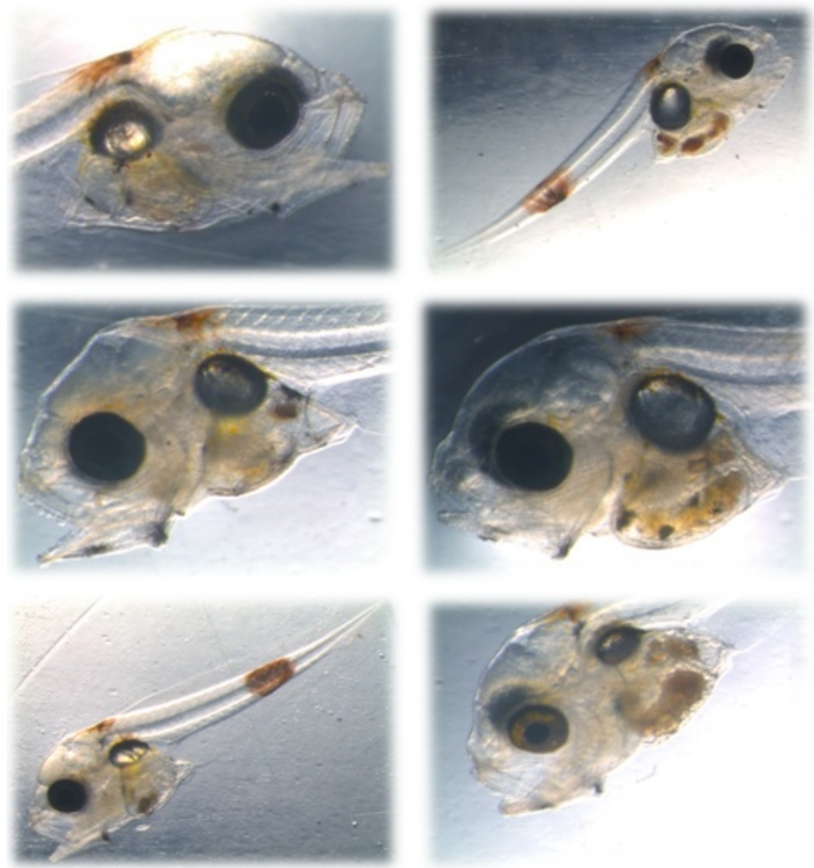


Diet composition reflected two different fatty acid profiles Task 8.1

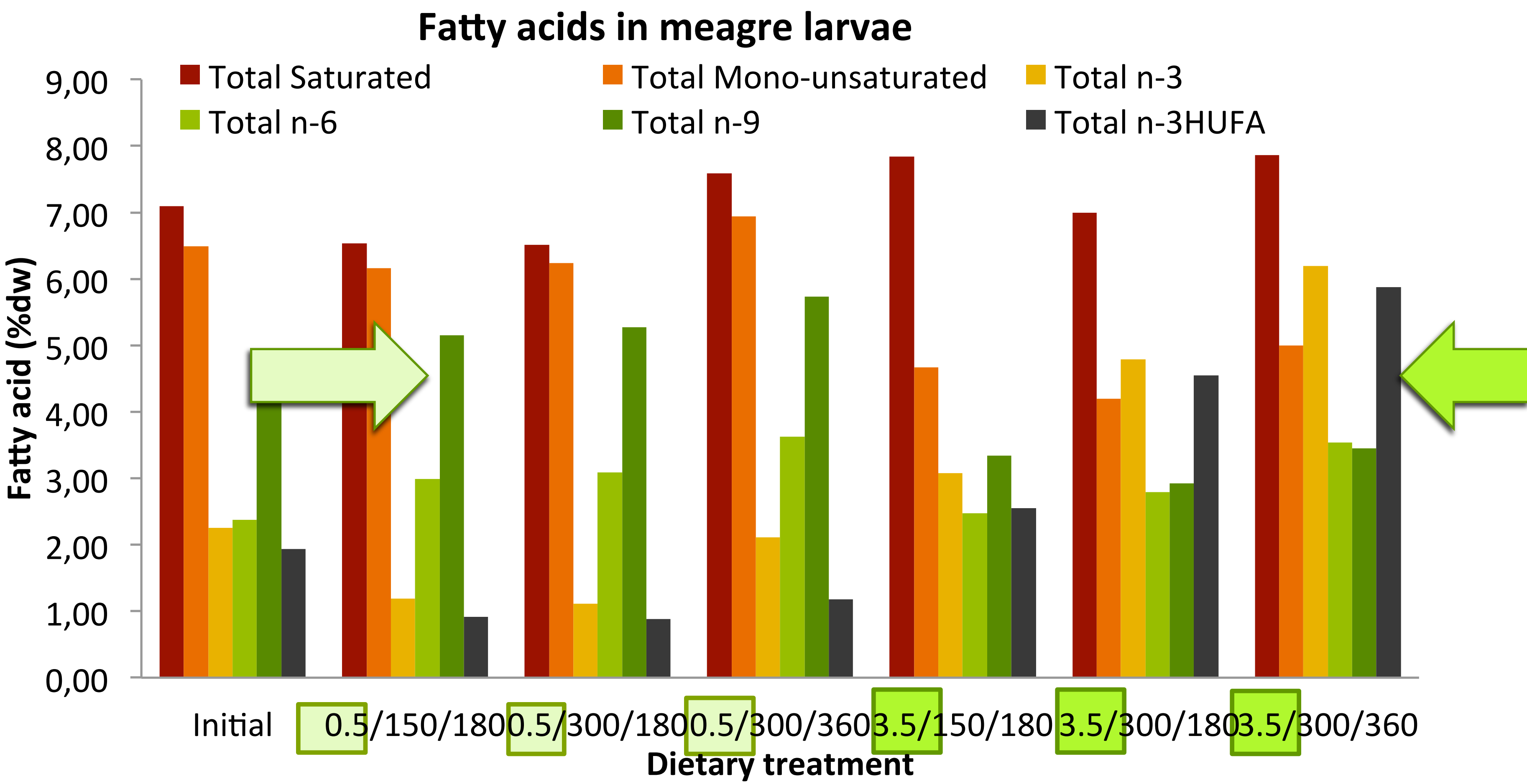


Good feed acceptance and growth with complete weaning at 15 dah . Task 8.1

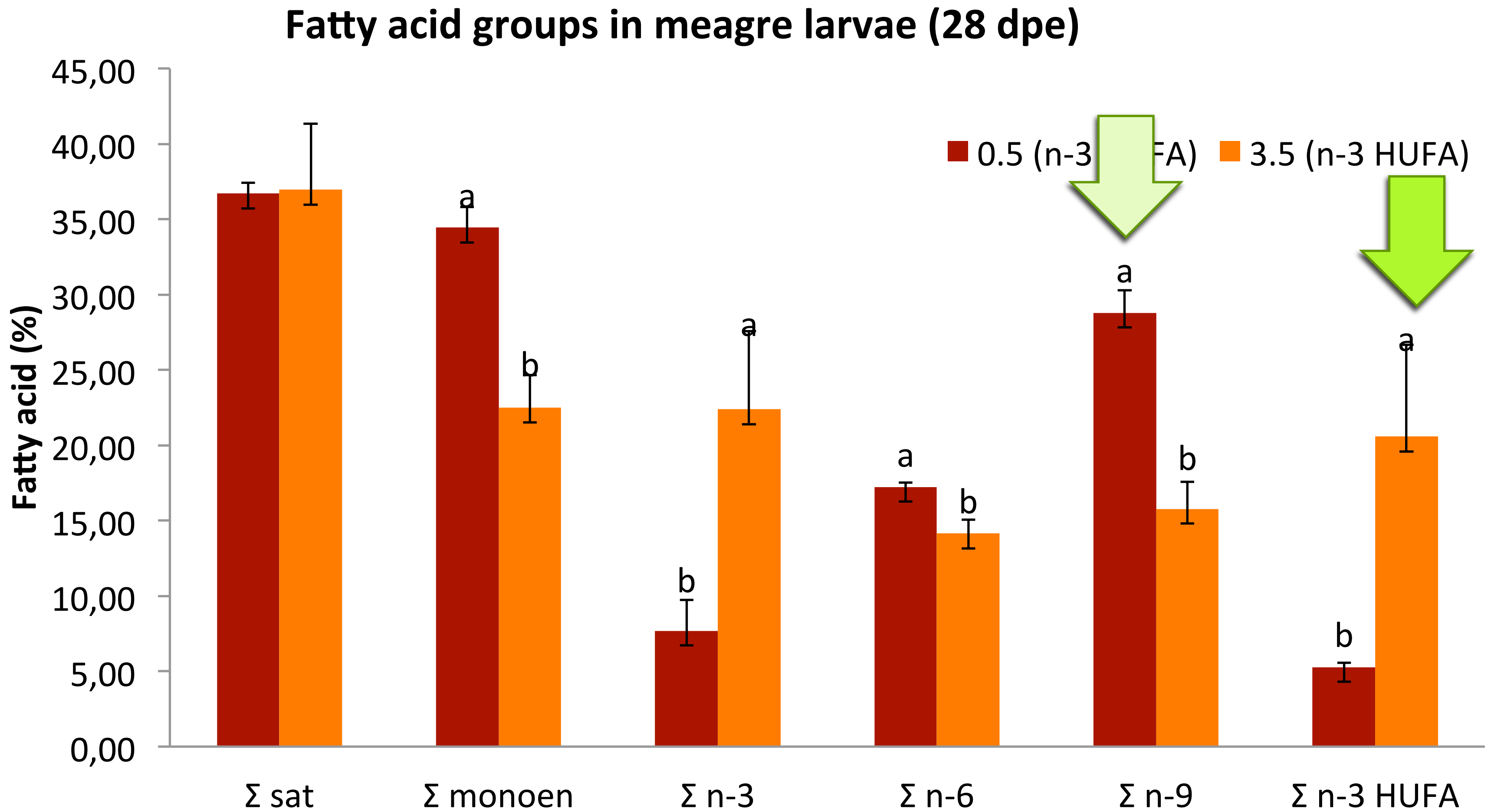
- Good diet acceptance
- Good daily growth (24% daily weight increase from initial weight) (similar to Hernández-Cruz et al., 2007)
- Reasonable survival (12-17%) in relation to complete weainning at 15 dah and experimental weaning diet composition



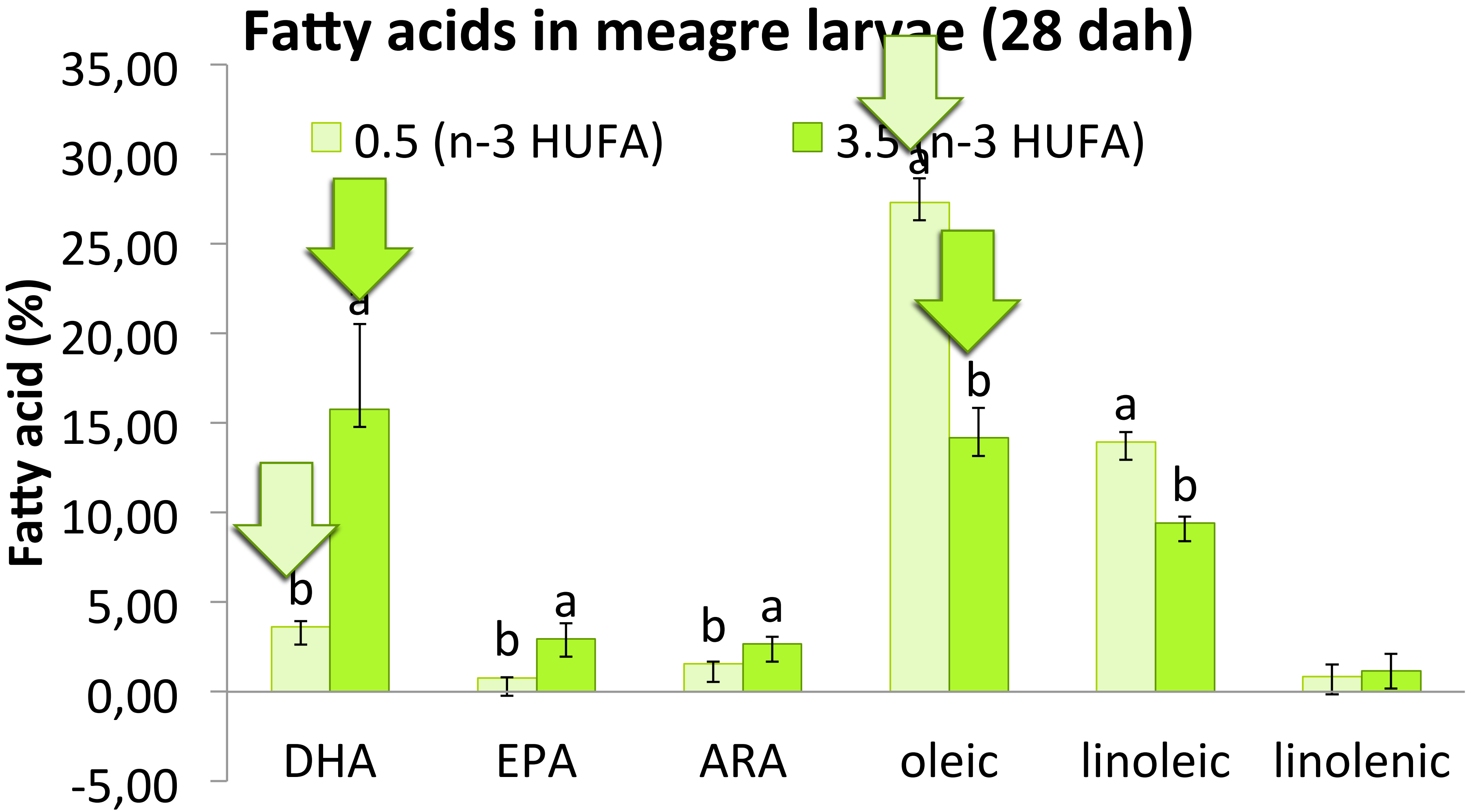
Fatty acid composition of the larvae reflected dietary fatty acids Task 8.1



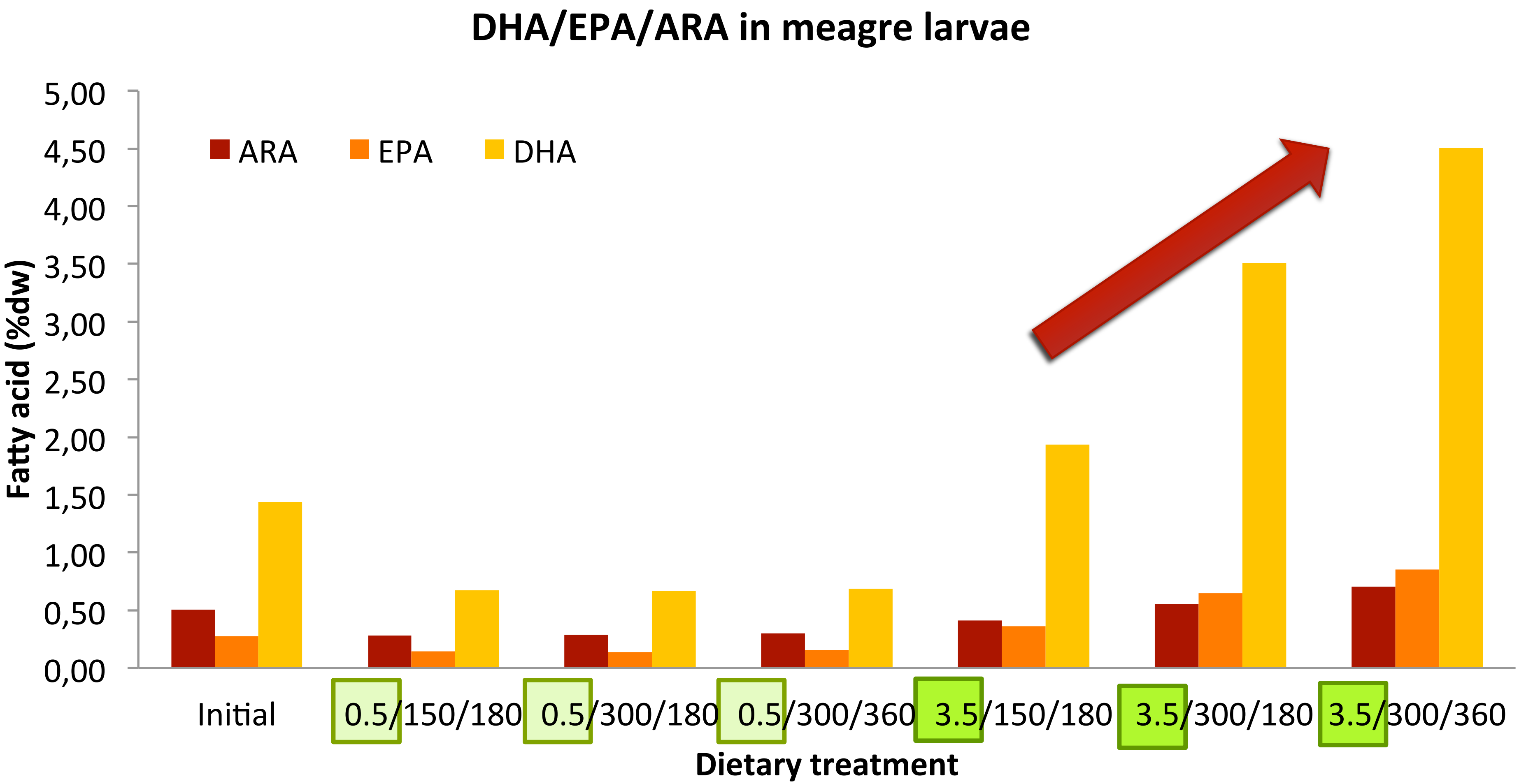
Larvae fed low n-3 HUFA had higher monoenoic and n-9 fatty acids Task 8.1



Larval composition reflected two different fatty acid profiles Task 8.1

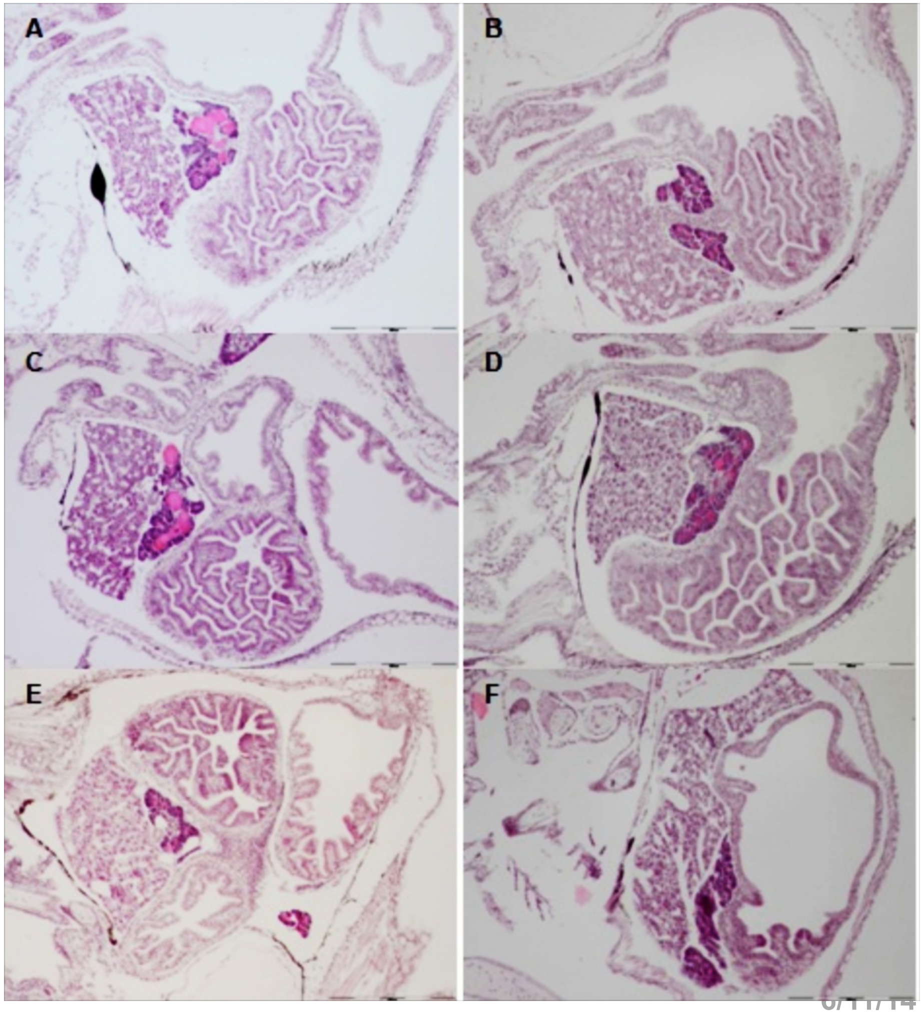


Increase in dietary vit E+Vit C increase DHA content in the larvae Task 8.1

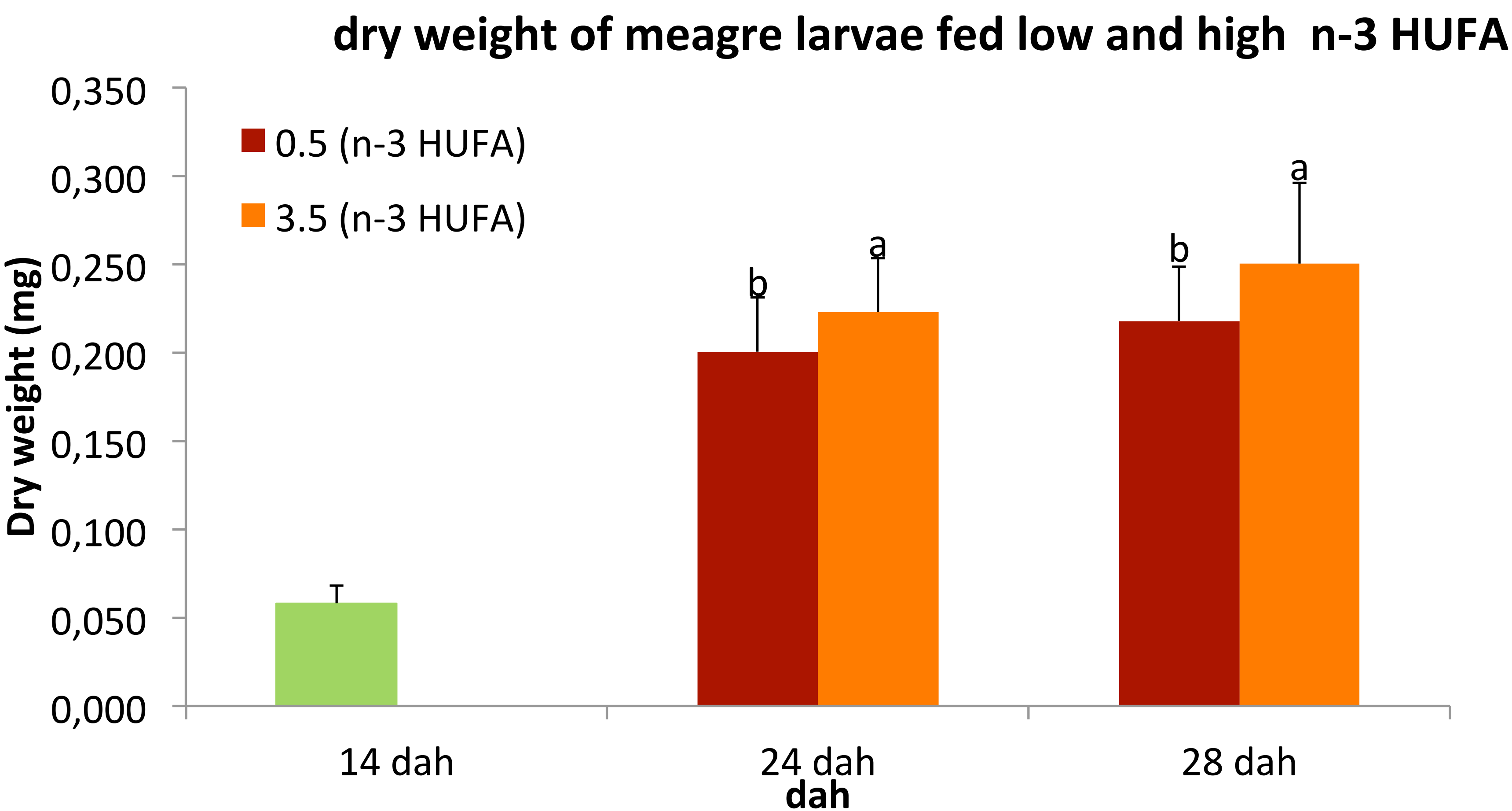


Reduced lipid absorption and deposition with low n-3 HUFA diets. Task 8.1

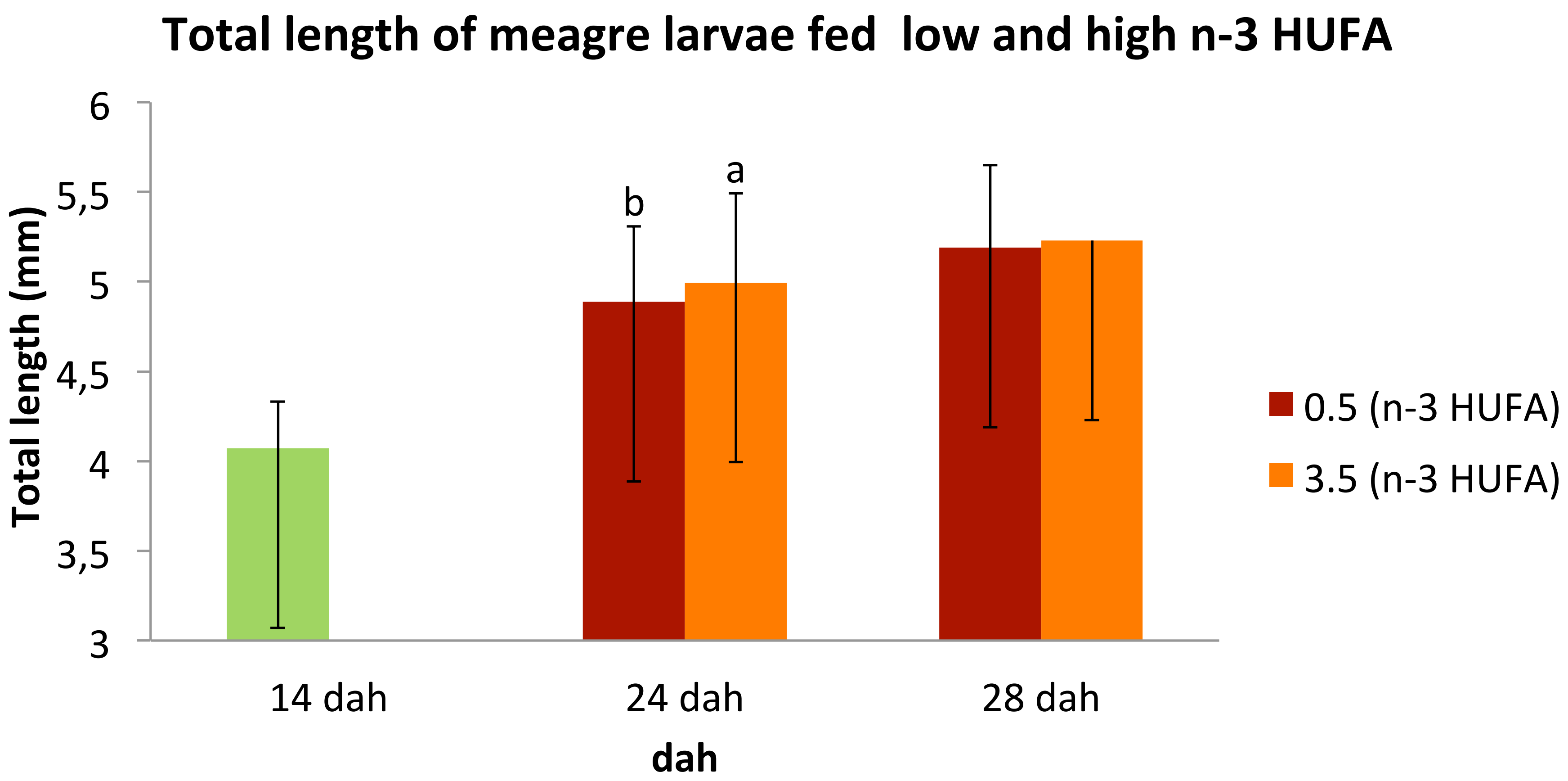
- Lower lipid vacuoles in intestine and liver of 0.5 (n-3 HUFA) larvae (in agreement to lower body lipid content suggesting lower fat absorption and accumulation, described for n-3 HUFA deficiency (Izquierdo et al., 2001)



Body weight improved by higher n-3 HUFA weaning diets. Task 8.1

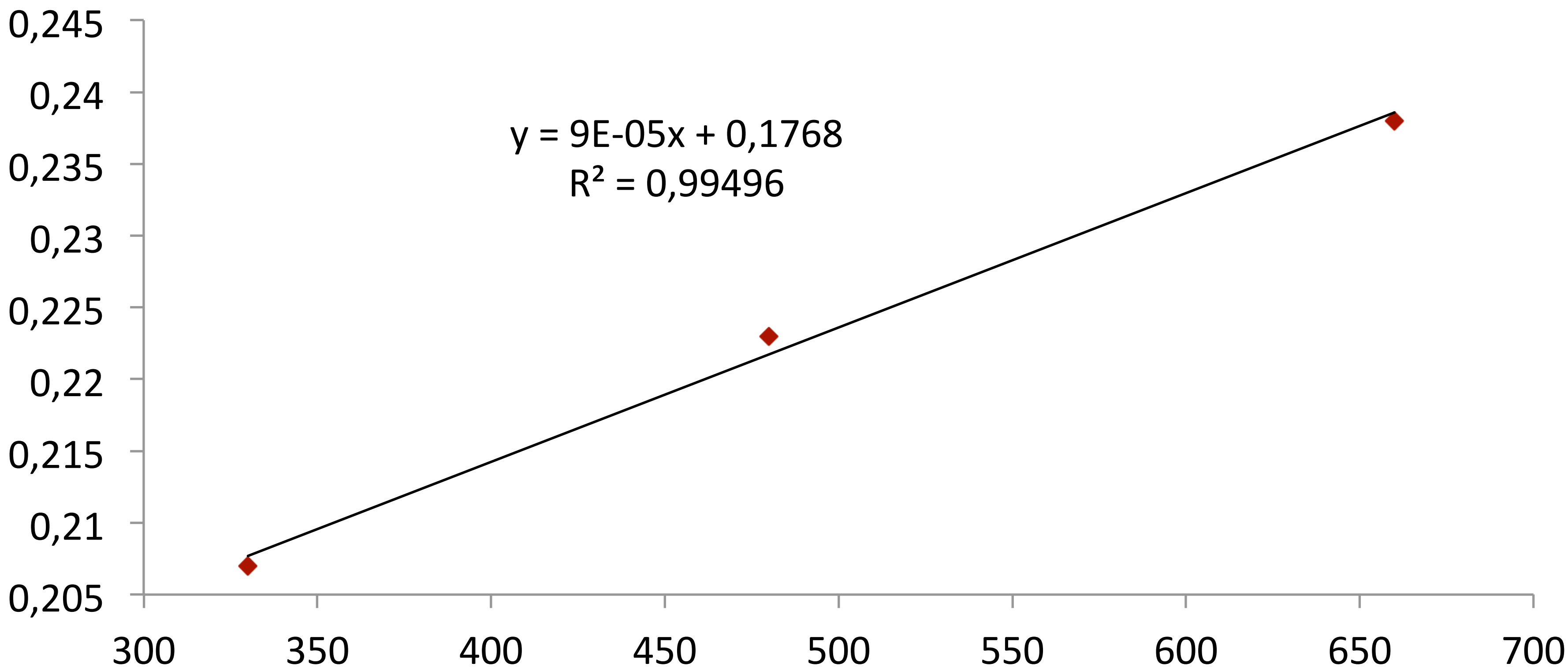


Fish length improved by higher n-3 HUFA weaning diets. Task 8.1

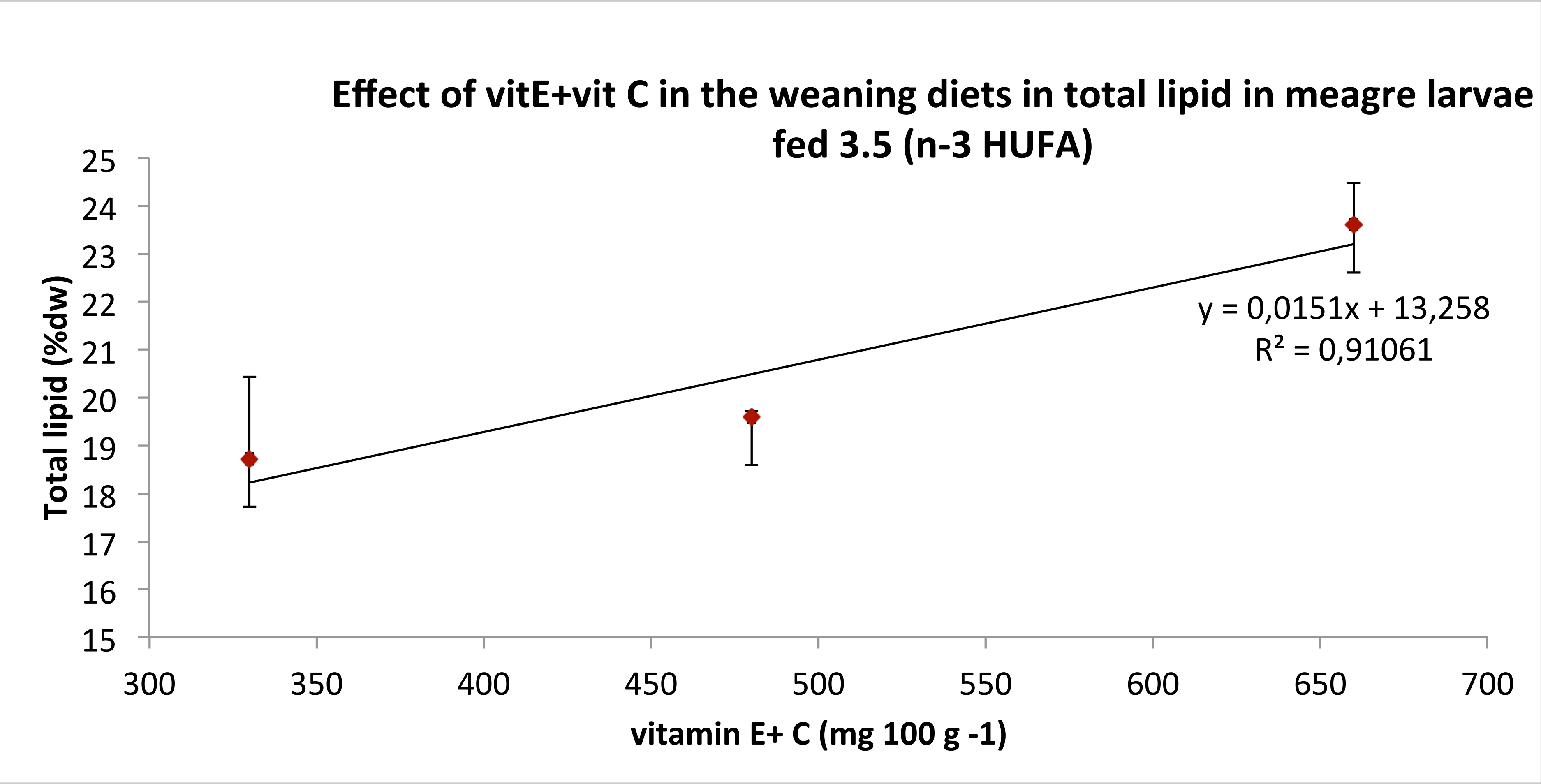


Body weight improved by increase in vit E +vit C weaning diets. Task 8.1

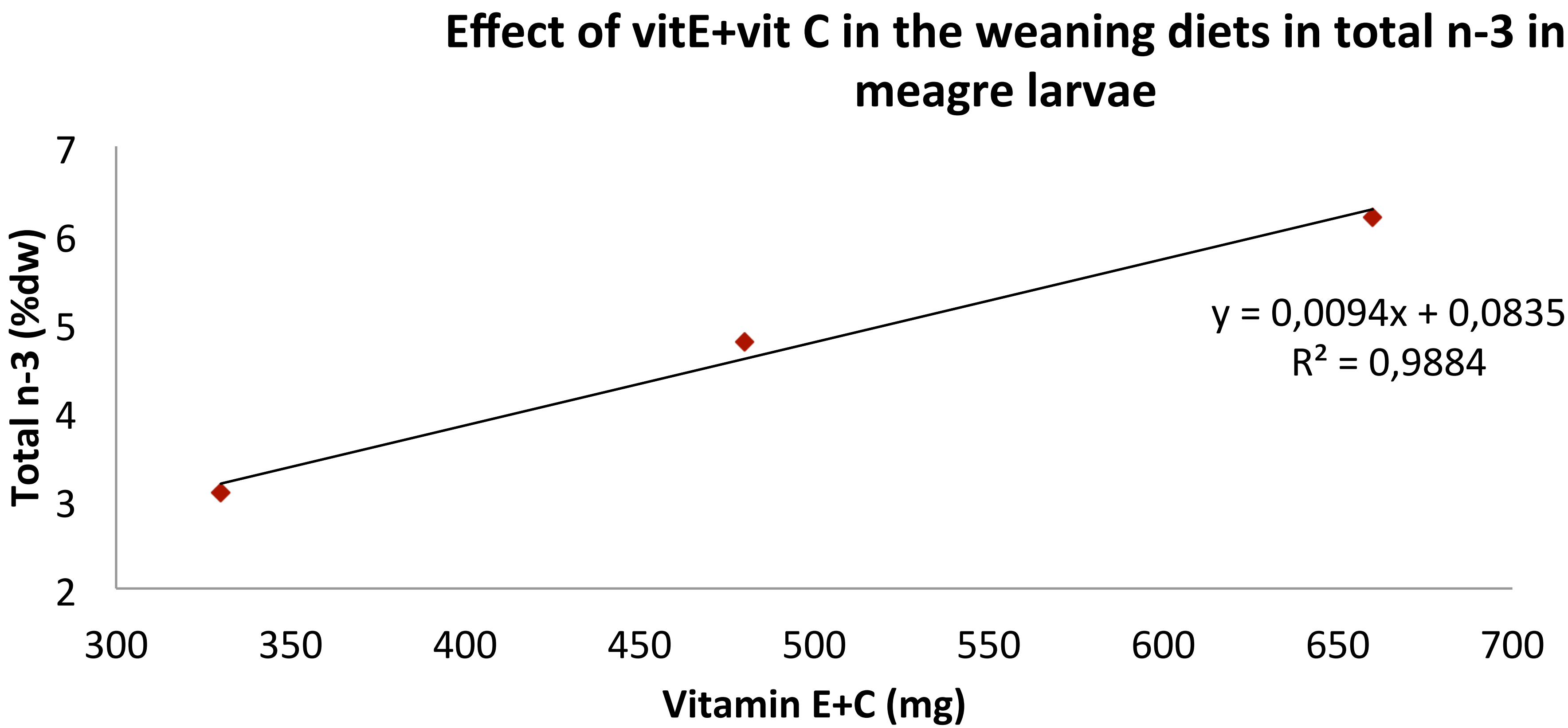
Effect of vitE+vit C in the weaning diets on dry body weight of 24 dah meagre larvae fed 3.5 n-3 HUFA



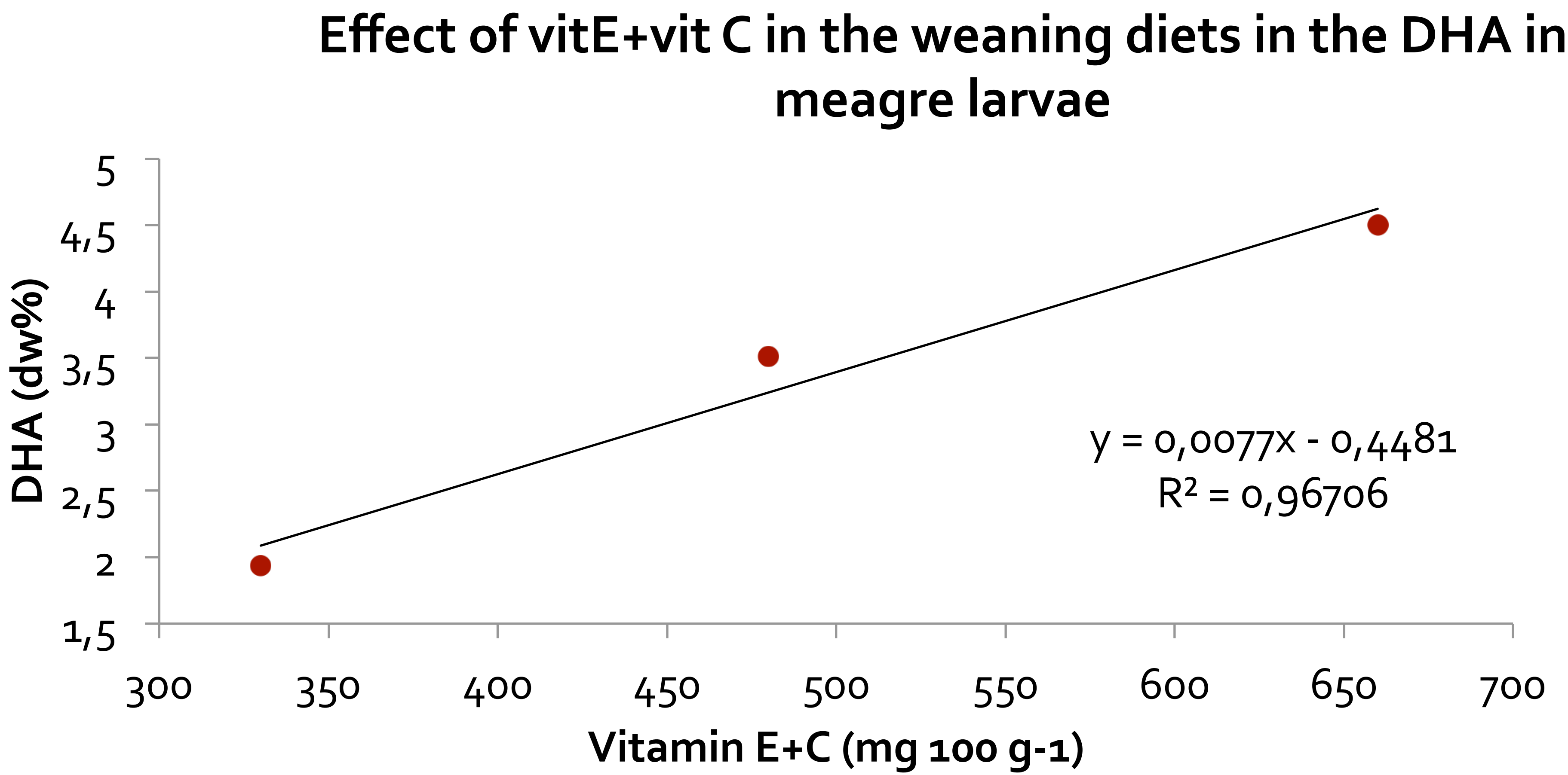
Total length weight improved by increase in vit E +vit C weaning diets. Task 8.1



Total larval n-3 HUFA improved by increase in vit E +vit C weaning diets. Task 8.1



Larval DHA content improved by increase in vit E +vit C weaning diets. Task 8.1



Conclusions Task 8.1

- Low larval growth and larval n-3 HUFA with low HUFA content (0.5% dw) denote deficiency (Izquierdo and Koven, 2011)
- Increase n-3 HUFA up to 3% improved lipid absorption and deposition, n-3 HUFA levels in larvae and larval growth, confirming the high requirement (Hernandez-Cruz et al.,2010).
- Increase in vit E+vit C in diets containing 3.5% improved DHA and n-3 HUFA incorporation into larval tissues and growth in terms of length and body weight
- Welfare, behaviour and digestive enzymes activities to be analysed (FCPCT, DTU and ULL)

GWP Nutrition WP9 Amberjack 2014 Action Plan

- Task 9.1 Improve larval enrichment products to enhance production of larvae and juveniles (led by FCPCT).

Start in 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

- Task 9.2 Development of diets for grow-out of amberjack to maximize growth (

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

Fish being produced to start in 2015

- Task 9.3 Design adequate feeding regimes for broodstock to optimize reproduction (led by IEO).

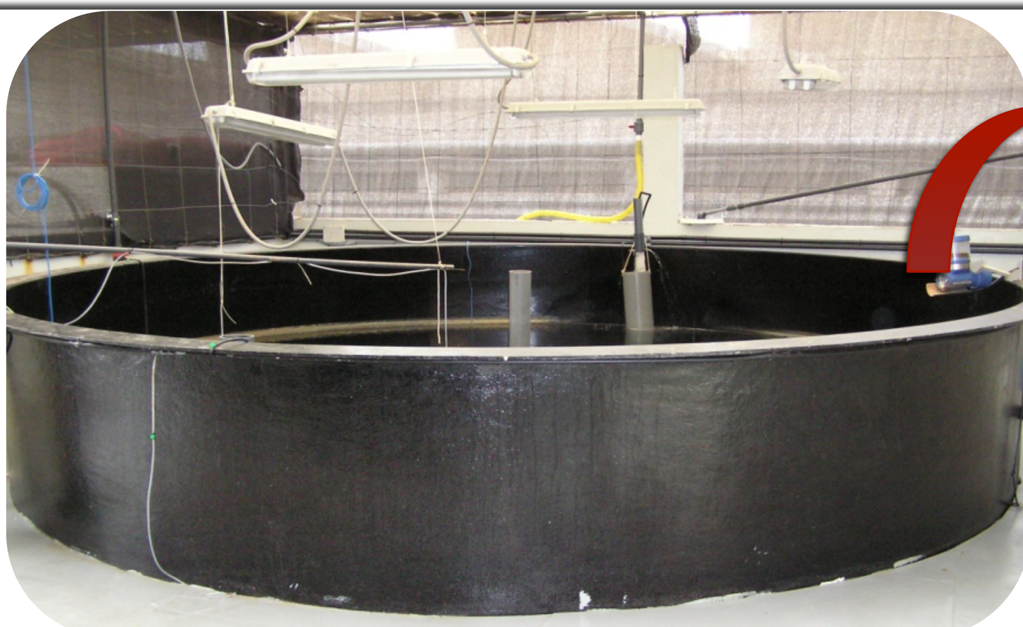
Diets discussed and in process of formulation

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

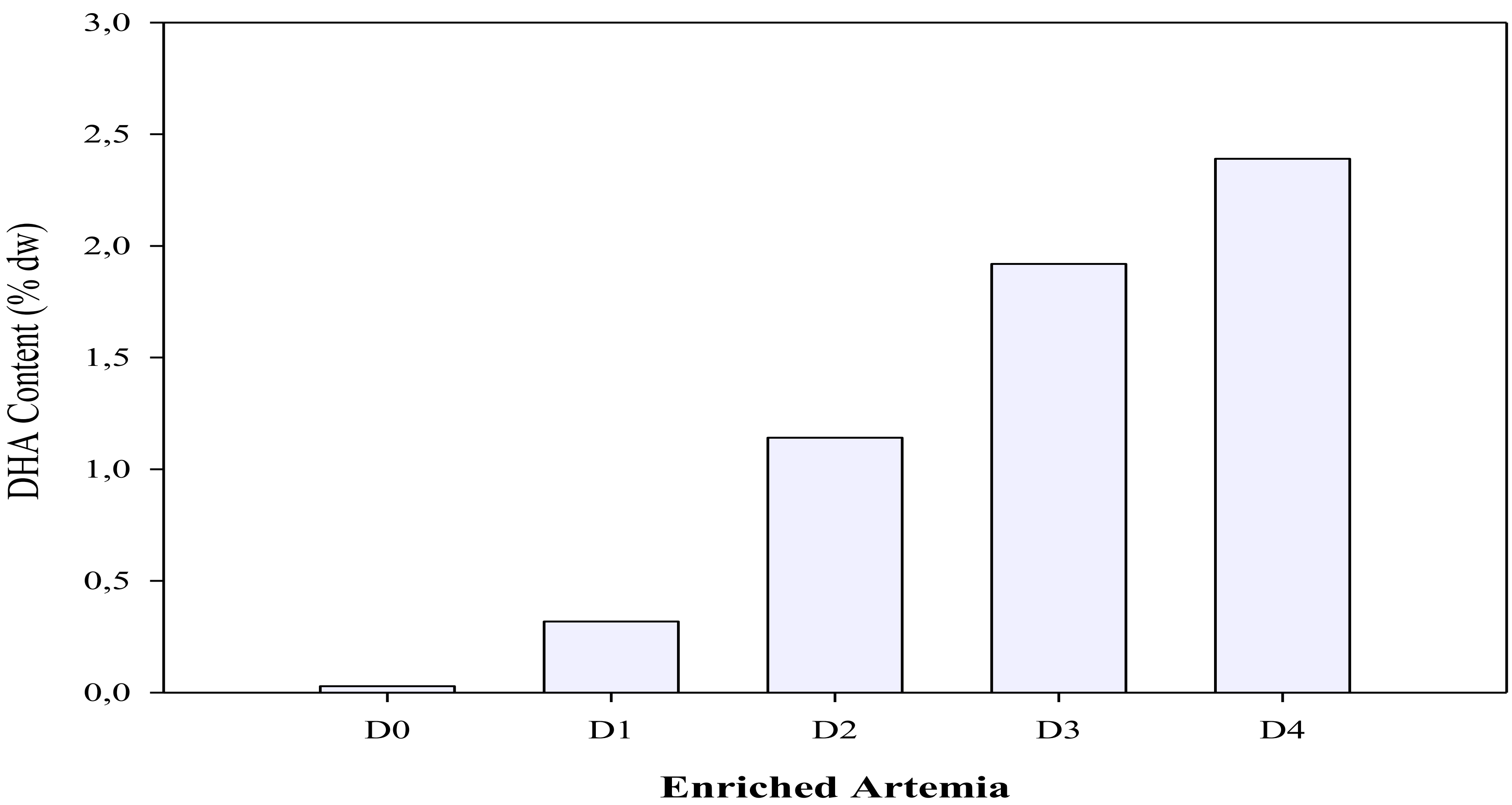
Optimum levels of essential fatty acids in enrichments for live preys. Task 9.1

- To determine the optimum levels of essential fatty acids in enrichment products
- Greater amberjack larvae were fed Artemia enriched with different levels of DHA (Trial 1) and EPA (Trial 2)
- Larval performance in terms of survival, growth and welfare (survival to handling stress test) was studied. Proximate and fatty acid composition of enrichment products, live preys and larvae will be analysed.

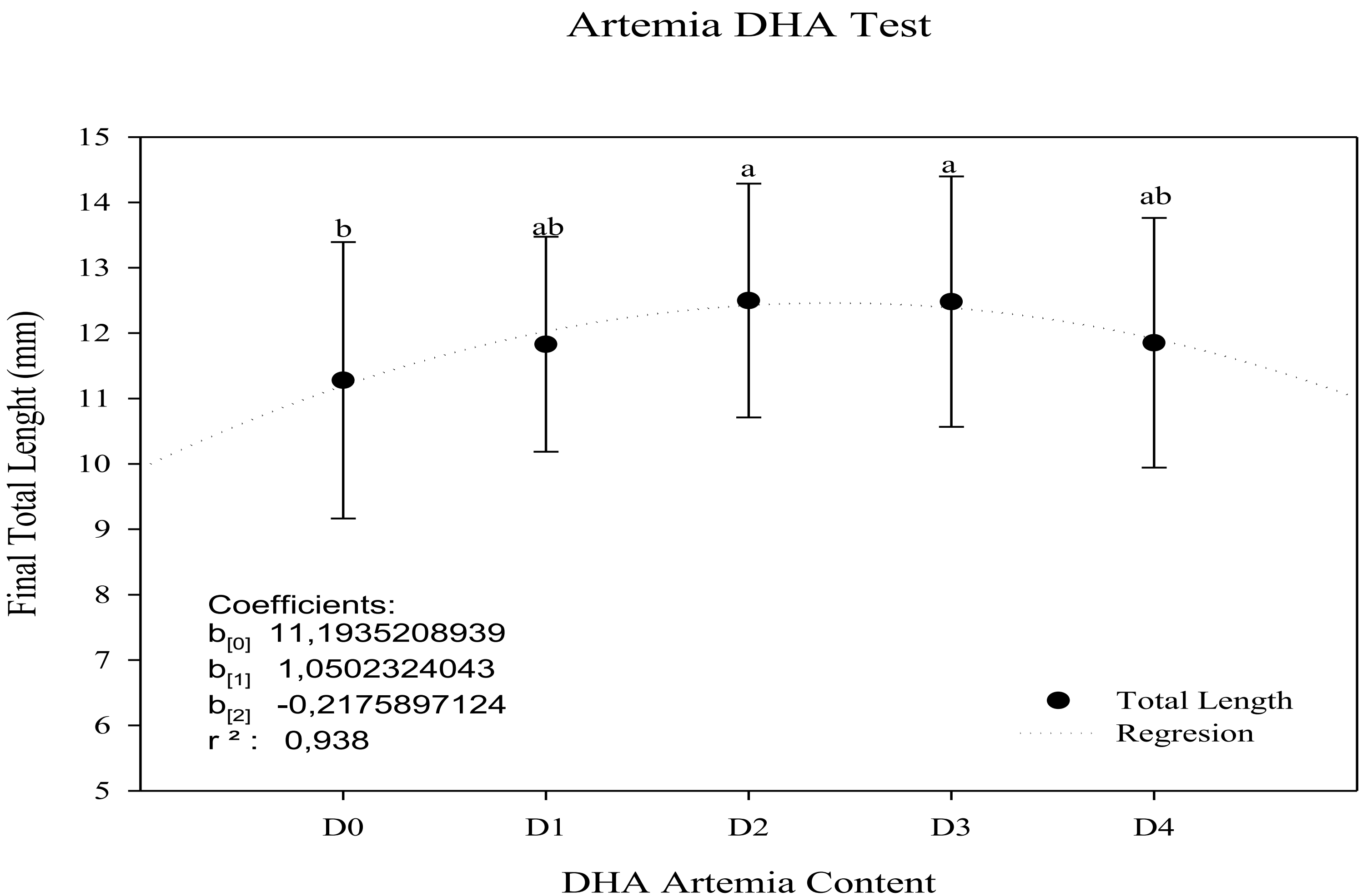
Optimum levels of essential fatty acids in enrichments for live preys. Task 9.1



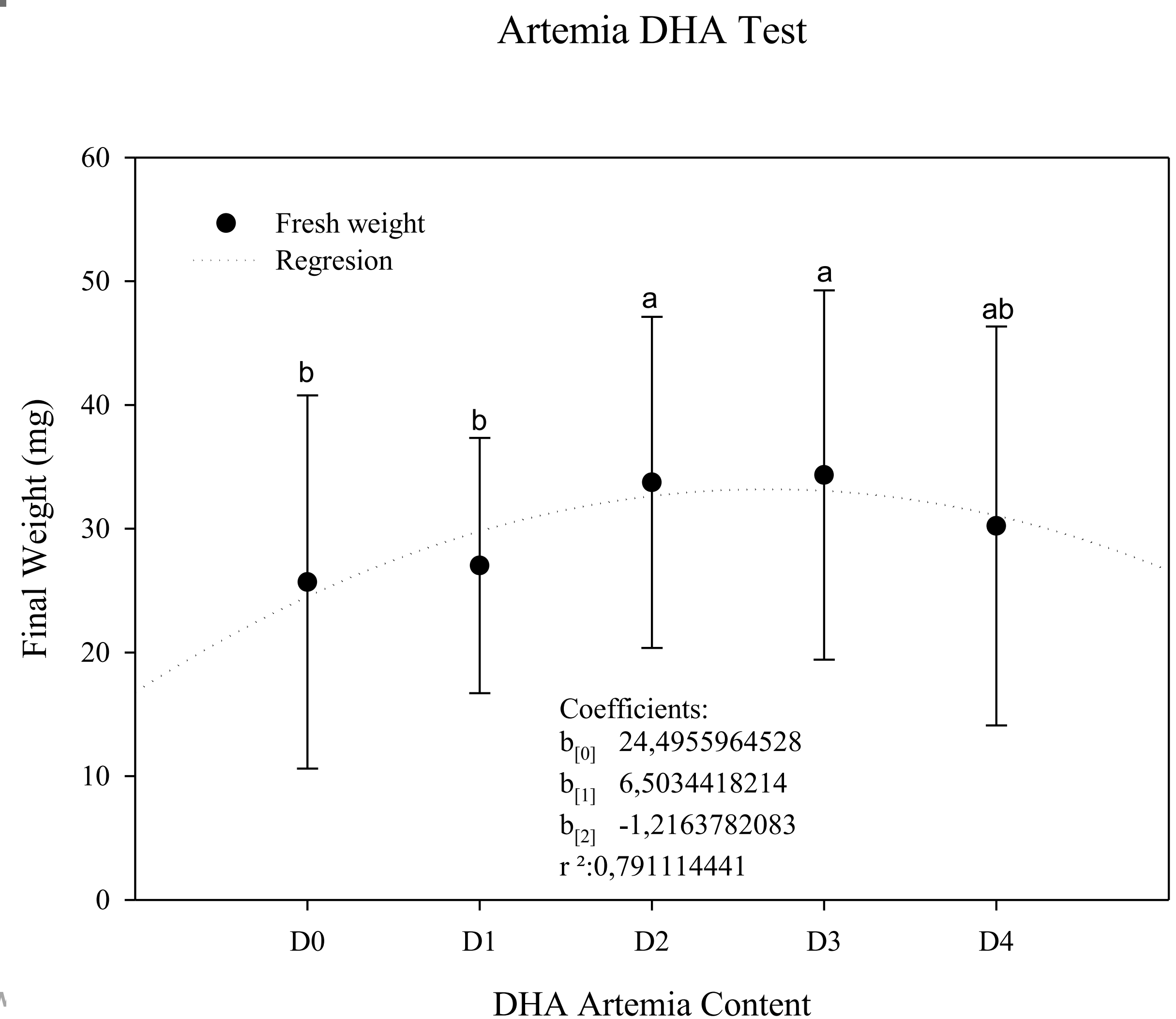
Artemia was succesfully enriched at 5 different levels. Task 9.1



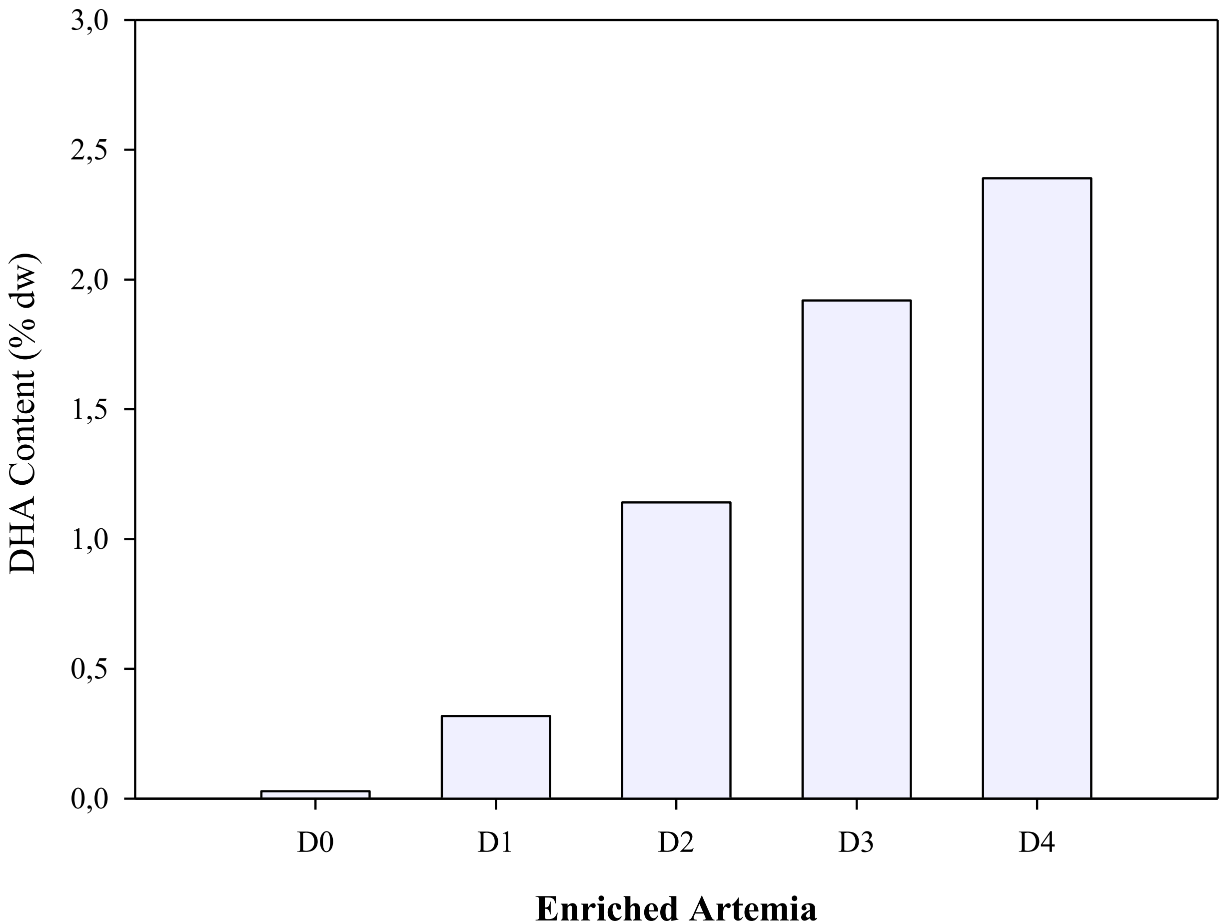
Larval total length was increased by dietary DHA elevation up to 1.5%. Task 9.1



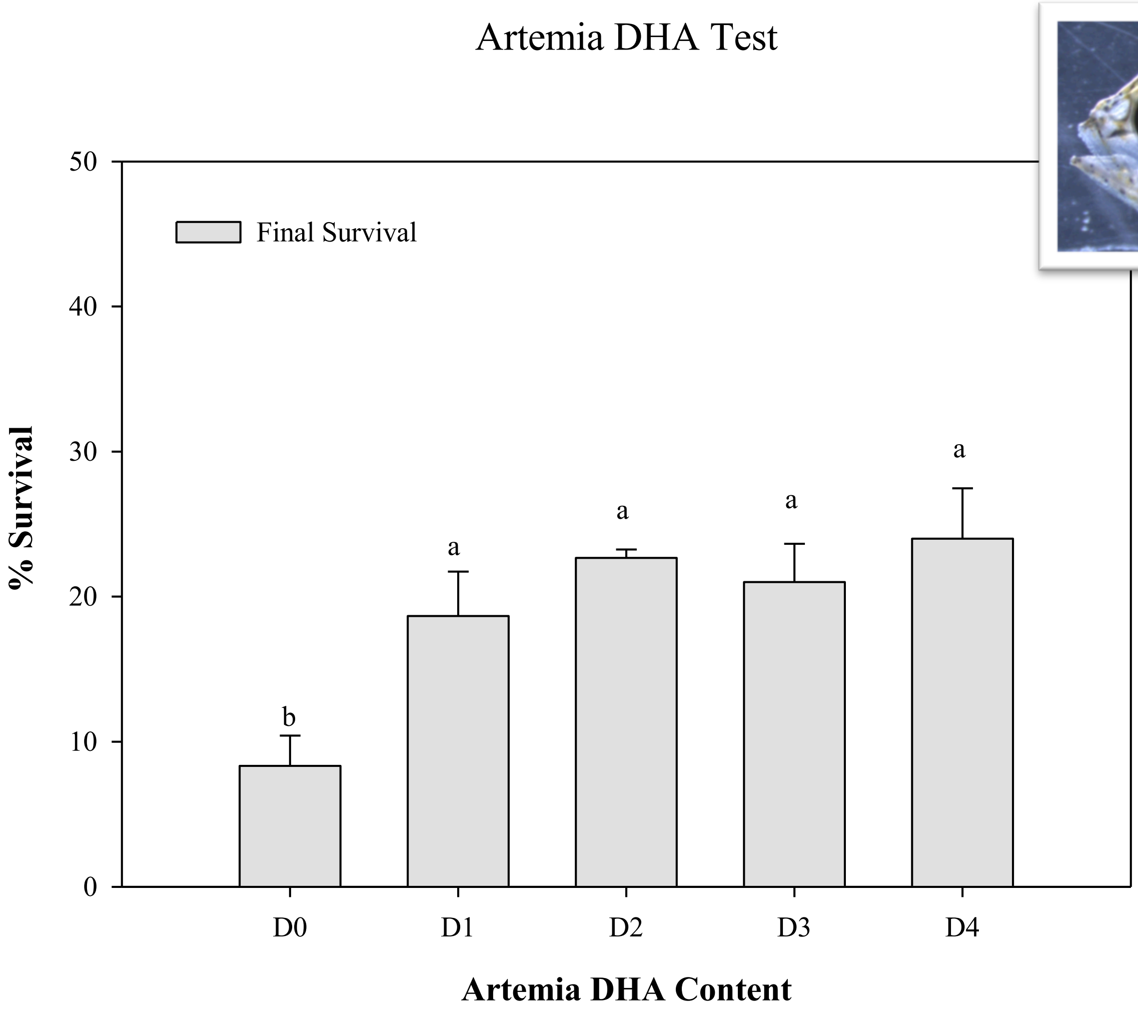
Larval body weight was increased by dietary DHA elevation up to 1.5%. Task 9.1

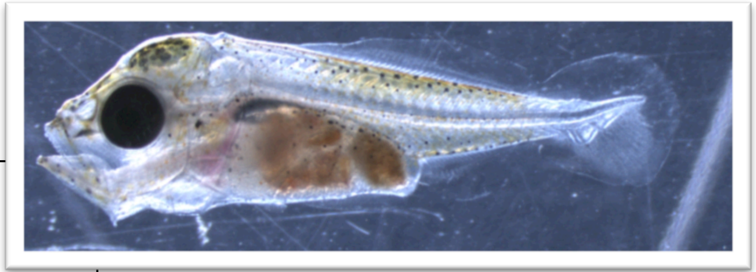


Larval DHA content increased proportionally to dietary DHA. Task 9.1

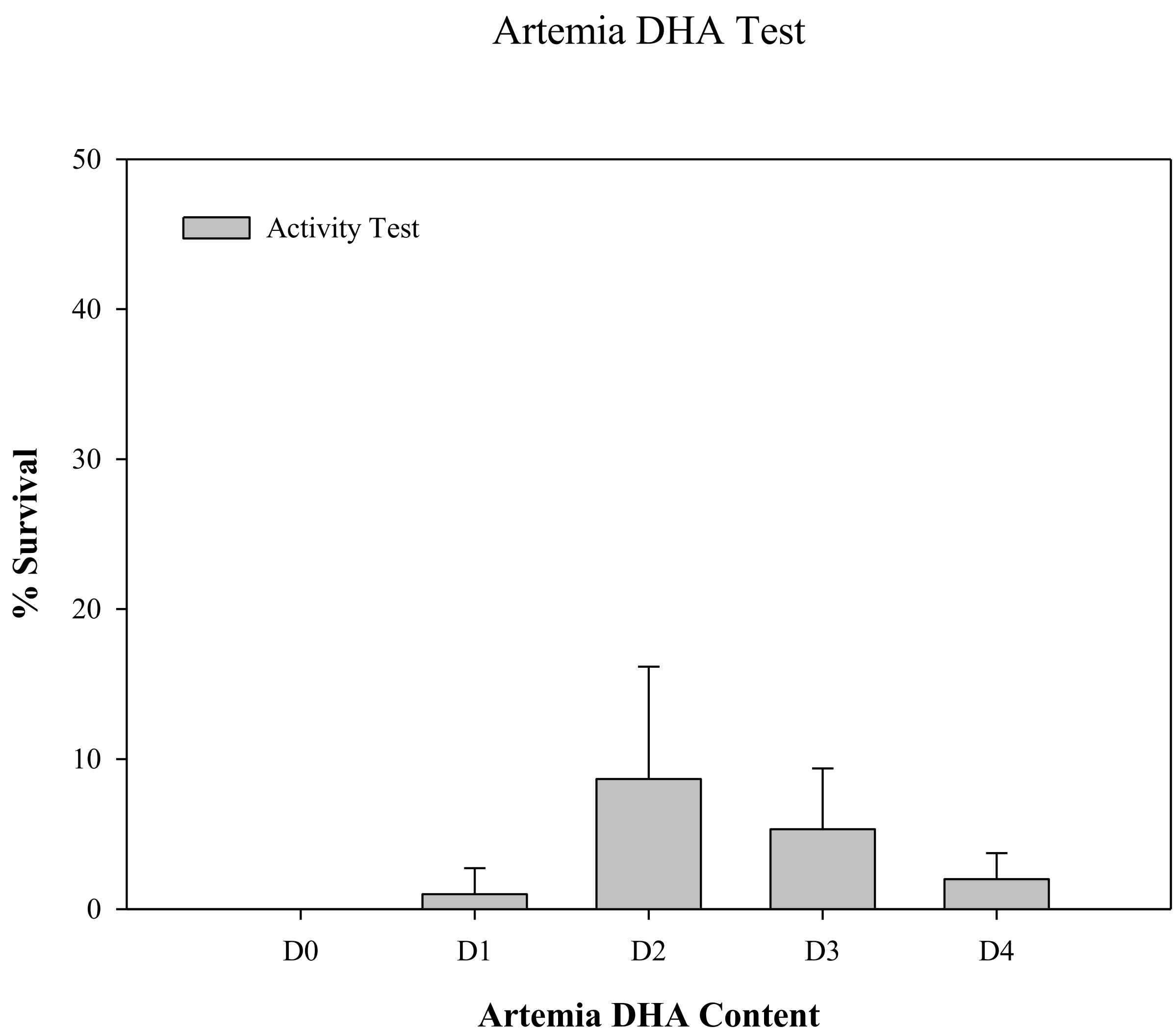


Larval survival was increased by dietary DHA elevation up to 1.5%. Task 9.1

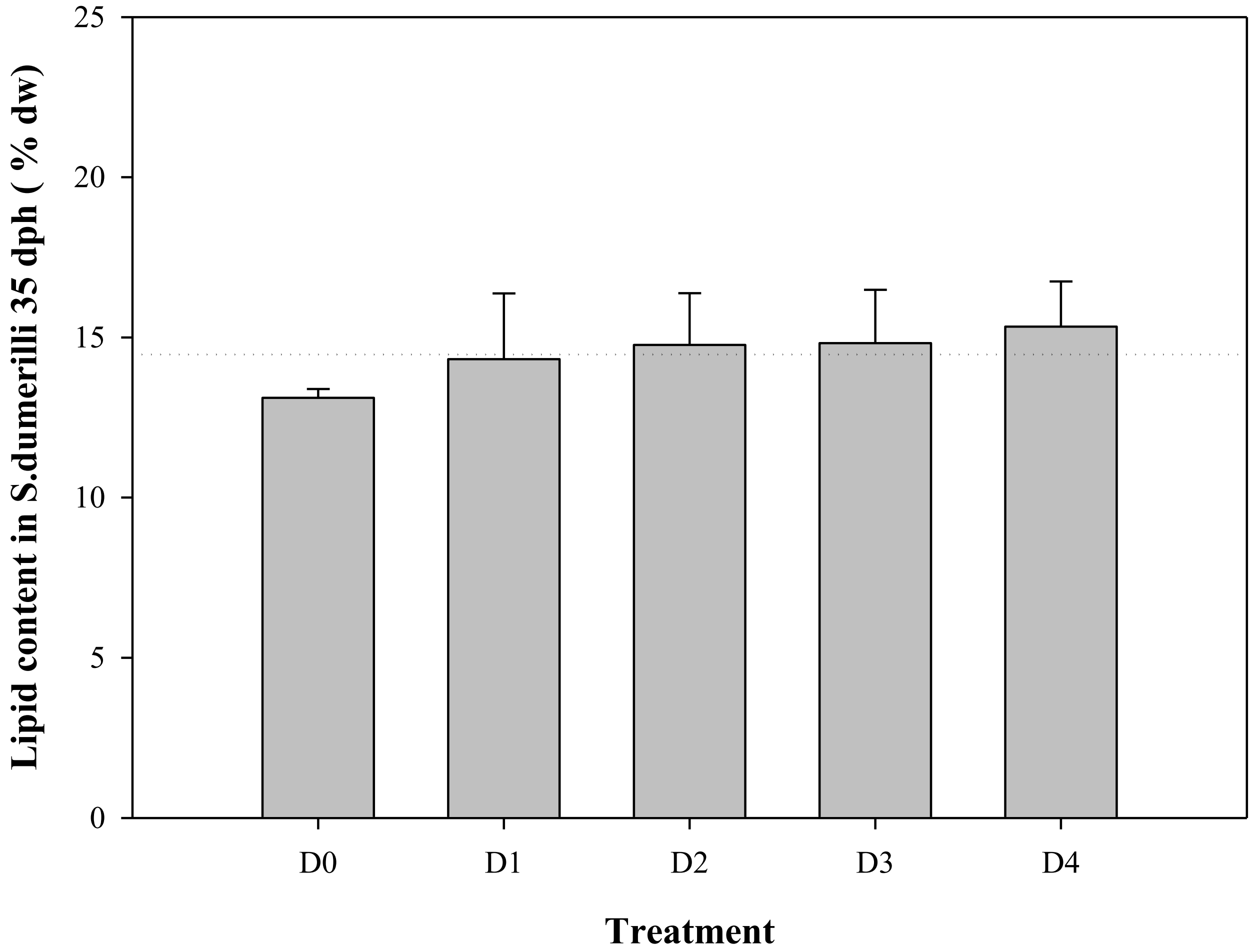




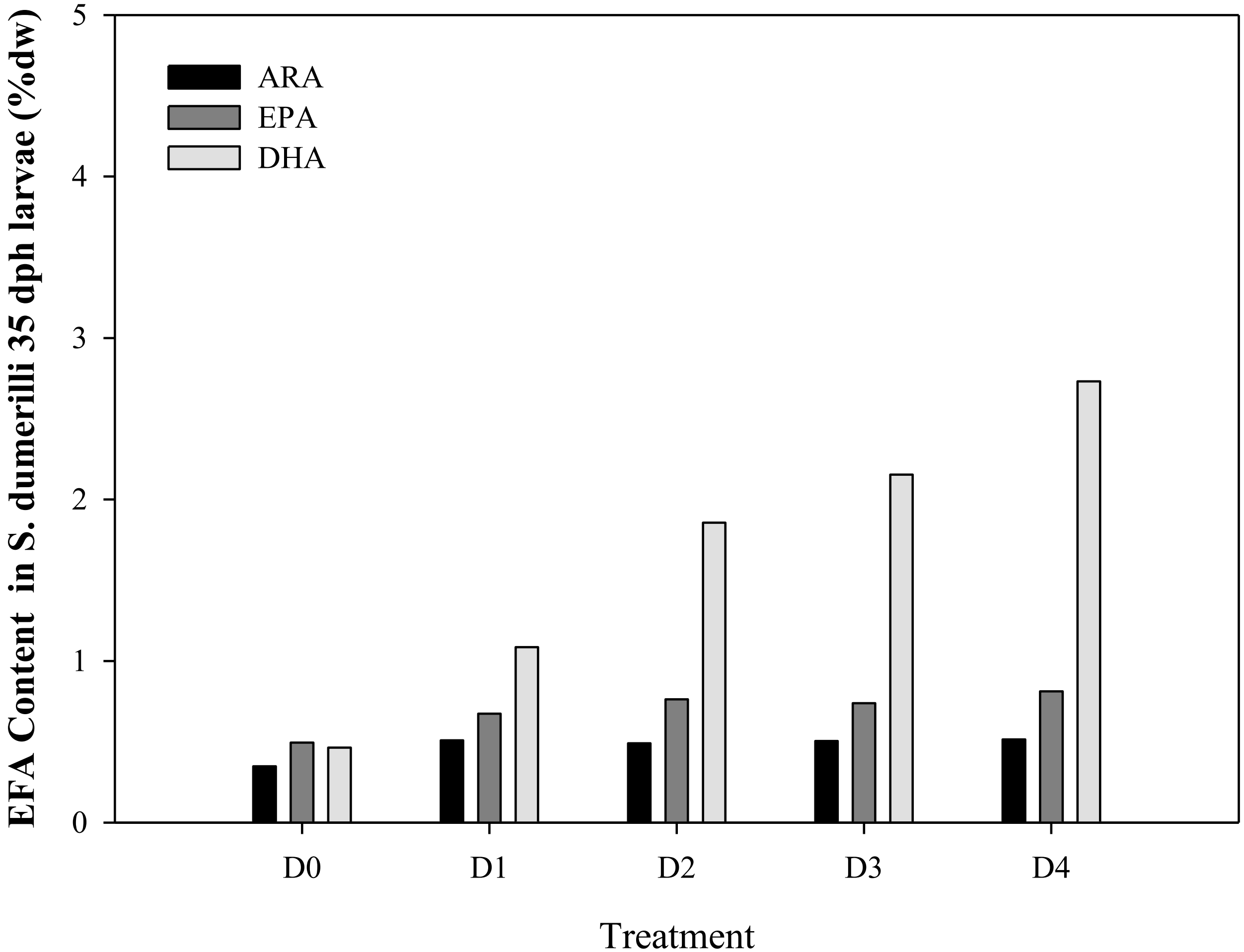
Survival after stress was increased by dietary DHA elevation up to 1.5%. Task 9.1



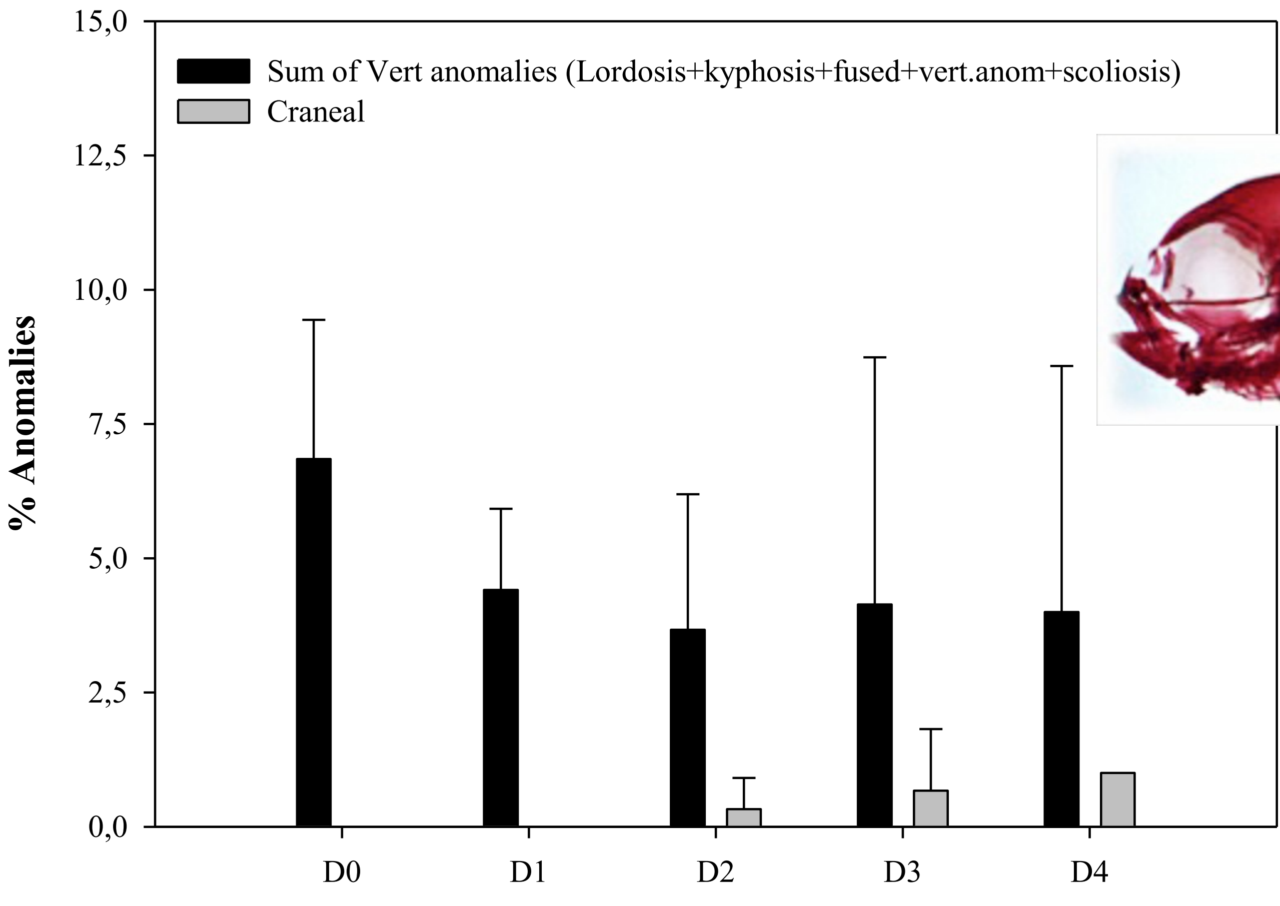
Larval lipid content was not affected by dietary DHA. Task 9.1

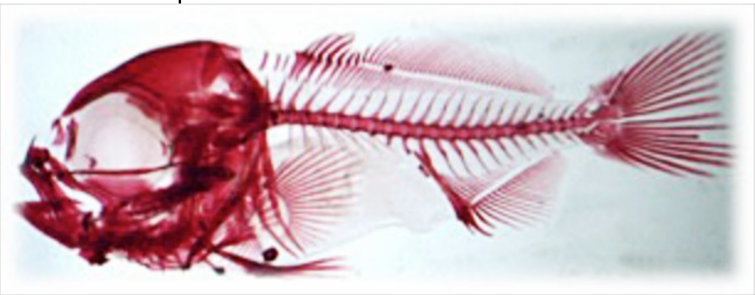


ARA and EPA contents were not affected by dietary DHA. Task 9.1



Vertebral anomalies were reduced by dietary DHA elevation up to 1.5% but further DHA increase raised cranial deformities. Task 9.1





Conclusions Task 9.1

- Optimum DHA levels in Artemia are around 1.5% to promote growth and survival and reduced the incidence of vertebral deformities
- Over 2% DHA contents in Artemia increase the incidence of cranial deformities and do not improve growth or survival

Progress made so far (until November 2014) Subtask 9.1.2

- Rotifer enrichment to establish a good protocol for LC-PUFA enrichment accordingly to the lipid composition of wild seriola viable eggs.
  - Four lipid enrichment treatments were tested by triplicate:
    - C: commercial enrichment product as control treatment
    - E1: 100% marine lecithin
    - E2: 30% marine lecithin + 50% DHA-rich TG oil + 20% cod liver oil
    - E3: 60% DHA-rich TG oil + 40% cod liver oil
  - Culture conditions: Tank volume: 10 l, continuous light and aeration, temperature 20ºC, initial density: 300 rot/ml., Sampling at 0, 3, 6, 10 and 24 hours for register: survival (%), ovigerous females (%), temperature (ºC), oxygen (% saturation), samples were collected and immediately frozen (-80ºC) until analysis of total lipid contents, lipid classes and fatty acid profiles

Progress made so far (until November 2014)
Subtask 9.1.2

Survival (%), ovigerous female (%), Temperature (ºC) and oxygen saturation (%) from the different experimental treatments (E1, E2 and E3) vs. control treatment (C) used to enrich live prey (rotifers).

C, commercial booster; **E1,** 80% commercial booster + 20% Echium oil; **E2,** 80% marine lecithin + 20% Echium oil; **E3,** 90% marine lecithin + 10% Echium oil. Different letters within a column denote significant differences among hours of enrichment for a dietary treatment; different numbers within a column denote significant differences among dietary treatments for a particular enrichment period (P<0.05).

Treat.	Time (h)	Survival (%)			Ovígerous (%)			Temp. (ºC)	Oxygen (%)		
C	0	100. ± 0.0	a		14.2 ± 0.0			22.2 ± 0.1	95.1 ± 0.7	a	
	3	72.0 ± 8.0	bc	2	10.9 ± 2.4		12	22.6 ± 0.0	81.5 ± 0.7	ab	
	6	74.4 ± 3.2	b	1	9.8 ± 2.3		1	22.8 ± 0.0	81.5 ± 2.1	ab	
	10	60.1 ± 2.9	c	2	8.5 ± 1.9		1	22.9 ± 0.1	71.0 ± 8.7	b	
	24	66.8 ± 5.3	bc	1	9.8 ± 3.6		1	22.9 ± 0.2	73.2 ± 13.1	b	2
E1	0	100. ± 0.0	a		14.2 ± 0.0			22.1 ± 0.0	95.3 ± 1.0	a	
	3	79.3 ± 3.0	b	12	10.3 ± 2.1		12	22.8 ± 0.0	84.9 ± 3.6	b	
	6	76.6 ± 6.4	b	1	10.2 ± 2.5		1	22.9 ± 0.1	82.7 ± 2.9	b	
	10	68.7 ± 3.4	b	12	6.4 ± 1.9		1	23.0 ± 0.1	80.5 ± 3.1	b	
	24	78.4 ± 14.4	b	1	9.0 ± 4.2		1	23.0 ± 0.1	94.2 ± 2.1	a	1
E2	0	100. ± 0.0	a		14.2 ± 0.0			22.1 ± 0.0	95.0 ± 3.7	a	
	3	70.8 ± 1.5	b	2	9.7 ± 2.4	a	2	22.7 ± 0.1	83.8 ± 0.7	b	
	6	18.6 ± 4.9	c	2	1.7 ± 1.5	b	2	22.9 ± 0.1	83.0 ± 1.9	b	
	10	12.7 ± 5.2	c	3	0.0 ± 0.0	b	2	23.0 ± 0.1	76.4 ± 0.8	c	
	24	18.4 ± 1.4	c	2	8.5 ± 1.3	a	1	22.9 ± 0.0	94.6 ± 1.5	a	1
E3	0	100. ± 0.0	a		14.2 ± 0.0			22.1 ± 0.1	95.2 ± 1.1	a	
	3	80.1 ± 4.7	ab	1	15.6 ± 5.2	a	1	22.7 ± 0.1	84.5 ± 1.7	b	
	6	72.6 ± 5.2	ab	1	8.5 ± 1.5	ab	12	22.9 ± 0.1	81.3 ± 0.9	b	
	10	70.6 ± 15.7	ab	1	5.5 ± 4.1	b	12	22.9 ± 0.0	78.1 ± 3.4	b	
	24	50.7 ± 18.9	b	1	3.4 ± 1.3	b	2	22.8 ± 0.1	93.7 ± 4.5	a	1

Echyum oil and marine lecithin effectively increased ARA, EPA and DHA in rotifers after 6h. Subtask 9.1.2

Total lipid content (% DM) and main fatty acid composition of rotifers enriched with the control and experimental emulsions.

	C		E1		E2		E3	
	3 h	6 h	3 h	6h	3 h	6h	3 h	6 h
TL (% DW)	**12.73 ± 1.07 b**	**17.59 ± 0.08 B***	**19.95 ± 1.38 a**	**15.10 ± 0.23 B***	**19.95 ± 1.38 a**	**22.92 ± 0.83 A**	**12.68 ± 1.62 b**	**13.95 ± 1.44 B**
20:4n-6	1.22 ± 0.07 d	1.62 ± 0.04 D*	7.35 ± 0.02 a	8.36 ± 0.21 A*	4.79 ± 0.42 b	4.66 ± 0.15 B*	3.83 ± 0.30 c	3.79 ± 0.41 C*
20:5n-3	2.27 ± 0.16 c	3.21 ± 0.22 D*	8.01 ± 0.19 a	9.28 ±0.09 A*	8.55 ± 0.33 a	8.44 ± 0.31 B	4.79 ± 0.28 b	5.76 ± 0.11 C*
22:6n-3	13.54 ± 0.46 c	19.10 ± 0.73 B*	17.41 ± 0.48 b	20.35 ± 0.08 B*	31.87 ± 0.45 a	32.10 ± 1.25 A	16.11 ± 1.95 bc	19.08 ± 1.32 B*
Total n-3 HUFA	16.76 ± 0.63 d	23.51 ± 0.99 D*	25.92 ± 0.60 b	30.45 ± 0.15 B*	42.91 ± 0.77 a	42.71 ± 1.60 A	21.86 ±2.34 c	26.91 ± 1.27 C*
PL (% TL)	**26.12 ± 1.86 bc**	**25.98 ± 2.17 AB**	**31.47 ± 2.87 c**	**31.11 ± 0.80 A**	**13.56 ± 0.45 a**	**17.46 ± 2.74 C**	**24.89 ± 0.16 b**	**24.05 ± 1.85 B**
20:4n-6	0.78 ± 0.10 b	1.61 ± 0.04 C*	4.03 ± 0.01 a	4.55 ± 0.50 A	3.74 ± 0.26 a	4.38 ± 0.27 A*	3.72 ± 0.16 a	3.60 ± 0.02 B
20:5n-3	1.13 ± 0.11 d	3.32 ± 0.16 B*	6.36 ± 0.15 a	6.51 ± 0.72 A	5.01 ± 0.48 b	6.35 ± 0.64 A*	3.06 ± 0.29 c	4.06 ± 0.58 B
22:6n-3	2.36 ± 0.16 c	11.35 ± 0.44 B*	16.26 ± 0.45 a	16.48 ± 2.79 A	15.31 ± 1.06 a	18.08 ± 2.77 A	7.36 ± 0.10 b	9.54 ± 0.14 B*
Total n-3 HUFA	4.32 ± 0.29 c	16.00 ± 0.66 B*	23.19 ± 0.51 a	23.72 ± 2.40 A	21.02 ± 1.68 a	25.61 ± 2.23 A*	11.16 ± 0.39 b	14.93 ± 0.51 B*
TAG (% TL)	**33.53 ± 0.70 b**	**39.84 ± 1.78 A ***	**24.49± 0.87 c**	**33.47 ± 0.33 B ***	**43.40 ±0.82 a**	**42.17 ± 2.39 A**	**35.93 ± 2.45 b**	**41.59 ± 2.38 A ***

C, commercial booster; T1, 80% commercial booster + 20% Echium oil; T2, 80% marine lecithin + 20% Echium oil; T3, 90% marine lecithin + 10% Echium oil. Different letters within a row denote significant differences among treatments for a particular enrichment period; * denote significant differences between hours of enrichment for a dietary treatment (P<0.05).

Task 9.3

- Task 9.3 Design adequate feeding regimes for broodstock to optimize **reproduction** (led by IEO).

- Sub-task 9.3.2 Experimental diets with optimized EFA and carotenoid contents will be tested in groups of amberjack broodstock (IEO, ULL)

  Determinations:

  Fecundity, egg quality and haematological and biochemical indicators of fish health will be studied (IEO).

  Sperm, eggs and larvae will be analyzed for lipid contents and lipid classes, EFA and carotenoids profiles (ULL).

GWP Nutrition WP10 Pikeperch 2014 Action Plan

- Task 10.1 Effect of selected dietary nutrients on pikeperch larval development and performance (led by DTU). Start in 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

- Task 10.2 Effects of pikeperch early fatty acid nutrition on long-term stress sensitivity (led by DTU). Not planned for 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

WP10 – Nutrition pikeperch Task 10.1 & 10.2

Objectives:

Increase knowledge on the effect of ***nutrients essential for first feeding*** *of pikeperch.*

Develop specific ***enrichment products and formulated diets*** *to improve pikeperch larval performance.*

Effect of phospholipid levels and HUFA levels on ontogenetic development and performance of pikeperch larvae. Task 10.1

(Experimental study (Oct. 2014-Nov. 2014)

Objectives : Investigate the effects of phospholipids and single HUFAs (EPA and DHA) on pike perch larval performance (growth, stress sensitivity) and larval development (i.e. organ development, tissue/liver morphology, digestive tract.

Further effects on digestive enzymatic activity, liver proteomics, candidate gene expression and skeleton morphogenesis will be examined.

Effect of phospholipid levels and HUFA levels on ontogenetic development and performance of pikeperch larvae. Task 10.1

Experimental conditions:
Fish origin: Eggs obtained from AquaPri Innovation, Denmark (F1-F2 domesticated generation)

Tanks: Study carried out at DTU Aqua facilities, 18 tanks of 50 L, flow through, and heated water.

Feed: 6 dry feed diets with increasing phospholipid content combined with levels of EPA & DHA. Artemia dph 3-17. Weaning: dph 12-17. **Dry feed: dph 18 -30.**

INGREDIENTS/DIETS	D1	D2	D3	D4	D5	D6
	%	%	%	%	%	%
MicroNorse	45,000	45,000	45,000	45,000	45,000	45,000
CPSP 90	7,000	7,000	7,000	7,000	7,000	7,000
Squid meal	13,000	13,000	13,000	13,000	13,000	13,000
Fish gelatin	1,000	1,000	1,000	1,000	1,000	1,000
Wheat Gluten	4,400	4,400	4,400	4,400	4,400	4,400
Wheat meal	6,100	5,900	5,600	6,100	5,900	5,600
Algatrium DHA70	0,000	0,000	0,000	0,550	2,000	3,400
Olive oil	18,900	12,100	3,400	18,350	10,100	0,000
Vit & Min Premix PV01	1,000	1,000	1,000	1,000	1,000	1,000
Soy lecithin - Powder	3,000	10,000	19,000	3,000	10,000	19,000
Binder (guar gum)	0,200	0,200	0,200	0,200	0,200	0,200
Antioxidant powder (Paramega)	0,200	0,200	0,200	0,200	0,200	0,200
Antioxidant liquid (Naturox)	0,200	0,200	0,200	0,200	0,200	0,200
Total	100,000	100,000	100,000	100,000	100,000	100,000

As fed basis	D1	D2	D3	D4	D5	D6
Crude protein	52,74	52,72	52,69	52,74	52,72	52,69
Crude fat	27,01	26,99	27,01	27,01	26,99	27,01
Fiber	0,14	0,14	0,13	0,14	0,14	0,13
Starch	4,02	3,90	3,72	4,02	3,90	3,72
Ash	8,12	8,12	8,11	8,12	8,12	8,11
Gross Energy	24,02	23,34	22,48	24,02	23,34	22,48
Lys	4,22	4,22	4,22	4,22	4,22	4,22
Met + Cys	1,91	1,91	1,91	1,91	1,91	1,91
Tau	0,52	0,52	0,52	0,52	0,52	0,52
Available P	1,30	1,30	1,30	1,30	1,30	1,30
Ca	1,84	1,84	1,84	1,84	1,84	1,84
EPA	0,41	0,41	0,41	0,47	0,61	0,75
DHA	0,66	0,66	0,66	1,04	2,06	3,04
PC	1,51	2,88	4,64	1,51	2,88	4,64
PE	0,62	1,58	2,81	0,62	1,58	2,81
PI	0,69	2,10	3,90	0,69	2,10	3,90
TPL	3,16	7,45	12,96	3,16	7,45	12,96

Facility and exp. set up at DTU Aqua for first experiment (Oct 2014)

- (Cannibalism induced) mortality has been very high (survival 10-20 %)
- Growth seem lower than in previous exp. (i.e. with live feed feeding and
- postponed dry feed weaning).

DTU

GWP Nutrition WP11 Halibut 2014 Action Plan

- Task 11.1 Early Weaning of Atlantic halibut (led by IMR).

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
■	■	■	■	■	■	■	■	■	■	■	■								

Start in 2014

- Task 11.2 Development of a production strategy for on-grown Artemia (led by IMR).

Start in 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
■	■	■	■	■	■	■	■												

- Task 11.4 Comparison of nutrient retention in Atlantic halibut larvae reared in RAS vs FTS (led by NIFES).

Not planned for 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
■	■	■	■	■	■	■	■	■	■	■	■								

Task 11.1 Early weaning

- Task 11.1 Early Weaning of Atlantic halibut (2014-2016, led by IMR).
  - The **main problem** with **earlier weaning** trials may have been the **fitness of the larvae**. Rearing methods have been considerably improved and at present survivals are high and stable
  - MHS have produced a 55000 juveniles from a batch that was weaned at 20 dpff. We start with establishing this method
  - Run numerous short term trials where we measure instantaneous feed intake, varying different parameters:
    - Diet, time of weaning, weaning strategy, desinfication…

Task 11.2 Production of ongrown Artemia

- Task 11.2 Development of a production strategy for on-grown Artemia (2014-15, led by IMR).
  - Use **Marine Harvest procedure**, which has proven to give a clean culture, and feed **Oriculture or micronized fish meal**
  - Use a 4 day culture and take samples of nauplii, unenriched ongrown Artemia and enriched ongrown Artemia for whole **nutritional profile**.
  - Take one sample per **day** during culture for analyses of critical nutrients to see if there is any **abrupt change in nutrient value**.

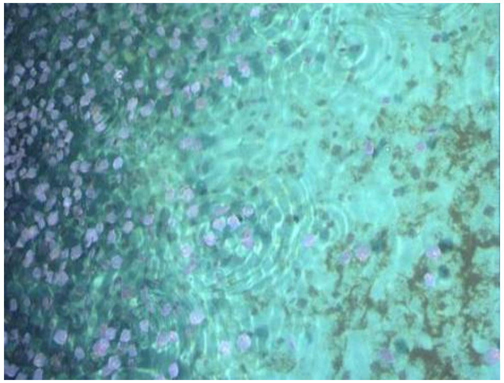
Task 11.3 Feeding of ongrown Artemia

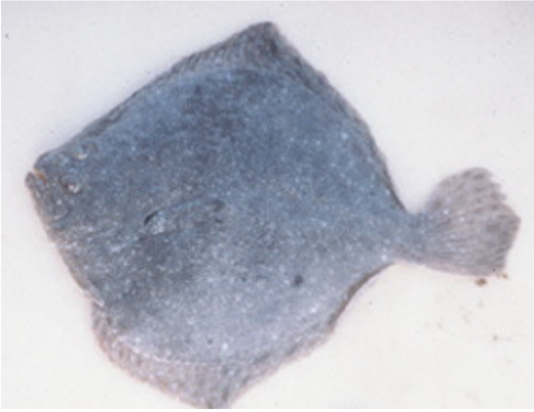
- Task 11.3 Nutrient retention and digestive physiology of Atlantic halibut larvae fed Artemia nauplii or ongrown Artemia (2015, led by NIFES)
  - 2-3 groups, experiment 0-70 dpff:
    - Nauplii throughout
    - Nauplii until 20 dpff, then ongrown Artemia (DOW)
    - Ongrown Artemia throughout (Preferred by the industry)

- Samples analyzing whole nutrient profile of whole body on 0, 20 and 50 dpff.
- Samples for analyses of digestive physiology and ATPase activity (ULL)

Task 11.4 RAS vs FTS effect on nutrition

- Task 11.4 Comparison of nutrient retention in Atlantic halibut larvae reared in RAS vs FTS (2016, led by NIFES).
  - 2 groups (RAS or FTS) fed according to the feeding strategy deduced from the previous tasks
    - 2 samples of whole body for nutrient analyses (day 30 and 50 according to the DOW but this will be adjusted if there is a change in feed)
    - Samples for analyses of digestive enzymes and ATPase.





Task 11.5 Dietary PL: Effect on lipid metabolism

- Taks 11.5 Effect of dietary PL on digestion, absorption and metabolism of lipids in Atlantic halibut juveniles (2017, led by NIFES).
  - Plan will come later

GWP Nutrition WP11 Halibut 2014 Action Plan

- Task 11.1 Early Weaning of Atlantic halibut (led by IMR).

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

- Task 11.2 Development of a production strategy for on-grown Artemia (led by IMR).

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

- Task 11.3 Nutrient retention and digestive physiology of Atlantic halibut larvae fed Artemia nauplii or ongrown Artemia (Led by NIFES)

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

- Task 11.4 Comparison of nutrient retention in Atlantic halibut larvae reared in RAS vs FTS (led by NIFES).

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

Planning/literature/discussions

Experiment

Analyses

Report/publication

GWP Nutrition WP12 Wreckfish 2014 Action Plan

- Task 12.1 Live preys and enrichments for wreckfish larvae (led by CMRM).

Not planned for 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

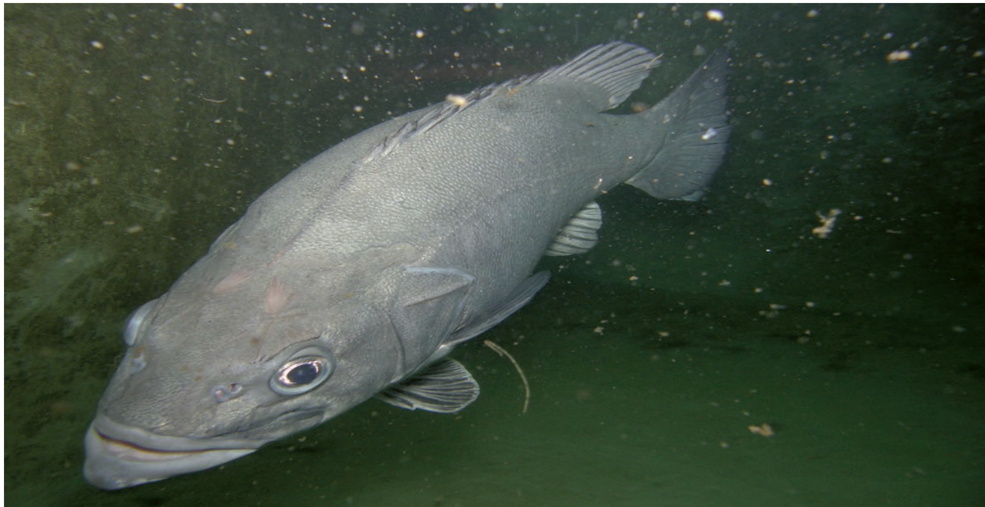
- Task 12.2 Influence of broodstock feeding regimes for fecundity and spawn quality (led by IEO).

Start in 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

Partners involved

- ✓ CMRM: CIMA and IGAFA
- ✓ IEO (Oceanographic Center of Vigo)
- ✓ FCPCT (Las Palmas of Gran Canarias)



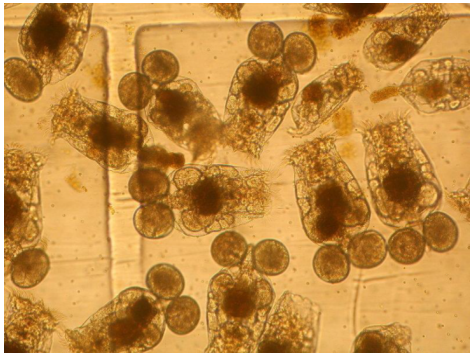
Start month: 1

End month:57

OBJECTIVES and TASKS

1.Test the effectiveness of live prey and influence of enrichment on wreckfish larvae

Task.12.1. **Live preys and enrichments for wreckfish larvae**

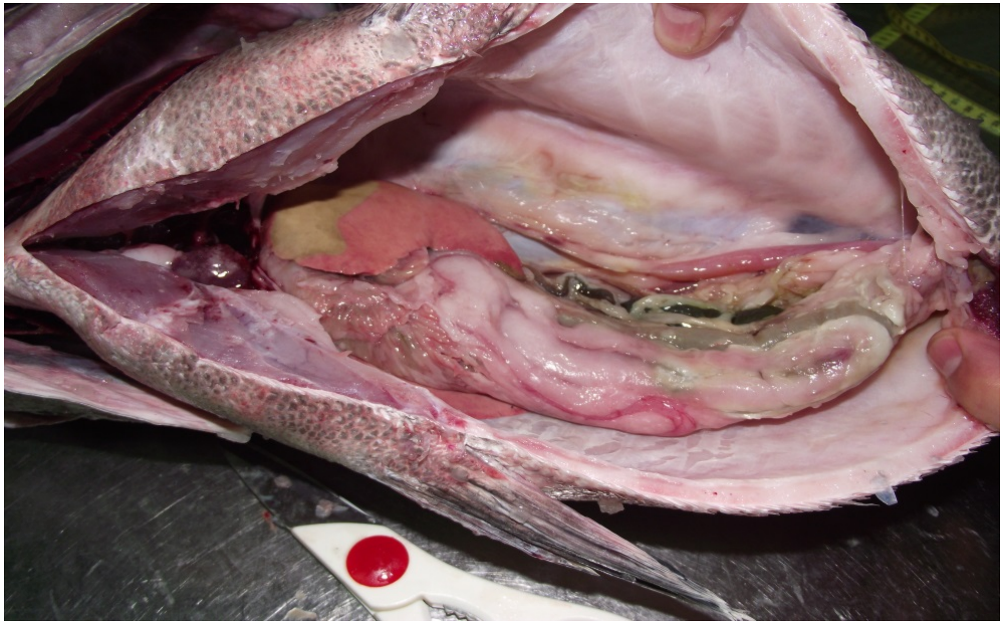

2.Determine the influence of broodstock feeds on fecundity and spawning quality

Task 12.2. Influence of broodstock feeding regimes for fecundity and spawn quality

Activities conducted in 2014. Task 12.2

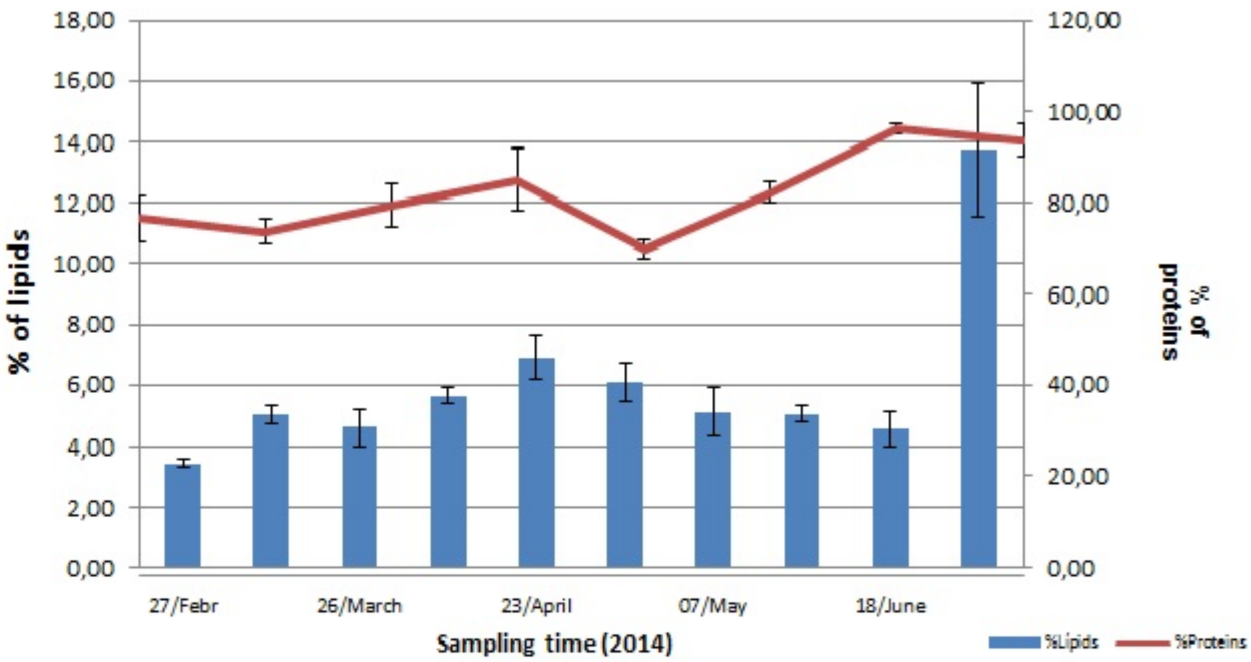
- To obtain information for diet development an extensive bibliographic revison of the wild fish feeding habit and wild fish composition was studied.

- Besides, wild wreckfish was sampled from February to October in two places: O Grove (Pontevedra) and Vigo although the fish came from Azores. The number of fish examined were 60



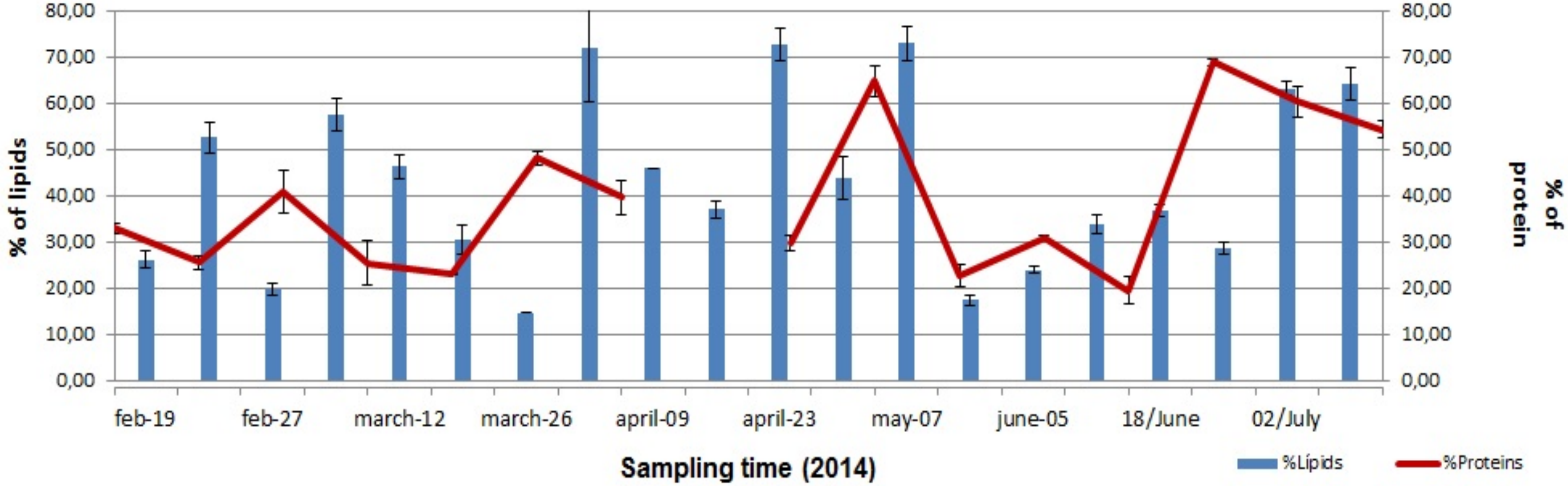
Biochemical composition of different tissues (wild wreckfish)

Muscle



The level of proteins (%DW) vary between 74-79% (mean value 82%) and lipid content ranged among 3-14% (mean value 6%). Values represent mean±std.

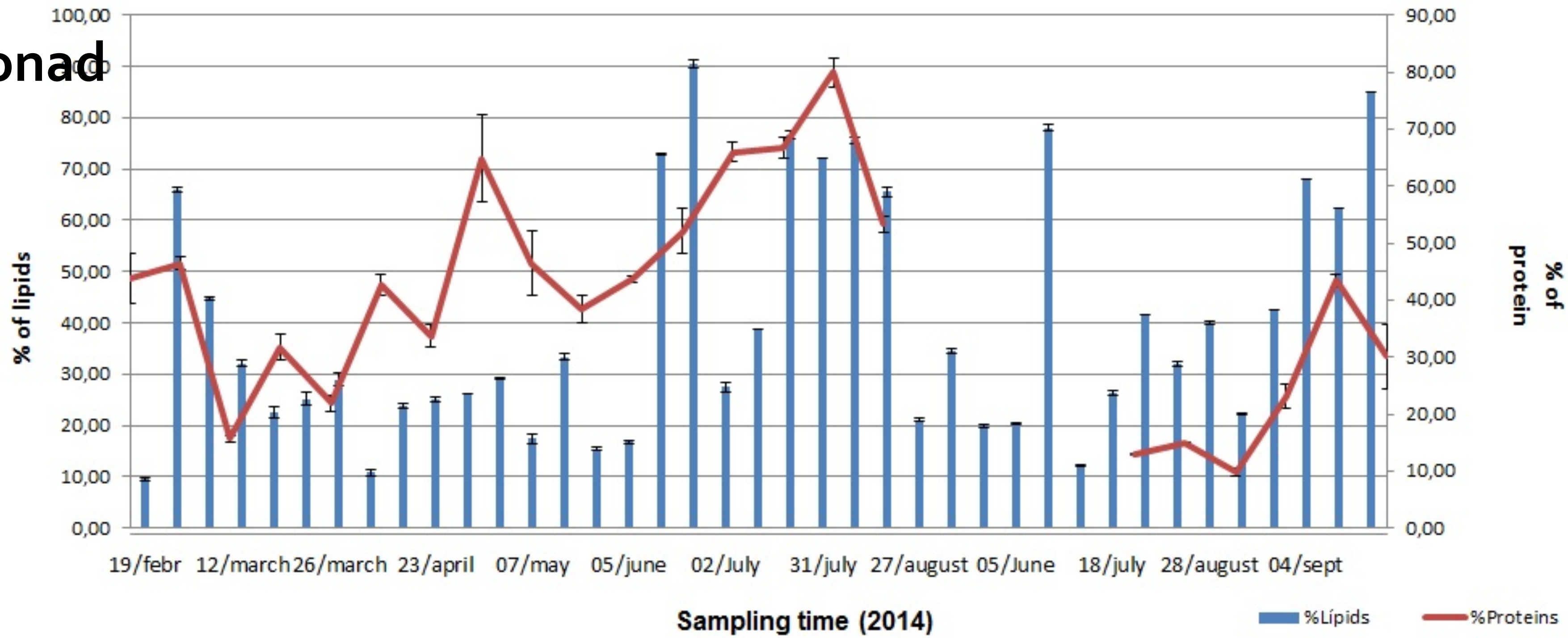
Biochemical composition of different tissues (wild wreckfish)



In the liver, the protein and lipid content show a high variability, proteins ranged among 19-69% (mean value 39%) and lipids among 15-73% (mean value 40%). Values represent mean± std.

Biochemical composition of different tissues (wild wreckfish)

Gonad



In gonads, proteins ranged among 10-80% (mean value 40%) and lipids among 9-90% (mean value 40%). When samples were taken with perigonadal fat had 24% of proteins and 51% of lipids and without perigonadal fat, the protein content was 49% and lipid content 25%. Values represent mean ± std.

Fatty acid profile (% of total fatty acids) of wild wreckfish

	Muscle	Liver	Gonad
14:0	1.95±0.34	1.91±0.59	2.84±0.55
15:0	0.42±0.06	0.33±0.17	0.54±0.08
16:0	19.67±0.97	17.56±3.64	17.80±0.96
17:0	1.03±0.21	1.12±0.38	1.23±0.23
18:0	5.90±0.58	5.43±1.09	5.66±0.90
ΣSFAs	28.96±1.43 (28-30)	26.33±4.51 (21-41)	28.07±1.51 (27-31)
16:1n-9	0.44±0.06	0.98±0.29	0.56±0.08
16:1n-7	5.33±1.50	8.54±3.41	6.48±1.01
18:1n-9	16.97±3.75	30.77±7.14	22.19±2.55
18:1n-7	4.88±0.91	9.77±1.57	6.26±0.56
20:1n-9	1.69±0.24	2.82±0.72	2.78±0.99
22:1n-9	0.32±0.09	0.27±0.12	0.54±0.21
22:1n-7	0.07±0.04	0.05±0.05	0.09±0.04
ΣMUFAs	32.50±5.94 (25-33)	56.33±10.37 (37-69)	42.96±4.56 (36-50)
18:2n-6	0.95±0.11	0.97±0.43	1.06±0.19
18:3n-3	0.29±0.05	0.34±0.14	0.40±0.10
18:4n-3	0.20±0.05	0.18±0.08	0.33±0.13
20:4n-3	0.54±0.08	0.54±0.45	0.74±0.17
ARA	3.04±0.70	1.45±0.92	2.91±1.76
EPA	4.32±0.69	2.95±1.52	4.46±0.75
DPA	2.22±0.31	1.44±0.77	2.32±0.30
DHA	26.20±3.77	9.27±5.75	16.33±2.31
ΣPUFAs	38.53±5.06 (36-46)	17.34±9.44 (4-33)	28.97±4.18 (23-37)
Σn-3	33.76±4.33	14.71±8.19	24.57±2.77
Σn-6	3.99±0.71	2.42±1.29	3.97±1.75
n-3/n-6	8.59±0.95	6.01±1.58	7.08±2.34
DHA/EPA	6.10±0.74	3.06±0.96	3.71±0.51
EPA/ARA	1.50±0.41	2.21±0.64	2.04±1.07

Broodstock food composition

To know the influence of the broodstock food composition on the reproductive development, some samples of **semimoisture diet** were collected to perform the biochemical analysis.

This diet is supplied to the IEO broodstock and is a mixture of:

14.8% white fish
14.8% oily fish
18.0% mussel
17.6% squid
24.8% fishmeal

Lipids 14-16%,PUFA 35-39%, SFAs 29-32%,MUFA 32-34%, EPA 9-10%, DHA 14-16% and ARA 1-2%

No differences were found between samples taken at different times and with different freezing times

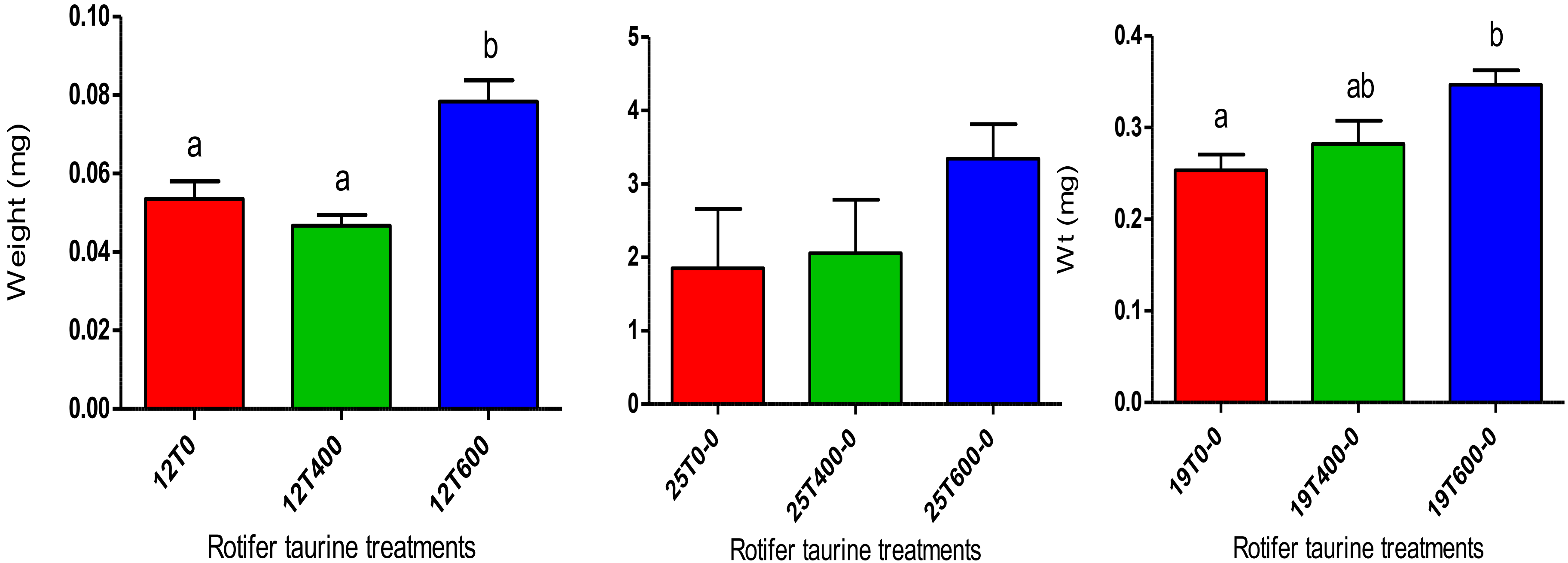
GWP Nutrition WP13 Grey-Mullet 2014 Action Plan

- Task 13.1 Improvement of larval performance (led by IOLR).

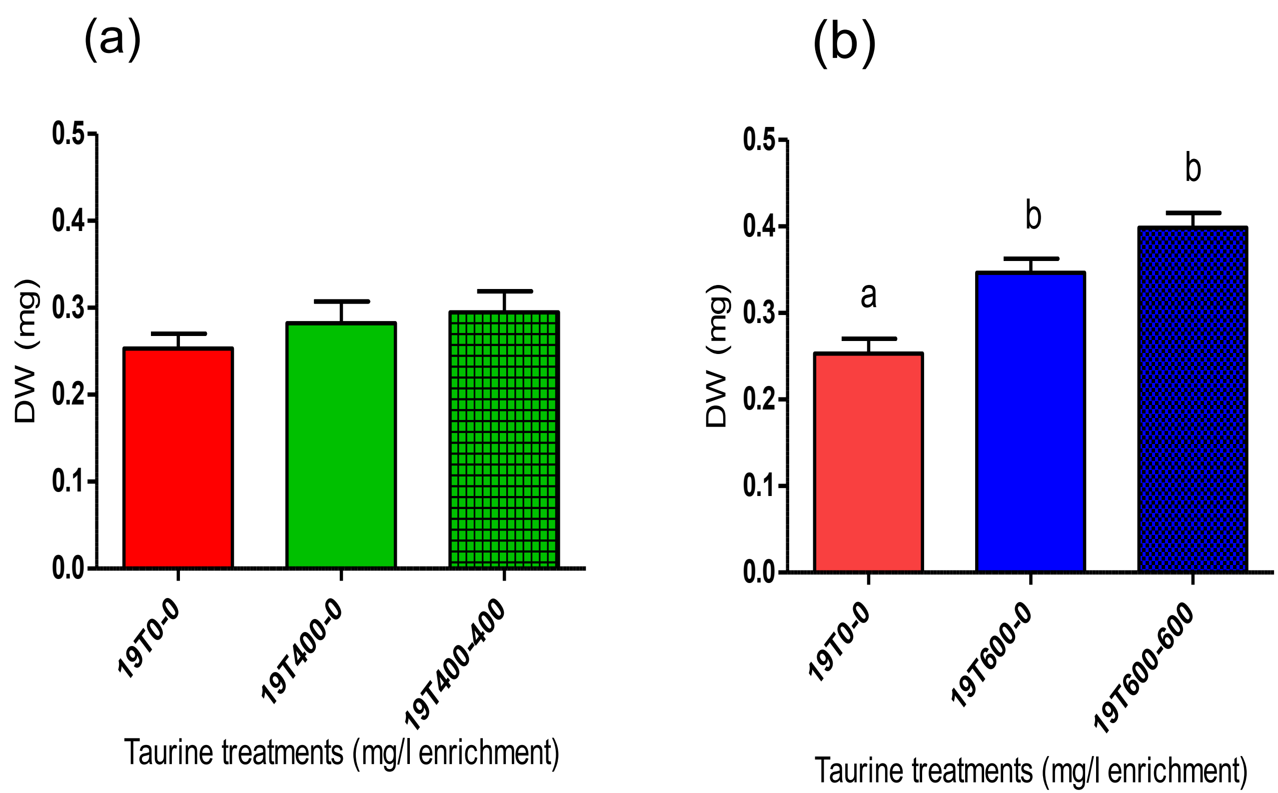
Start in 2014

3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60

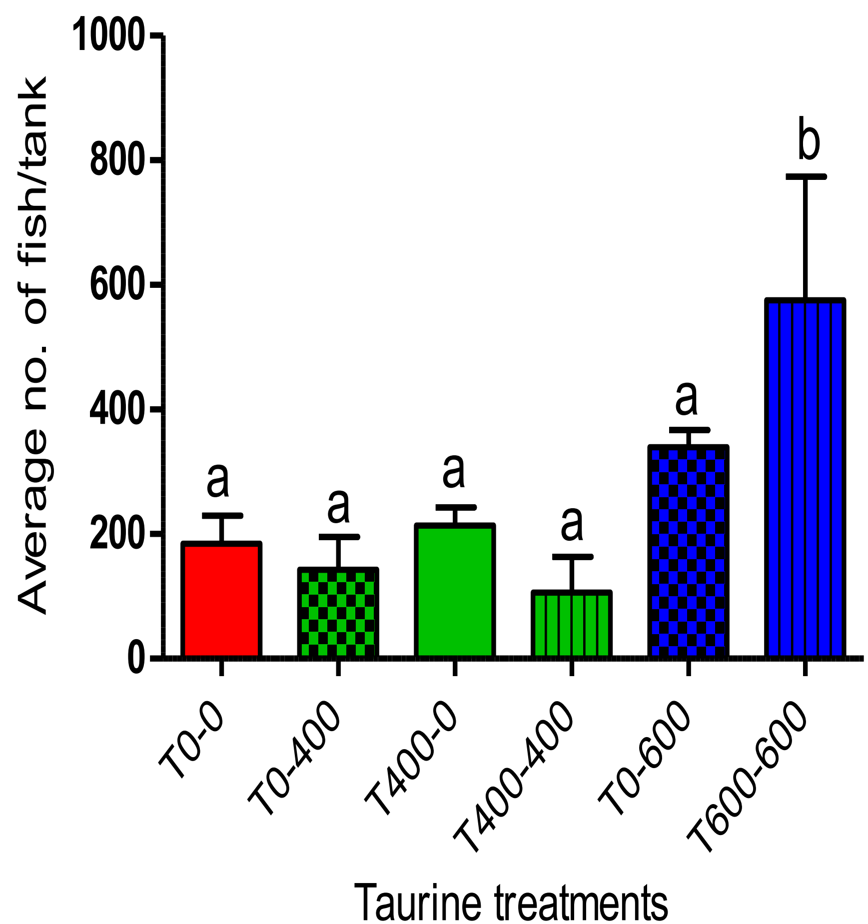
The effect of rotifer taurine treatments (2-15 dph) on dry wt at (a) 12, (b) 19 and (c) 25 dph



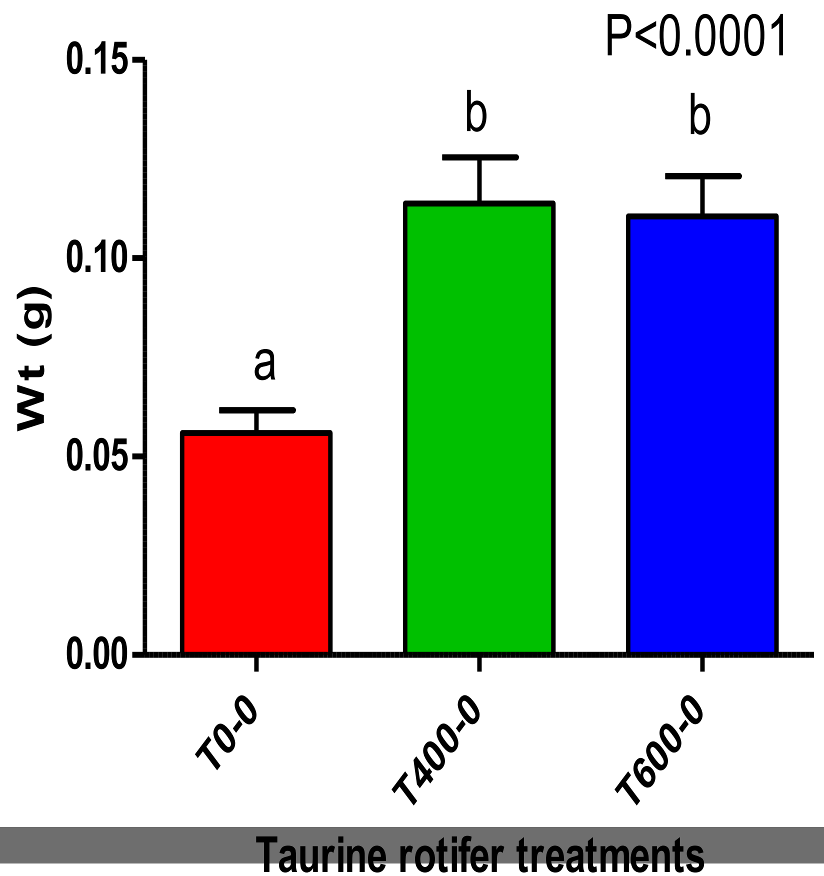
The effect of (a) moderate (400 mg/l) and (b) high (600 mg/l) dietary taurine during rotifer feeding alone or in both rotifer and Artemia feeding on 19 dph mullet larvae



Survival at 25 dph in larvae fed taurine (0, 400, 600 mg/l) in rotifers and/or Artemia



The effect of rotifer taurine treatments (2-15 dph) during larval rearing on 44 dph juvenile wet weight



Conclusion

- Significant (P<0.05) **taurine dose dependent effect on DW** during **rotifer feeding (2-12 dph)** through to the end of feeding non-taurine Artemia (19 dph).
- Significant (P<0.05**) rotifer taurine** dose dependent effect on **length at 25 dph.**
- Significant (P<0.05) **rotifer taurine** effect on **wet wt** was observed in 44 dph juveniles.
- Rotifer taurine fed to 2-15 dph larvae affected the size distribution in 44 dph juveniles.
- Diet supplementation during **rotifer feeding influenced juvenile growth more than during Artemia feeding** despite the much higher growth rate in the latter.
- Fish fed **high taurine rotifers and Artemia (T600-600)** were markedly (P<0.05) the largest fish produced from the study.

Thanks for your attention!