



# aquaculture europe

VOL. 43 (2) SEPTEMBER 2018



**Cockles take  
centre stage!**



New species for EU aquaculture

**DIVERSIFY  
Grey Mullet**

**Breakthrough:  
First DIVERSIFY  
wreckfish juveniles  
produced**



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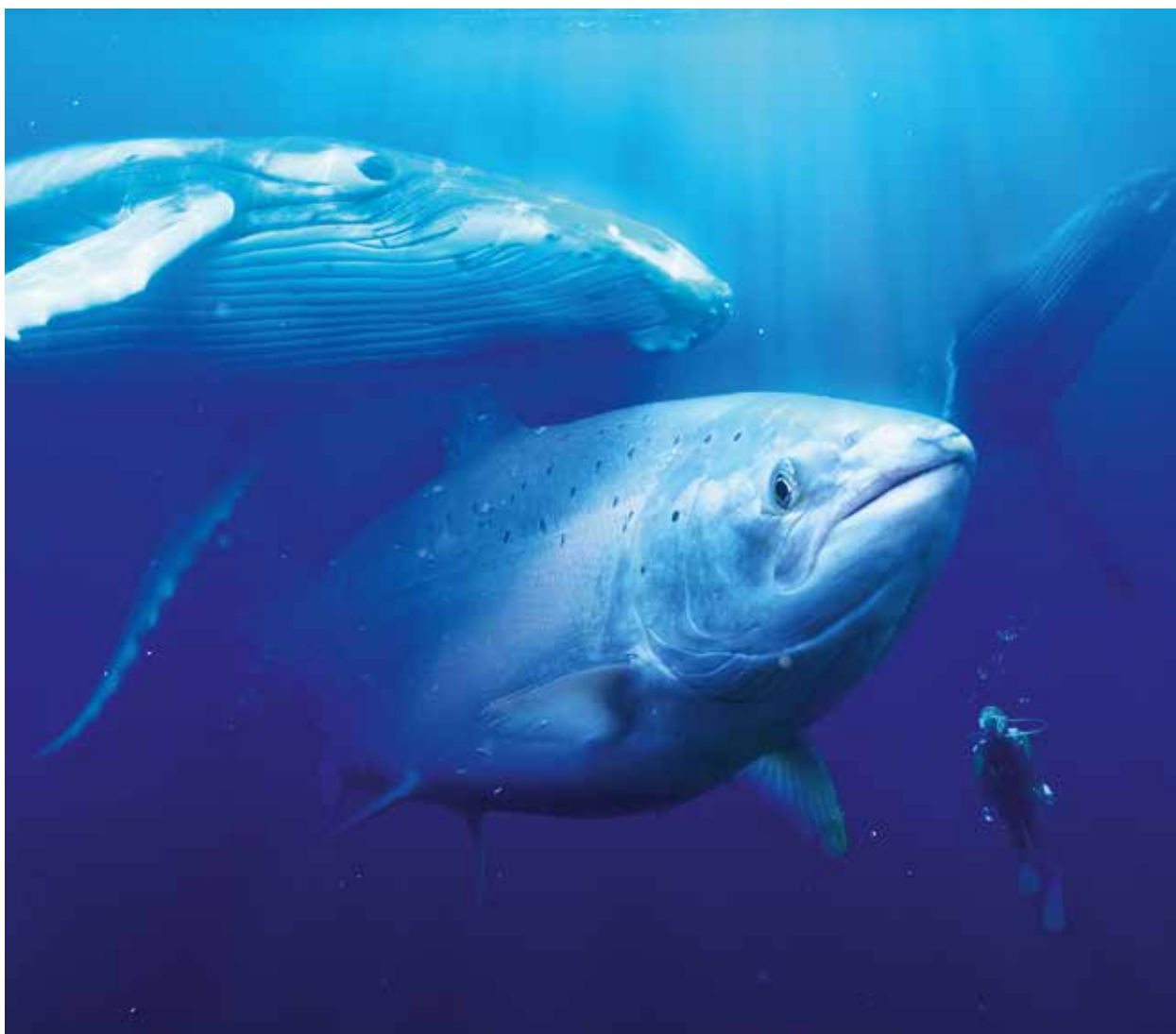
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**AQUACULTURE EUROPE**

**EAS is a non-profit society that aims at promoting contacts among all involved in aquaculture. EAS was founded in 1976. Aquaculture Europe is the members’ magazine of EAS.**

**Secretariat**

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Gavin Burnell  
*President*

It is with great pleasure that I undertake one of my first duties as the new President of this society. That is to write an editorial to introduce the latest issue of our society magazine. I formally took over from Bjorn Myrseth in Montpellier where we had yet another very successful conference and trade show (AQUA 2018 #WeRAquaculture). Before going any further, I would personally like to thank Bjorn for his dedicated leadership these past two years and for all the help and advice he has given me while I was on the Board as President Elect. I take great comfort from the fact that he will still be around as Past President to guide me in my new role. Once again, we have a very experienced and dynamic Board - more than half of which are new Board members and with a perfect gender balance!

In Montpellier there were over 3,000 delegates from 109 countries. 800 oral and 317 poster presentations were made in 80 sessions over the 4 days. The AQUA 2018 trade show was our biggest yet, with 175 booths and 10 industry events. The final figures and accounts are not yet available but there is every indication that it will be a financial success. Every six years EAS combines with WAS in a mutually agreed location in Europe and both societies benefit from the cross-cultural exchanges and diversity that this brings to our conference programme and associated activities. Previous joint meetings include Nice, Florence and Prague. This year, in addition to the sessions mentioned above, we had a special partnership with FAO who ran several workshops, including Biosecurity and Antimicrobial Resistance and Advancing Integrated Agriculture-Aquaculture through agro-ecology and with the European Commission that organised special sessions on Food Value Creation from the Atlantic Ocean and (with EATiP) entitled "Feed Globally – Produce Locally." Later in the conference, EAS, WAS and FAO sat down together to see how we could continue to work together in future EAS and WAS events.

It is with great sadness that I report on the deaths of two key figures from the Irish aquaculture scene. On June 2<sup>nd</sup> this year Dr John Mercer passed away after a short illness. John had been an active member of EAS in its early years and played a key role in the pioneering days of fish farming in Ireland. It was John who gave me my first break in aquaculture by offering me a PhD position in the Shellfish Lab in Carna in 1978. During my 7 years in Connemara I saw how his vision and drive resulted in the first introductions of not only the Pacific Oyster and the Manilla Clam but also the European and Japanese abalones. Each species was quarantined in the Shellfish Laboratory and then propagated in the hatchery to provide a nucleus of stock for the embryonic shellfish growing industry. John was a great lateral thinking, people person who fought long and hard to keep his team of scientists and technicians together against a backdrop of national cutbacks in research funding. He once boasted that one of his staff was actually employed as a telephone installation! Later on he devoted the same expertise and energy to keeping AquaTT afloat during a period when EU funding was temporarily curtailed due to some financial irregularity in one of the member countries (NOT Ireland!). In retirement he remained active and applied his "alternative" way of doing things to local conservation issues like controlling alien plant species and removing marine litter. We can say with certainty that the Irish shellfish industry would not have achieved its current production figures without John's influence and dedication in the early years.

The second shock for the Irish aquaculture community was when Richie Flynn passed away suddenly on August 24th on the day that I travelled to Montpellier. Richie worked for the Irish Farmers Association (IFA). He joined their Press Office in 1991 and in 1996, he moved to the aquaculture section, where he represented fish farmers around the coast for the last 22 years. He began with salmon farming and then the Irish Shellfish Association was added to IFA membership in the 1990s. He became well known and respected in the international arena when he chaired the EU Advisory Committee on aquaculture from 2001 to 2011 and when he served as President of the European Mollusc Producers Association from 2012 to 2016. Richie was also the first President of the EU Aquaculture Advisory Council, which was established in 2016. Recently I had asked him to join the Local Organising Committee of AE2020 in Cork and he was advising me on how to access EU funding for this event. So not only have Ireland and the EU lost a talented advocate for the industry but we have lost a valuable member of the AE2020 LOC.

So a couple of good friends have left us, but we make new ones at each annual event as we share our knowledge and passion for aquaculture. I hope you enjoy this edition of the magazine, in which you will also see the Minutes of our 2018 General Assembly.



## Margriet Drouillon receives EAS Distinguished Service Award

*At the opening plenary session of the EAS/WAS co-organised AQUA 2018 event in Montpellier on August 25<sup>th</sup> the European Aquaculture Society gave its Distinguished Service Award to Dr. ir. Margriet Drouillon MBA, Aquaculture Business Developer at Ghent University in Belgium, for her commitment and contributions to the objectives and activities of the Society. AQUA 2018 was attended by 3003 participants from 109 countries.*

Björn Myrseth, EAS President 2016-2018 introduced and presented the award in front of a packed auditorium at Le Corum in Montpellier. He explained the fact that although the award is made to those that have shown outstanding service to furthering EAS and its objectives, it is not just for those that have given many years of their life to EAS, but it is also about effort and impact.

From Ghent University in Belgium, Margriet Drouillon succeeded Peter Bossier as EAS Treasurer in 2012. Her financial background and job in business development for the University were ideal attributes for the role.

Although Margriet was “only” treasurer for 6 years (the maximum mandate for consecutive terms of Board members), she has been instrumental in changing the way that we prepare and report our finances and has provided substantial inputs into the pension scheme and the liability of EAS as an employer. She developed a new template for financial reporting of the EAS accounts (profit and loss, balance sheet and cash flow), making the quarterly and annual reporting easier to understand by Board members and by members at the General Assembly.

In recent years, this was complemented by working with our Executive Director to put in place a contributory pension plan and liability insurance that we put in place for the Board to cover the responsibility for EAS finances, until they are removed by approval of the annual General Assembly.

As he presented the award, Björn added that he was personally very pleased to make the presentation and that “Margriet definitely merits her place as one of those few special people that have given their time and energy in abundance to further the objectives of EAS and to contribute to its development”.



EAS Distinguished Service Awardee Margriet Drouillon with EAS Executive Director Alistair Lane at the opening of AQUA 2018 in Montpellier. Photo courtesy of Pedro Muñoz López.

## The EAS Distinguished Service Award

**The EAS award for Distinguished Services is destined for individuals that have devoted very significant effort and time to the development of EAS and its objectives. The Award for Distinguished Services has only been presented four times in the 40-year history of EAS. The first time was to Prof. Guido Persoone, who was one of the “founding fathers” of EAS, its President from 1980 to 1982 and its Treasurer for 6 years. The second awardee was Prof. Niels de Pauw, EAS secretary for 4 years. More recently, it was presented to Yves Harache (in 2014) and Selina Stead (2016) for their very long service on the Board of Directors and as President of the Society.**



**Figure 1.** - Commercial size individuals of *Múgil cephalus*.



## Advances in larval and juvenile grey mullet (*Múgil cephalus*) culture: The DIVERSIFY project

The grey mullet (*Múgil cephalus*) (Fig. 1) is one of 6 species selected for the European program DIVERSIFY (FP7, GA 603121), a five-year project to advance our knowledge and its practical application in the culture of new and emerging finfish species, with the potential of satisfying an expanding sustainably the European market for a variety of fresh sea food. There is increasing interest in the culture of the omnivorous grey mullet as a high quality source of protein and as a species that requires little or no dietary fishmeal (FM). Moreover, the salted and dried roe (bottarga) from gravid females is considered a highly prized delicacy in the southern Mediterranean and an added value product from the culture of this species.

The future growth of the grey mullet aquaculture is limited by a number of bottlenecks, which have been addressed in DIVERSIFY. The control of the reproductive cycle and improving egg quality via broodstock management and nutrition was necessary not only for the production of robust larvae, but also for obtaining high value bottarga. A very important issue has been the development of a larval rearing protocol necessary to reduce early mortalities and size dispersion, as well as increasing metamorphic synchrony, which can lead to a supply of high quality juveniles. Finally, development of a sustainable, economical, FM-free grow out feed providing good performance under different environmental conditions of temperature, pond type, and water quality, thus broadening the geographical range of grey mullet aquaculture in Europe, is under investigation.

### Reproduction control

Captive grey mullet fail to reproduce spontaneously, largely due to a failure to undergo complete gametogenesis (Aizen et al., 2005). DIVERSIFY first evaluated the effectiveness of hormone-based treatments on synchronizing gonadal development (Fig. 2). A combined treatment consisting of follicle stimulating hormone (FSH) and dopamine antagonist (metoclopramide) on spermatogenesis in males and follicle growth and maturation in females was tested. The methylotrophic yeast (*Pichia pastoris*) expression system was used to produce large quantities of bioactive recombinant single-chain FSH (rFSH), which was used in a series of in vivo assays. Unlike the controls, the hormonally treated groups (injected with rFSH and metoclopramide during the onset of the reproductive season) demonstrated synchronized gonadal development within and between sexes, with higher rates, over time, of spermiating males and post-vitellogenic females. Once gonadal development was accomplished, we proceeded with the development of hormone-based treat-

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**Figure 2.** Grey mullet breeder (left) ready for an ovarian biopsy (right) to evaluate reproductive stage of development (IOLR, Israel).



ments for inducing spawning. Spawning induction trials that timed the administration of gonadotropin releasing hormone agonist (GnRH $\alpha$ ) and metoclopramide with advanced stages of gamete maturation were quite successful, producing tens of millions of fertilized eggs. Nevertheless, our results highlighted two major problems: (i) the female's failure to ovulate in 42% of the spawning induction trials and (ii) the variable fertilization success ranging between 0 to 98%, underlining the need to fine-tune further and optimize the hormone-based breeding protocol for captive grey mullet.

### Larval Husbandry

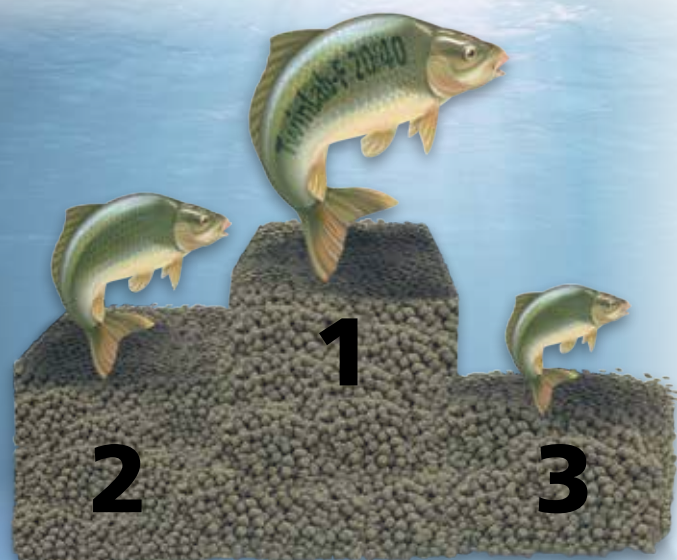
In the commercial rearing of marine fish larvae, tanks are frequently "greened" with microalgae such as *Nannochloropsis oculata* or *Isochrysis galbana*. It is widely believed and demonstrated that the provision of these algae to the tanks improves significantly larval performance and has become an inseparable part of commercial rearing protocols in fish farms around the Mediterranean basin and in Europe. On the other hand, it

remains speculative how algal supplementation contributes to larval growth and survival or if different algal species are equally effective. The biochemical composition of algal species (e.g. fatty acids) varies considerably and it is entirely possible that species-specific compounds secreted from the algal cell (e.g. polysaccharides) and/or are released during digestion might stimulate the immune system or enhance the digestive process. In addition, water turbidity from specific algal concentrations may provide optimal backlighting for larvae to facilitate live prey identification (e.g. rotifers), and, thereby, enhance hunting success.

In DIVERSIFY trials, the effect of two tank turbidity levels has been tested (0.76 and 1.19 NTU (Nephelometric Turbidity Units)) from two algal species (*N. oculata* and *I. galbana*) compared to the no-algae control (0.26 NTU) in 2-25 days post hatching (dph) grey mullet larvae. This study demonstrated that the higher turbidity (1.19 NTU) increased rotifer consumption independently of algal type (Fig. 3a), while the pattern of survival in 51 dph juveniles (3 weeks after the addition of the algal treatments to the tanks) was strikingly simi-

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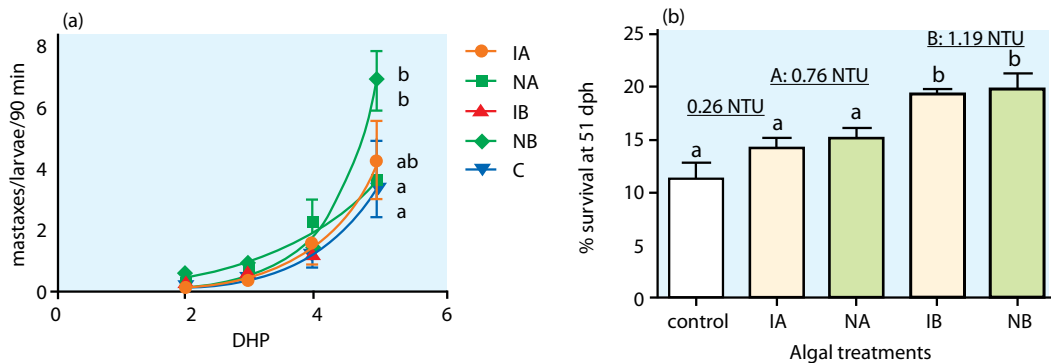
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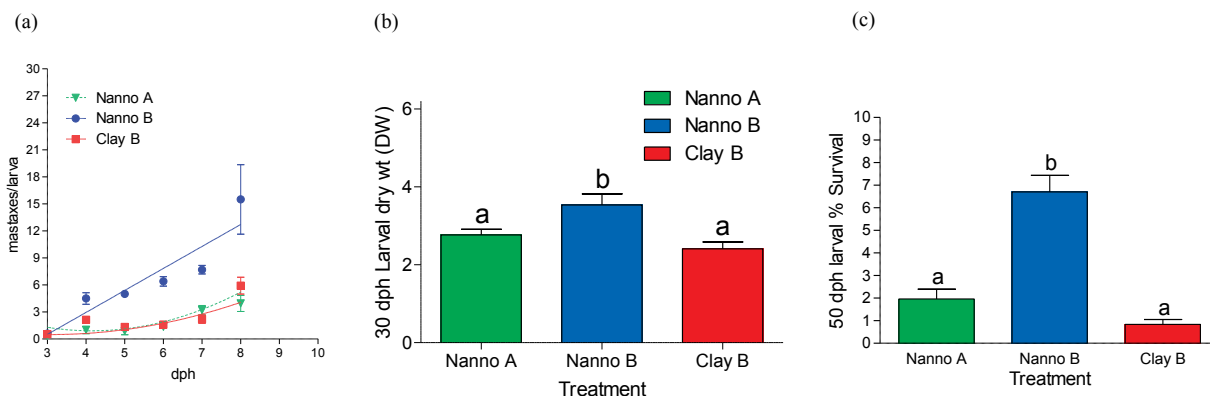


**Figure 3.** The effect of turbidity treatments; no algae (control), *Isochrysis galbana* low turbidity (IA), *Isochrysis galbana* high turbidity (IB), *Nannochloropsis oculata* low turbidity (NA), *Nannochloropsis oculata* high turbidity (NB) on (a) average rotifer (number of mastaxes) consumption larva-1 found 90 min after feeding from 2-5 dph and (b) percent (%) larval survival at 51 dph. Mastax number at 5 dph and percent (following arcsine transformation) survival values of the algal treatments on 51 dph having different letters were significantly ( $P < 0.05$ ) different.

lar to rotifer ingestion at 5 dph (Fig. 3b). This suggested the importance of rotifer feeding during early larval development on later juvenile survival in grey mullet. However, it was still unclear if turbidity or background lighting was the main factor influencing rotifer consumption and larval growth or common biochemical factors between these algal species were influencing larval performance.

When potter's clay (red or white) was added to the larval rearing tanks at the same turbidity (1.2 NTU) as *N. oculata*, rotifer consumption (Fig. 4a), as well as growth in 30 dph larvae and

survival in 50 dph juveniles (Fig. 4b, c) was markedly ( $P < 0.05$ ) lower and was similar to the lower turbidity level of *N. oculata* (0.76 NTU). This suggested a further advantage that live algae provide, in addition to its ability to produce turbidity in the larval rearing of grey mullet. Moreover, in another study the benefit of algal addition at higher turbidity was not altered if the algae were freeze dried. This means that the costly culturing of live algae could be replaced by more economical off-the-shelf algal products in the rearing of grey mullet, which would translate into a significant saving in energy and labour.



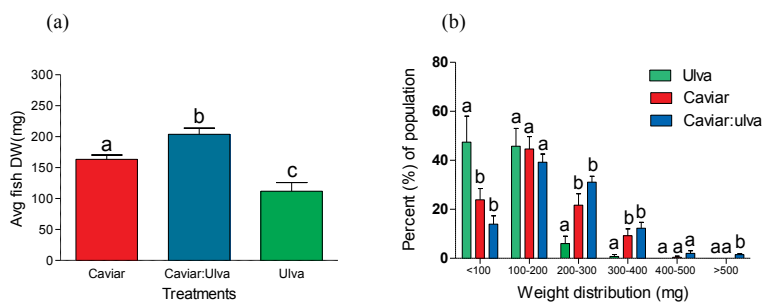
**Figure 4.** (a) Average number of mastaxes consumed per larvae 90 minutes after feeding. The Nanno B curve was significantly ( $P = 0.0004$ ) different than the Nanno A and Clay B curves while the latter two curves were not significantly ( $P > 0.05$ ) different from each other. The effect of the Nanno A, Nanno B and Clay B turbidity treatments on (b) 30 dph larval dry weight and (c) 50 dph juveniles are shown. DW values having different letters were significantly ( $P < 0.05$ ) different.

### Juvenile Weaning

The grey mullet larvae, as in all early developing marine teleost fish, are strict carnivores feeding on zooplankton such as rotifers and *Artemia* in commercial hatcheries. However, after the mullet larvae have metamorphosed into juveniles, they begin to change their mode of feeding from a carnivorous to an herbivorous/omnivorous diet as the fish begin to search out less saline estuaries with higher primary productivity of micro and macroalgae. We demonstrated that the digestive tract reaches full maturation around 61 dph and considerable pancreatic amylase production exists at 79 dph, while maintaining alkaline protease activity, as the grey mullet adapt to a high carbohydrate, low protein diet. This contrasts to other marine species such as the gilthead sea bream (*Sparus aurata*) and the European sea bass (*Dicentrarchus labrax*), which remain carnivorous throughout their life and consume a high protein, low

carbohydrate diet. From 24-38 dph, grey mullet juveniles at the IOLR (Israel) facilities can be incrementally weaned off live *Artemia* and onto a dry, more energy dense starter diet. As the weaning period appears to overlap the transition period where the mullet juveniles change their mode of feeding, the question remains if weaning diets should be carnivorous, herbivorous or omnivorous in nature in order to maximize growth and survival. In the DIVERSIFY studies, we demonstrated that mullet juveniles grew significantly ( $P < 0.05$ ) less when fed only a macroalgae (*Ulva lactuca*) based herbivorous weaning diet compared to a commercial carnivorous feed (Caviar, Bernaqua, Belgium), while fish fed the 1:1 omnivorous mix of these diets exhibited markedly ( $P < 0.05$ ) superior growth than all the treatments (Fig. 5a). Fish fed the herbivorous diet demonstrated significantly ( $P < 0.05$ ) higher numbers of smaller fish ( $< 100$  mg), than the carnivorous and omnivorous diet fish. Conversely, 200-300 mg carnivorous and omnivo-





**Figure 5** The effect of the commercial starter diet Caviar (Bernaqua, Belgium), macroalgae *Ulva lactuca* (*Ulva*) and the 1:1 mix Caviar: *Ulva* on (a) dry weight (DW) at the end of the experiment and (b) weight distribution. Weight (mg) values having different letters were significantly ( $P < 0.05$ ) different.

rous treatment fish represented a significantly ( $P < 0.05$ ) higher percentage of the population than in the herbivorous diet fed fish (Fig. 5b). Grey mullet juveniles retaining high amylase and considerable protease capability would be well suited to digest the relatively starch-rich micro and macroalgae, as well as benthic protein rich organisms characterizing the lower salinity estuarine waters they move into at this developmental stage. Furthermore, the high amylase and maltase activity in fish fed the omnivorous diet would provide glucose as an energy substrate, which could be protein sparing, resulting in improved growth. Taken together, the results broadly suggest that aquaculture feeds at this developmental stage should be designed for omnivorous feeding fish and include higher levels of starch or other low cost amylolytic energetic compounds.

These results were generally reinforced in another study, which weaned fish onto compound diets that differed in their levels (50 and 75%) of FM substitution with a plant-based meal blend (corn gluten, wheat gluten, soy bean meal and soy protein concentrate) supplemented with L-lysine and DL-methionine free amino acids. This study showed that diets with 75% fish meal substitution can be successfully used for

weaning and on-growing wild fry without any detrimental effect on fry performance and condition (see Gisbert et al. 2016, *Aquaculture* 462, 92-100).

### Larval and juvenile DHA requirement

It is well documented that the long chain n-3 polyunsaturated fatty acid (LC-PUFA) docosahexaenoic acid (DHA; 22:6n-3) promotes growth more effectively than the other LC-PUFAs eicosapentaenoic acid (EPA; 20:5n-3) and arachidonic acid (ARA; 20:4n-6) in marine fish larvae. The benefit of DHA to weight gain lies in its contribution to membrane fluidity and function primarily in the neural membranes of the eyes and brain, as well as its involvement in immune function and gene expression. Optimum DHA levels in larval feeds to promote growth and survival range from approximately 0.5 to 2.5% DW diet. We found no dietary DHA effect on larval grey mullet wet weight gain and rotifer consumption rate above the 5.5% DHA level (analyzed at the IOLR) in the commercial enrichment preparation “Red Pepper” (Bernaqua, Belgium) suggesting that, in terms of DHA content, this product is suitable for the larval rearing of grey mullet. Interestingly, the 5.5% DHA

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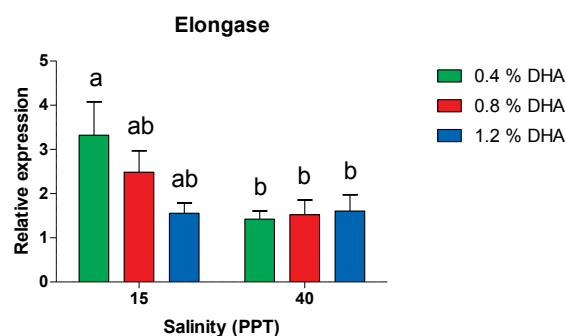
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**Figure 6.** The effect of salinity and DHA treatment on elongase gene expression. Bar values having a different letter(s) were significantly ( $P < 0.05$ ) different.

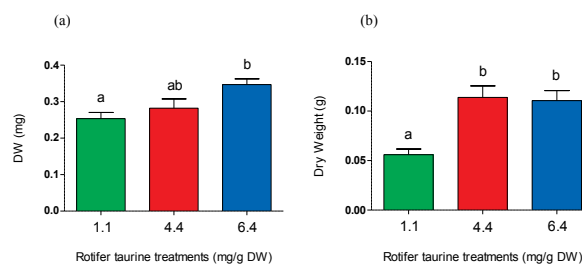
DW diet level resulted in significantly ( $P < 0.05$ ) improved larval survival over the other higher DHA treatments when fish were 40 dph or 15 days after the rotifer treatments had been discontinued. This emphasizes the importance of feeding an effective level of DHA at the rotifer stage on survival in later development stages. Similarly, there was no dietary DHA benefit when increasing DHA from 0.4% to 0.8 and 1.2% DW diet during juvenile mullet growth, where all treatments demonstrated excellent survival (92.4, 88.8 and 97.6%, respectively).

Although there was no apparent DHA benefit at levels greater than 0.4% DW diet to juvenile mullet reared in 40‰ seawater, the question remained if a DHA requirement would be influenced by lower salinity seawater when, in nature, mullet juveniles are moving into lower saline estuaries. Our studies showed that a seawater salinity of 15 ‰ appears to trigger desaturase and elongase capability. In fact, elongase gene expression markedly ( $P < 0.05$ ) increased, when fish were fed low DHA dietary levels (0.4% DW diet) (Fig. 6). Overall, these results suggested that it may be more efficient and economical to grow grey mullet from juveniles to market weight in lower salinity seawater while feeding them relatively low levels of dietary DHA.

### Larval and juvenile taurine requirement

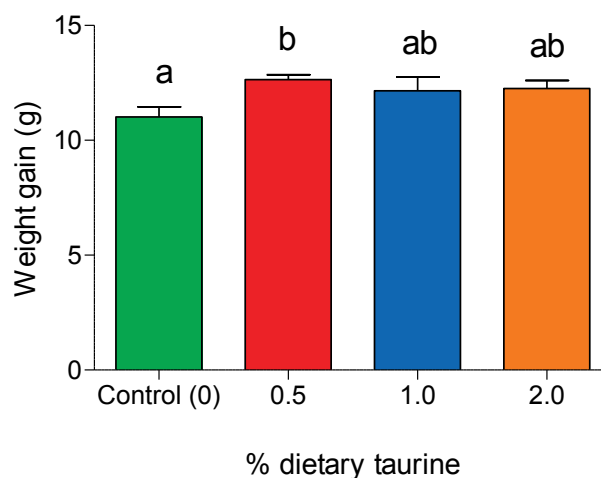
The  $\beta$ -amino sulfonic acid taurine, which is not incorporated into proteins, plays an array of critical roles in its free form. These include involvement in bile salt synthesis, anti-oxidative defense, cellular osmoregulation, as well as contributing to visual, neural and muscular function. In general, taurine cannot be synthesized in carnivorous teleosts and must be provided in the diet. However, it is unclear if omnivorous/herbivorous species have taurine synthesis capability, as their natural plant-based diet would likely be taurine deficient. Our studies found not only a significant ( $P < 0.05$ ) taurine requirement during rotifer feeding (Fig. 7a), but the benefit of ingesting this nutrient during early feeding was still apparent in much later stages of juvenile growth (Fig. 7b).

On the other hand, *Artemia nauplii* have considerable natural levels of taurine and we found no benefit feeding taurine enriched *Artemia* on larval growth and survival. Moreover, we showed that juvenile grey mullet have a 0.5% DW dietary taurine requirement (Fig. 8), which is within the range of the requirement for this nutrient in a variety of marine species such as the Florida pompano (*Trachinotus carolinus*), California yellowtail (*Seriola lalandi*), cobia (*Rachycentron canadum*), common dentex (*Dentex dentex*), Japanese flounder (*Paralich-*



**Figure 7.** The effect of rotifer taurine treatments on dry weight (DW) in (a) 19 dph larvae and (b) 44 dph juveniles. Values having a different letter(s) were significantly ( $P < 0.05$ ).

*thys olivaceus*) and red sea bream (*Pagrus major*). Despite this taurine requirement, there was a taurine dose-dependent response on liver CSD (cysteine sulfonate decarboxylase) expression, which increased 9.2 times from 0 to 1% taurine DW diet, but then decreased substantially in the highest taurine diet (2% DW diet) (Fig. 9a). The synthesis of taurine in the liver, when levels of this nutrient are increasing in the diet, seems counter intuitive. However, taurine can function as an osmolyte to maintain cell volume. Conceivably, increased taurine in the blood circulation of the liver, due to higher dietary taurine, may stimulate increased synthesis within liver cells to reduce osmotic pressure across the membrane, in order to prevent cell shrinkage and changes in intracellular hydro-mineral balance. This suggests that the overall taurine requirement might be higher than 0.5%, as part of the taurine requirement appears to be satisfied through endogenous synthesis of this nutrient. On



**Figure 8.** The effect of percent (%) dietary taurine on weight gain in juvenile grey mullet. Bar values having different letter(s) were significantly ( $P < 0.05$ ) different.

the other hand, fish fed the 2% taurine diet may be ingesting excessive levels of taurine resulting in decreased production of endogenous taurine.

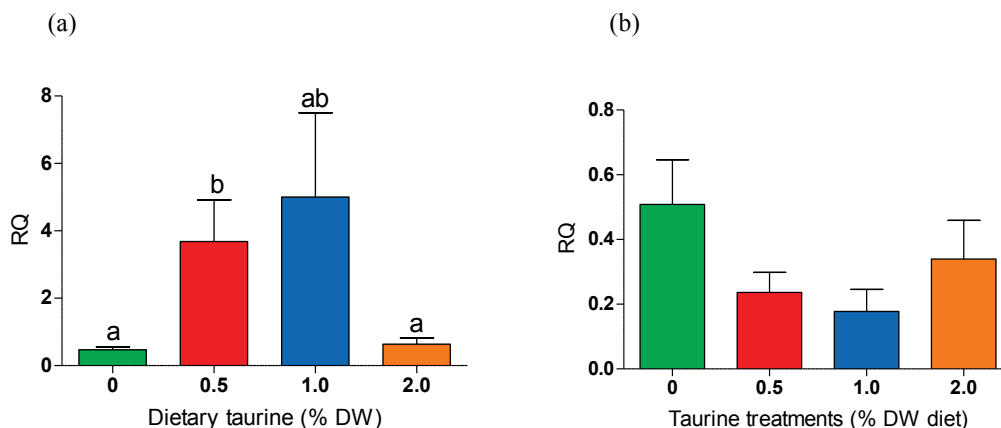
One of the major roles for taurine is to conjugate with bile acids such as cholic acid or chenodeoxycholic acid in the liver, which is then stored in the gall bladder. Conjugated bile acids, when released into the lumen of the intestine after feeding, emulsify fats to make them more accessible for digestion and absorption. The enzyme  $7\alpha$ -hydroxylase (CYP7A1) is the rate limiting enzyme in bile salt synthesis and has been associated with dietary taurine and its growth promoting properties. The synthesis of this enzyme did not change markedly with dietary taurine level, which suggests that endogenous taurine synthesis

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**Figure 9.**

The effect of percent (%) dietary taurine on (a) CSD and (b) Cyp7a gene expression (RQ). Bar values having different letter(s) were significantly ( $P < 0.05$ ) different.



is sufficient to produce adequate levels of bile acids (Fig. 9b) and that the dietary lipid requirement for this species may not be high. Furthermore, these results suggest that the growth promoting effect of taurine is not primarily due to improved lipid digestion and absorption, but possibly its contribution to other physiological pathways such as muscle function and growth.

### Juvenile production and grow-out of grey mullet

During October of 2017, grey mullet eggs at the IOLR were stocked (30-54 eggs/l) in three 6 m<sup>3</sup> V-tanks and were reared using the improved grey mullet larval rearing protocol, based on the results mentioned above, to 70 dph before being transferred to the nursery. The survival rate to this age ranged between 12.5 to 16.6% and produced in excess of 44,000 high quality juveniles. Nevertheless, during the grow out of juveniles to market weight in monoculture, there was a wide size distribution of the population that appears to be amplified with increasing stocking density, although survival remains high. This presents a significant obstacle to the successful culture of this species and is currently being studied.

A farm trial performed in earthen ponds in the South of Spain (CTAQUA) has also shown an effect of density on the size distribution of grey mullet juveniles during grow out (Fig. 10). These results are being evaluated at the moment of this article publication.

### New fish product development

Besides the technical improvement of the selected species, DIVERSIFY project has a substantial socio-economic work package. This work package includes not only scientific sound but practical market development solutions on perception of aquaculture products, market demand insights, buyer preferences understandings, new product development ideas and value adding designs (Banović et al., 2016; Grigorakis, 2017; Lazo et al., 2016; Reinders et al., 2016). These outcomes can help the EU aquaculture sector and the supply industry in targeted marketing and

improvement of its international competitive position.

The socioeconomic work of DIVERSIFY has three main objectives: (a) find out the consumer market opportunities for the six new species (i.e. grey mullet), (b) examine the business-to-business market opportunities for the species and (c) develop business models for the new species on the basis of an online market test. These insights are being generated for the five largest European fish markets: France, Germany, Italy, Spain and the United Kingdom. Although these insights are generated for the six species producers, suppliers and traders of other species might find consumer insights in this project that are interesting for their products too.

A quantitative online study with 2,500 consumers in the above mentioned five countries demonstrated that some consumer segments are open to try new species and/or products (“involved innovators” and “involved traditional”). Especially in Germany and Spain, consumers from the segment «involved innovators» are very open to new fish species and/or products.

On the other hand, in France and Italy “involved traditional” consumers are the ones most interested in new fish species despite their traditional fish choices. British consumers were much less involved towards offerings from new fish species and more ambiguous in their product choices making the “ambiguous indifferent” segment.

A qualitative study with focus groups undertaken across the five study markets has generated the most promising product ideas for new fish products per investigated country. On the basis of this study, a long list of product ideas has been developed for the different countries. However, not all products were practically possible with the different fish species. Therefore, only a selection of products has been sensory-tested in the five countries among regular fish consumers. The developed products for grey mullet were: 1) fresh filet with healthy seasoning, 2) thin smoked filet and 3) fish filets in olive oil (Fig. 11). All the grey mullet products were prepared by the DIVERSIFY partner Ctaqua.

The sensory test showed that the two tested products from grey mullet were well accepted. (Fig. 12). Products with



**Figure 10.** Top: weight sampling of on-grown grey mullet. Bottom: Harvest of grey mullet at the pond farm in the South of Spain.



**Figure 11.** The three grey mullet products developed. From less processed product (left): fresh filet with healthy seasoning; medium process (center): thin smoked filet and higher processing (right): grey mullet filet bottled in olive oil.

a lower degree of processing were those who generated higher expected scores and higher acceptability in the blind test. It seems reasonable to infer that products having a higher degree of processing would be more appropriate for consumers who do not like fish because of its taste, presence of bones, odor, etc. In these cases, the existence of different processed alternatives could be a good solution for those individuals looking for a more convenient and less “fishy” product.

An online experimental choice study with product mock-ups (Fig. 13) was conducted to determine which product attributes should be communicated when selling the fish product (optimal extrinsic product quality profiles). This test was done for the created product ideas from the qualitative study and it was conducted in the five study countries. The study showed that country-of-origin and price come first when choosing new fish products, followed by quality certification, eco-label (i.e. Aquaculture Stewardship Council – ASC logo), while nutrition and health claims appear to have varying and minimal impact, which is highly dependent on the type of product and level of processing, and country. Thus, a certain degree of customization is needed for certain products, depending on the level of processing and countries.

Concerning the market analysis, it has been demonstrated that buyers (i.e. retailers) in the five countries of the study, find it very difficult to position the six new species (e.g. grey mullet) in relation to the current species in the market. Species such as grey mullet are unknown as aquaculture products as well as wild catch. However the buyers are open to welcome new species under the following conditions: (a) the product must be cultured in a sustainable way, (b) the product should be available as a fresh product (southern-Europe) and as a frozen

**Figure 13.** Example of products mock-up developed by DIVERSIFY for the online experimental choice study.

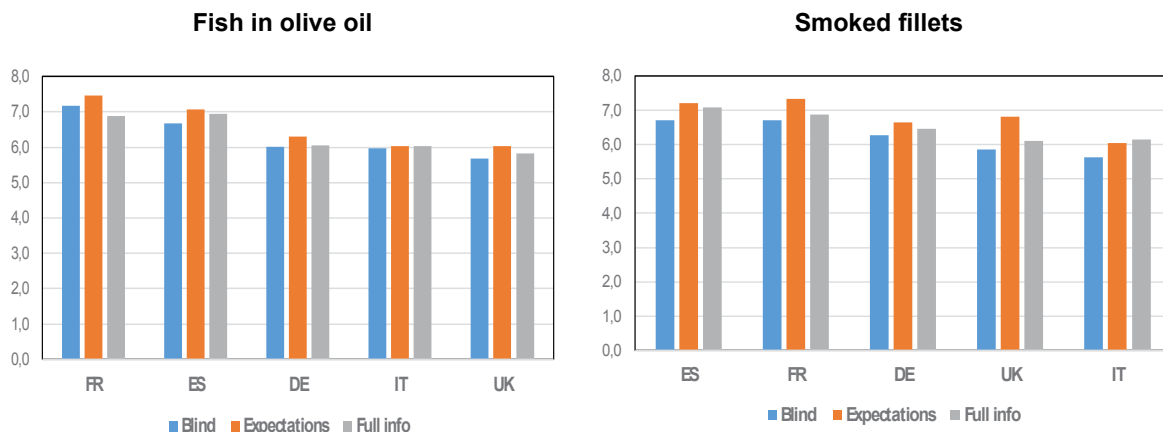


product (especially Germany), (c) the product must be easy to prepare and/or ready to eat, and (d) the product must be priced competitively. All these issues have been covered in DIVERSIFY.

The feasibility study based on real production cost prices and business plan development is planned for the last year of the project.

### KNOW-HOW TRANSFER SEMINAR

Among the dissemination activities of DIVERSIFY, full-day seminars on “Know-how Transfer” of the aquaculture of each of the DIVERSIFY species are being organized. At the moment of this publication, 5 seminars have been completed already for grey mullet (May 2018 in Bari, Italy), pikeperch (June 2018, Nancy, France), wreckfish (July 2018, Vigo, Spain), Atlantic halibut (September 2018, Hjelmeland Spa, Ryfylke, Norway) and greater amberjack (September 2018, Electra Metropolis Hotel, Athens, Greece). In October the following seminar is planned: meagre: 9th October (Palau Macaya, Barcelona, Spain). All the information on the seminars, as well as the presentations given, can be found in the DIVERSIFY web site <https://www.diversifyfish.eu/species-workshops.html>



**Figure 12.** Results of the consumers' acceptance tests for grey mullet new developed products performed in 5 European countries. Consumers were not informed about the product (blue bar). They were asked about their expectation once informed about the products (orange bar) and finally they had the full information before tasting the product (grey bar).

continued on page 13



The seminars include several presentations on selected aspects (e.g. reproduction and spawning induction, final product diversification and quality, socioeconomic issues and marketing, etc.), given by DIVERSIFY partners. In addition, presentations are also given by scientists and authorities in the species (European and world-wide), whose work is relevant although it has not been part of the project. Farmers and producers, but also European aquaculture support companies (feed, pharmaceutical, equipment, engineering, etc.), researchers and educators, government organizations and other institutions are invited to attend these meetings.

The grey mullet know-how seminar was organized by Dr. Aldo Corriero from the University of Bari, Italy and Dr. Bill Koven, grey mullet Species leader from IOLR, Israel. The workshop was addressed to the aquaculture industry, with the objective of transferring the knowledge acquired by the project on the various aspects of grey mullet rearing to enable any commercial aquaculture operation to include this species in their production.

In total 14 presentations on the species were given during the seminar. Apart from the presentations given by the DIVERSIFY partners, five invited speakers (Dr. Donatella Crossetti (Institute for Environmental Protection and Research, Rome, Italy), Dr. Ken Leber (MOTE Marine Laboratory, Florida, USA), Dr. Sherif Sadek (Aquaculture Consultant Office, Cairo, Egypt), Dr. Dario Vallanic (International Marine Center, Cagliari, Italy) and Dr. Antonella Rosa (University of Cagliari, Italy), all of them authorities in the species, provided relevant insights on key aspects of the species such as the need for restocking programs (Dr. Leber), the cultural heritage of grey mullet culture (Dr. Crossetti) and the nutraceutical properties of mullet bottarga (Dr. Rosa).

The seminar ended with a round-table discussion providing a summary on the main issues for the species:

- Grey mullet has a high potential as sustainable aquaculture species.
- There is need for a stock assessment in the Mediterranean area.
- It is essential to have fingerlings available at affordable prices, given the low cost of wild-caught juveniles, which is still allowed in many countries (e.g. Spain, Egypt and Israel).
- There is a need for further and more in depth research on the different grow out culture systems.
- It is crucial to define and establish the species business model.
- Designing of a market strategy for the species is of utmost importance.

The DIVERSIFY project has addressed some of the above points such as the need for further and more in depth research on the different grow out culture systems, the definition and establishment of the business model and the design of a market strategy for the species.



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# Breakthrough in the reproduction and larval rearing of wreckfish in the DIVERSIFY project



**Fig 1.** Wreckfish juveniles at the IGafa facilities.



**Fig 2.** The wreckfish (*Polyprion americanus*).

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The first wreckfish (*Polyprion americanus*) juveniles have been produced in Galicia, Spain, after years of research in the reproduction and larval rearing of the species in the framework of the DIVERSIFY project ([www.diversifyfish.eu](http://www.diversifyfish.eu)). Early this year, researchers in Vigo, Illa de Arousa, Vilanova de Arousa and A Coruña have finally seen their efforts coming to fruition with the consistent acquisition of large quantities of fertilized eggs after spontaneous tank spawning of their captive reared broodstocks. Given the continuous supply of eggs, the planned research efforts for the development of larval rearing methods have been implemented and the result is a small number of hatchery-produced juvenile wreckfish happily swimming in the tanks of IGafa and IEO (**Fig. 1**). The results of the wreckfish research of DIVERSIFY have been presented in a special workshop on the 19 of July, 2018 at the facilities of IEO, Vigo, Spain and a Technical Manual is available for downloading at the web site of the project (<https://www.diversifyfish.eu/wreckfish-workshop.html>).

The cosmopolitan wreckfish is one of the largest Serranid species, reaching a size of 100 kg (**Fig. 2**) and it is one of the most interesting new species for aquaculture diversification, due to its fast growth, late reproductive maturation, high market price, limited fisheries landings and easy manipulation in captivity (Suquet et al., 2002; Papandroulakis et al., 2004; Rodríguez et al., 2017). However, until this year the lack of consistent reproduction control in captivity (Fauvel et al., 2008; Papandroulakis et al., 2008) and the limited trials for the development of larval rearing protocols (Álvarez-Blázquez et al., 2017) prevented the production of any significant results towards the production of juveniles for grow out.

The EU FP7-funded DIVERSIFY project begun in December 2013 with the objective of acquiring the necessary knowledge for the diversification of the European Aquaculture production with some new/emerging finfish species (meagre, greater amberjack, pikeperch, grey mullet, Atlantic halibut and wreckfish). This project is the largest and most multidisciplinary effort made so far for the acquisition of knowledge for the aquaculture of wreckfish, in many ways a unique species for aquaculture. The project had a total budget of 11.8 million € for its 5 year duration, making it one of the largest research projects in the area of aquaculture funded by the European Commission. In the case of wreckfish, DIVERSIFY brought together almost all partners involved up to date in Europe in wreckfish domestication, in order to acquire the necessary knowledge and develop the required procedures for the production of fertilized eggs and juveniles to launch commercial production. After 5 years of work, the project has succeeded in achieving its target and the future looks promising!



Three different broodstocks have been maintained for the last 5 years in the facilities of the Spanish Institute of Oceanography in Vigo (IEO), the Instituto Gallego de Formacion en Acuicultura (IGAFa) of the Xunta de Galicia and the Aquarium Finesterrae in A Coruña (Fig. 3). The research carried out during the first years of the DIVERSIFY project on (a) the description of the reproductive cycle in captivity, (b) the development of methods for the induction of spawning using hormonal methods and (c) the production of an appropriate broodstock diet for this species have finally paid off! The IEO broodstock began spawning first in January 2018 and produced a total of 43 spontaneous spawns in the course of 5 months, with one female spawning 10 times in the course of the season. Then the stock of IGAFa began spawning and produced 30 spawns in 5 months. Finally, the broodstock at the Aquarium Finesterrae was induced to spawn using hormonal implants produced by the Hellenic Center for Marine Research, Greece and has produced more than 15 natural and spontaneous spawns until the end of July 2018. Spawning periodicity was every 3-5 days in all stocks and the time of spawning was mainly between 05:00 and 08:00 h, with some exceptions that took place at midday. Fertilization success was between 50 and 100% with better quality eggs towards the mid or end of the spawning season for each female. In the case of the males, a single male was noted to spawn for 30 times, in a period of 5 months.

In the area of larval rearing, the objectives of DIVERSIFY were to establish a rearing protocol. In particular, the effect of rearing temperature was studied and the description of the ontogeny of the digestive system was considered as a prerequisite for the development of an appropriate feeding protocol. Having done these, once egg availability ceased to be a bottleneck this year, a number of larval rearing trials were initiated in 2018 with very good larval hatching (42-82%). Larval length was 4.7 mm at one day post hatching (dph) and 7.2 mm at 22 dph, and yolk sac consumption was completed at 11 dph at 14-17°C sea water temperature and 8 dph at 17-20°C. The moment of mouth opening was at 7 dph at 14-17°C and 4 dph at 17-20°C. Larvae were fed with rotifers and *Artemia* nauplii (Fig. 4).

A small number of juveniles were weaned to artificial feed and they are swimming in the tanks of IGAFa, at >100 dph and a mean weight of 4.5g. Also in the Aquarium Finesterrae and IEO, larval culture trials are currently being carried out with good expectations. It is the first time in the project that we succeeded in producing juveniles weaned to inert food, which is a milestone in the efforts to produce wreckfish under aquaculture conditions. This trial provides important data on the growth parameters of the species and increased our knowledge about the feeding protocol and the specific behavior and metamorphosis of wreckfish larvae.

So, an important step in the production of juvenile wreckfish has been achieved as promised in the DIVERSIFY project. Based on this important development, we expect that the efforts towards the aquaculture of this great species will intensify, both at the national and European level, and we hope to be able to offer **farmed wreckfish** to the European consumer in the not-so-far future!

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*continued on page 16*



Fig 3. Wreckfish breeders at the Aquarium Finesterrae, A Coruña



Fig 4. Seven-day-old larvae of wreckfish.



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This 5-year-long project (2013-2018) has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration (KBBE-2013-07 single stage, GA 603121, DIVERSIFY). The consortium includes 38 partners from 12 European countries –including 9 SMEs, 2 Large Enterprises, 5 professional associations and 1 Consumer NGO- and is coordinated by the Hellenic Center for Marine Research, Greece. Further information may be obtained from the project site at “www.diversifyfish.eu”.



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# Cooperation for restoring cockle shellfisheries & their ecosystem services in the Atlantic Area



Cockles are an emblematic resource that provide a wealth of services to coastal communities in the Atlantic Area (AA), including environmental, societal, cultural as well as economic benefits. They are considered a delicacy of Atlantic gastronomy and an asset for tourism. From a social perspective, cockles are traditionally exploited by small associations, often with high rates of female employment. Regarding protected areas, the cockle is a key-species for many top predators (finfish, waders).

However, this emblematic resource – especially the most valued native species, *Cerastoderma edule* – is threatened by disease outbreaks and suboptimal management. An ongoing EU Interreg project is looking to address this.

## How do cockles benefit society?

Ecosystem services is a term used to describe the many different benefits that humans get from the natural environment and from healthy biological systems. They are grouped into four broad categories (Fig 1): (1) supporting services, such as providing habitat for other animals, water filtering, bioturbation and supporting food chains; (2) provisioning, such as the production of food and shells; (3) regulating, such as removing nutrients from the sea, and the control of climate and disease; and (4) cultural, such as spiritual and recreational benefits. Thinking about nature in this way can help us understand the wider benefits we get from cockles, which are much more than just the cockle meat. Understanding these wider benefits is useful to decision-makers and will help us manage cockle stocks responsibly and sustainably into the future.

COCKLES project aims to quantify the contribution of cockles at important sites in Portugal, Spain, France, Ireland, and Wales. The work focuses on three aspects:

- Cockles act as an ‘engineer species’. They disturb (bioturbate) large areas of intertidal sandy sediment, which alters the amount and movement of nutrients and microscopic plants and algae that live at the sediment-water interface (SWI) and which form a vital foundation for coastal food webs. Much of this work is being carried out in northern France using laboratory and field experiments with cockles to measure their effects and influence on the environment. A first set of experiments will accurately measure the rates at which cockles bioturbate the sediment column and their subsequent impact on: (1) nutrient fluxes across the SWI and (2) the spatial distribution and production of benthic

microalgae. The influence of different factors such as temperature, cockle size, density and disease will also be investigated.

- More direct benefits of cockles. Detailed information from all countries on the amount and value of the meat taken from cockles and the by-products that come from their empty shells will be collected. The project will work on **regulating services, to see how much carbon is taken from the environment and stored by cockles and how much nutrients they remove from the water column.** This work links up all the countries involved in this project, and works closely with other Work Packages to gain the maximum benefits of the research and to share information. Project partners are using standard methods and adopting a common approach to presenting and summarising their findings.



Fig 1. Diagram showing the four broad categories of Ecosystem Services with some specific examples for cockles

- An exciting challenge is to investigate the **cultural services** that people gain from cockles in each of the partner countries. Using a common framework, all the partners can contribute examples of the cultural aspects associated with cockles that occur in their countries. This does not just assess monetary values; there is a strong emphasis on non-monetary value which can be a powerful force to motivate people. A social approach is needed for this work, involving interviews and questionnaires with local people to draw out the stories of those with an interest in cockles. Some of the cultural ecosystem services we are studying include reference



to cockles in archaeology and history, recreation through cockle harvesting, the place of cockles in gastronomy and seafood festivals, the use of cockles in art and for ornaments and jewelry, the role of cockles in defining seascapes and coastal communities, and in instilling a sense of place or identity within individuals and communities.

### What will the cockles project achieve?

Within this context, the activities planned in COCKLES project are aimed to restore cockle production and the services it provides by developing resistant strains, improving protocols for aquaculture and for recovering natural stocks, optimizing resource management and upskilling stakeholders, which will aid recovering resources, increase the understanding of ecosystem services and contribute to the good environmental status and boost coastal economies of AA.

Cockles and the ecosystem services they provide have never been targeted under the proposed approach at AA scale.

Population characterisation and food-web models will assess the impact of biological interactions between trophic levels in coastal habitats but also in cockle individuals. We will estimate how an impact on cockles, as a key ecosystem species, affects other organisms and the coastal biodiversity and ecology. Novel operational tools, based upon modelling and genetic data to figure out cockle larval dispersal in different environmental scenarios, will be tested. Efficient culture procedures, including hatchery protocols, and refined genetic tools to produce fast-growing and resistant strains will reinforce natural populations and improve, sustainably, the socio-economic performance of coastal communities. Outreach and awareness raised on the value of cockles will increase legitimacy for management decisions and the likelihood of compliance by all stakeholders. This will enhance the value of cockles as a natural asset for all stakeholders, including young generations. Sharing best practices for cockle enhancement

### CORE OBJECTIVES:

- To assess the health, diversity and interrelationships of cockle populations across the AA by characterizing population dynamics, genetic diversity and larval transport, threats from disease, pollution, invasive species and climate;
- To quantify the wider economic, societal and cultural benefits from ecosystem services provided by cockles (fishery, aquaculture, biodiversity, food for birds, tourism, cultural services), by surveys, interviews and socio-economic analysis;
- To provide new techniques for cockle management by developing new technology and procedures for cockle bed restoration, hatchery technology for seed production, selective breeding programmes to produce disease-resistant and fast growing strains, and conservation of genetic structure/diversity;
- To provide guidance on best practice for producers, administrations, environmental agencies, and NGOs, by evaluating and sharing best practice across the AA and optimizing management through mutual learning. This will result in improved cockle production, a strong, viable and sustainable industry, with recognized societal and biodiversity benefits.

and transferring knowledge will facilitate the standardisation of key procedures and spread benefits across the AA. Pioneer collaboration among stakeholders to generate and test the innovative tools and information will provide a sound basis for efficient protection and management policies and decisions, and to anticipate future scenarios.

### What's been done so far?

Work has started in most of the work packages, although the first project results are expected to be available from middle-2019 on.

- Assessment of the cockle's health, populations' status and diversity, threats from disease, invasive species and climate change: sampling protocols have been set up and sampling efforts coordinated for a more efficient accomplishment. The elaboration of the census of parasites cohabiting with cockles in the Atlantic Area, has been started. When ready, it will present the overall situation of cockles' diseases with guidance towards best practice for producers, administrations and environmental agencies.
- The genetics work, which will provide the basis for resistant strains, and for the conservation of the genetic diversity of the populations has also been launched.
- The development and optimisation of particle tracking models that couple to appropriate ocean models covering the AA and for a better understanding of larvae dispersal, has also started. The AA scale approach will allow simulating area-wide connectivity but also to address regional-scale models in the Irish and Celtic seas and for the Galician coast. Moreover, experiments and models to understand the role of cockles in the environment have been started together with the experimental designs to better understand larvae behaviour of cockles.



- The quantification of the ecosystem services for a more sustainable management of the cockles and to enhance the appreciation of this resource within the coastal communities of the AA has been launched and experimental designs and methodological bases agreed.

All the above has been achieved with joint research efforts of the partners who have been actively sharing best practices and knowledge across the AA. Moreover, it needs to be emphasized that many of these targets are also being addressed with the support and engagement of the Associate Partners in all the project areas, which are supporting modelling and sampling work, facilitating data as well as offering a wide perspective of the stakeholders' expectations and priorities about the project. They will also contribute to disseminate the project towards their networks during its whole life-time and beyond.

### Involvement of stakeholders

Interaction and engagement with stakeholders beyond associate partners during and after the project is a major commitment of COCKLES consortium. A strong effort is being made in order to identify their main interests and expectations from the planned work and hearing their concerns about the identified issues affecting cockles. Five local stakeholders' meetings have been accomplished in Spain (2), France, Portugal and UK. Furthermore, a programme of stakeholder workshops is being carried out. It includes a number of preliminary local workshops (Spain accomplished in July; planned in France and Portugal, foreseen after the summer break) are being organised to pave the way towards the 1st stakeholder workshop to be held in Cork (Ireland) next October 16th. This meeting will focus on cockles' population status, major threats and management approaches in the dif-

ferent regions, in order to concentrate in those aspects where more information is already available. It is being organized as an interactive workshop to foster the exchange of perspectives about how the project can better address expectations of different stakeholder representatives. External stakeholders from the different participating regions will be invited.

### How can I find out more?

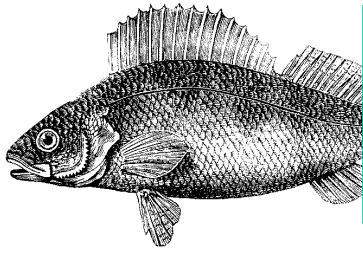
Communication and dissemination is another pillar, not only for stakeholder involvement but also to spread the word about relevance of this emblematic resource among the coastal communities and society as a whole. In this regard, the COCKLES website [www.cockles-project.eu](http://www.cockles-project.eu) was launched at the early stages of the project as a multilingual platform to spread to up-to-date knowledge provided in an accessible language and user-friendly way. The on-line community is also being boosted through Twitter (@cockles\_project) and Facebook (<https://goo.gl/DNmT6F>). Moreover, press releases on relevant project activities have been issued and published in more than 10 regional newspapers in France, Portugal and Spain.

**Join the COCKLES stakeholders' meeting in Cork, Ireland on October 16, 2018.**

**More at [www.cockles-project.eu](http://www.cockles-project.eu)**

COCKLES has received funding through the EU Interreg Atlantic Area programme over the period Oct 2017 to September 2020. Total funding is 3.6 Mio €. The project is coordinated by Rosa Fernández, Centro Tecnológico del Mar, Fundación CETMAR, Spain with project partners from ES, PT, FR, IE, UK. <https://cockles-project.eu/index.php/partners>





## Alternative feeding approaches to boost dietary fish oil utilization and n-3 LC-PUFA metabolism in European sea bass and gilthead sea bream

Like all animal production industries, further growth in aquaculture is dependent upon the supply of sustainable feed protein and energy resources. To date, the aquaculture feed sector has been a major user of marine resources such as fish meal and fish oil, but due to the rapid growth of the aquaculture sector, the volumes of these resources are no longer able to sustainably keep up with demand. Therefore, developing novel alternative sustainable feed resources represents one of the key long-term solutions to aquaculture's feed shortage. Currently, most available alternative feed resources that are being used are of terrestrial origin including plant proteins and oils - the main ingredients for aquafeeds. Currently available alternative lipid sources of terrestrial origin have been associated with a reduced n-3 LC-PUFA content in fish flesh and a possible compromised fish health across the growth-out phase (Turchini et al., 2009; Eroldoğan et al., 2013; Yılmaz and Eroldoğan, 2015). Increasing large number of several feeding strategies have been studied with the combined purpose of improving the n-3 LC-PUFA status of farmed fish and simultaneously minimizing the use of fish oil in aquafeeds, especially in grower feeds over the last four decade. For example, the use of finisher diets to make up fatty acid profiles in a wide range of fish species has shown that flesh n-3 LC-PUFA, primarily EPA (20:5n-3) and DHA (22:6n-3), content could be partially restored. This finishing, as named also washout period, following from a previous grow-out on a diet voided of, fish oil, have been reported to require at least 14 weeks in European sea bass (*Dicentrarchus labrax* L.) (Mourente et al., 2005a, b) and gilthead sea bream (*Sparus aurata*) (Izquierdo et al., 2005) to restore the final n-3 LC-PUFA content of the resulting final edible part of the fish. However, it should be stressed that, even though finishing diets were successful in achieving the restoration of the main fatty acid composition of fish tissues, there is still a need for a relatively large amount of fish oil to be used during the several final months before the harvest. Thereby, alternative novel feeding strategies to address fish oil replacement, as well as other nutritional challenges currently facing the aquaculture industry, are still required after, and one of these could be via a better understanding and the possible exploitation of alternating feeding schedules. These feeding strategies involve the alternation between two or more different diets routinely over different period of times, from diel rhythm of feeding or alternations to few days and/or weeks.

There is an interest to study the circadian and diel rhythms (exogenous and endogenous rhythms) in animals since these

rhythms are directly involved in the temporal and spatial organisation of the physiological mechanisms and response to repetitive events in fish. The metabolic principle behind this is that fish may experience varying metabolic activities relative to natural cycles, such recently demonstrated for circadian rhythms (Betancor et al., 2014; Paredes et al., 2014), and consequently the nutrient utilization efficiency differs following those temporal cycles (Boujard and Leatherland, 1992; Cowan et al., 2017). Consequently, studying these features will need to continue to contribute to better understanding of the principal mechanisms involved in alternate feeding behaviour, and there is potential towards developing more efficient feeding schedules.

This article presents highlights of the major achievements of the recent projects, related with alternative feeding approaches to boost dietary fish oil utilization, in European sea bass and gilthead sea bream so far in laboratory. These findings cover our two main experiments aiming a) to evaluate the effects of alternate feeding schedules, in which diets with different lipid sources were alternated, on fatty acid profile, accumulation of long chain omega-3 polyunsaturated fatty acids (n-3 LC-PUFA) and expression of selected fatty acid bioconversion genes (D6D, ELOVL, PPAR- $\alpha$  and SREBP-1) involved in fatty acid bioconversion in European sea bass juveniles and b) to aim at identifying, recording and quantifying the responses of the alternation of fish oil- and canola oil- based diets offered in a circadian alternating schedule, in gilthead European sea bass and Gilthead sea bream, two commercially important marine species in Mediterranean Sea.

### Design of the two experiments

Three experimental diets (3 mm) were specifically formulated and manufactured by Skretting (Norway), to have the same proximate composition (crude protein 50% DM, energy 21.9 Kj/g DM, lipid 20% DM). These diets differed only by lipid sources, containing 100% fish oil (FO), 100% canola oil (CO) and blend oil of these two oil sources (BLD; 1:1, w:w). Briefly, the fish oil-diet was characterized by a high content of total n-3 LC-PUFA (28.2%), including EPA (13.3%) and DHA (10.9%). The canola-diet was mainly dominated by oleic acid (18:1n-9). The EPA and DHA content in the CO-diet were roughly 85% lower than those in the FO-diet. In addition, the blend-diet (BLD) was almost half way between FO and CO diets in relation to relative quantities of individual fatty acids. Full fatty acid profile of the test diets was presented in Yılmaz et al. (2016, reported as % total lipid) and/or in Eroldoğan et al. (2018, reported as mol% of total fatty acids).

**1st Experiment:** Five treatments were administered to fish (European sea bass, initial weight ~24 g); fish oil treatment (FO; continuously fed a fish oil (FO)-diet), canola oil treatment (CO; continuously fed a canola oil (CO)-diet), blend oil treatment (BLD; continuously fed with a diet containing both FO and CO), alternate schedule treatment (AST; fish fed for 3 weeks with CO and the following 3 weeks with BLD), finishing schedule treatment (FST; fish fed for 9 weeks with CO



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and the following 3 weeks with FO) for 12 weeks. The diets were supplied to apparent satiation three times a day.

**2nd Experiment:** The experimental feeding schedules were: CO-D in the first meal with FO-D in the second meal (COam), and FO-D in first meal with CO-D in the second meal (COpm), and two control treatments: a positive control treatment, fed FO-D in both meals (posCT), and a negative control treatment, fed CO-D in both meals (negCT). The initial weight of sea bass and gilthead sea bream were respectively ~28.9 g and ~26.7 g. Test diets were fed twice a day at 2% body weight per day for 60 days.

Please see the experimental details for the 1<sup>st</sup> experiment and 2nd experiment in Yilmaz et al. (2016) and in Eroldoğan et al. (2018), respectively.

## Main Findings

### 1st Experiment:

The total levels of saturates was highest in the FO treatment and lowest in the CO treatment. The flesh of the fish fed the FO diet had significantly higher levels of total saturates than all other treatments (Table 1). However, total levels of saturates in the liver of fish in the FO treatment were similar to those in FST and AST. The total levels of monoenes in samples were highest in fish fed the CO diet and lowest in the FO diet. n-6 PUFA in fish fed the CO diet were significantly higher than those of the other treatments. The level of n-3 PUFA (mainly EPA and DHA) in the whole body, flesh and liver of sea bass fed the FO diet was significantly higher than all other treatments. However, the proportion of DHA was higher in the flesh of the fish in the FST treatment, competed to those in the CO, AST and BLD.

Analysis of gene expressions for LC-PUFA biosynthesis ( $\Delta 6$  desaturase, *Elovl5*, *D6D*, *SREBP1* and *PPAR- $\alpha$* ) in the liver of fish fed the experimental diets is shown in Figure 1. No significant differences in gene expression between all the experimental groups were detected. Nevertheless, despite the variations between individuals from the same experimental group for *D6D*, *Elovl5*, *SREBP1* and *PPAR- $\alpha$*  gene expression, we firmly believe there is a possible effect of alternate feeding regimes on these genes it must be deeply investigated.

### 2nd Experiment

Compared to other treatments, total SFA content was reduced with negCT treatment in gilthead sea bream and with negCT, COam and COpm treatments in European sea bass (Table 2) Total monounsaturated fatty acids (MUFA) content was highest in fish under the negCT treatment in both species. In European sea bass, MUFA was lowest for posCT, whereas in gilthead sea bream no difference in total MUFA among posCT, COam and COpm treatments were observed. The sum of n-6 PUFA was highest in fish under negCT and lowest in fish under posCT in both species. Interesting results were observed for the n-3 LC-PUFA. In fact, in gilthead sea bream, the whole-body EPA content was highest in COam followed by posCT, COpm and negCT, and it was statistically different across all four treatments. DHA was also statistically different across all four treatments, but it was highest with COpm followed by COam, posCT and negCT, respectively. The total n-3 PUFA of gilthead sea bream were significantly different among treatments, being highest in COpm, followed by COam, posCT and negCT, respectively. In contrast, EPA, DHA, n-3 PUFA and n-3 LC-PUFA recorded in European

sea bass were highest in posCT and lowest with negCT, and the two experimental treatments (COam and COpm) showed a similar response, with values intermediate to those recorded in posCT and negCT (Table 2). Thus findings imply the species possible preferential deposition of fatty acids and the existence of species difference in circadian metabolism of fatty acids.

## Summary and suggestions for future studies

- In 1<sup>st</sup> experiment, European sea bass were able to increase their efficiency of n-3 LC-PUFA deposition in the flesh. For the question “is there any metabolic mechanism influenced by alternative feeding on genes involved in fatty acid biosynthesis?”.
- Considering the difference in the trophic level between European sea bass and gilthead sea bream, 2nd experiment clearly suggested that gilthead sea bream is an excellent candidate to further explore mixed feeding schedules and circadian rhythmicity in the context of optimizing the use of dietary fish oil, enhance final product quality as well as overall contribute towards the sector sustainability and economic viability.
- In our studies, application of alternate feeding schedules seems to entrain several physiological parameters (ie. clock genes or plasma concentrations) but pre-feeding and post-prandial character of the corresponding shift should be investigated, in a way that will be custom-designed to match circadian metabolic patterns could result in further boosting feeding efficiency.
- There are several issues need to be addressed to further elucidate the mechanisms leading to the deposition of n-3 LC-PUFA in sea bass and gilthead sea bream fed altered feeding regimes, ie. clocking gene regulation of key genes involved lipid metabolism.
- Research should also address the real commercial feasibility of such feeding strategies, considering both economical and logistical considerations.

## Acknowledgments

We acknowledge our partners from France Dr. Geneviève Corraze and Dr. Stéphane Panserat for the 1<sup>st</sup> experiment and Australia Dr. Giovanni M. Turchini for the 2nd experiment for their great contribution.

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All cited references in the text can be find in:

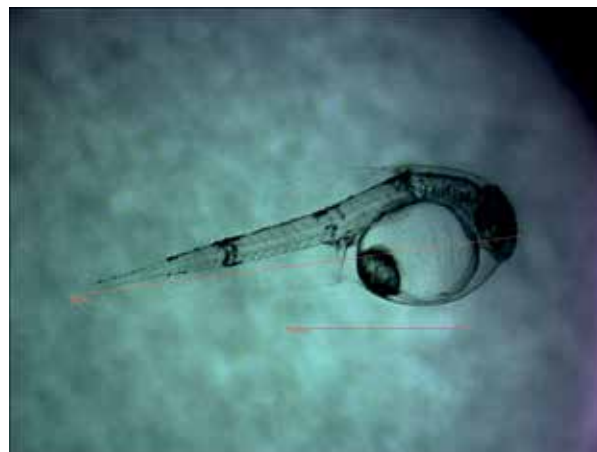
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# SPECIES-SPECIFIC MICRODIET PRODUCTION FOR MEAGRE LARVAE

In Ph.D. thesis title “**Determination using *in vitro* assay of inhibition values of different feed ingredients on the protease activities of meagre, *Argyrosomus regius* (Asso, 1801) larvae and production of species-specific microdiet**”, the first experimental microdiets (EMD) have been produced with high potential for species-specific commercialization, in which the nutritional (feed ingredient) requirements of the meagre larvae are determined by using *in vitro* assay.

The meagre, which has a high rate of development, is an important alternative species such as sole and turbot species produced as an alternative to the production of gilthead seabream and seabass in the Mediterranean Basin.

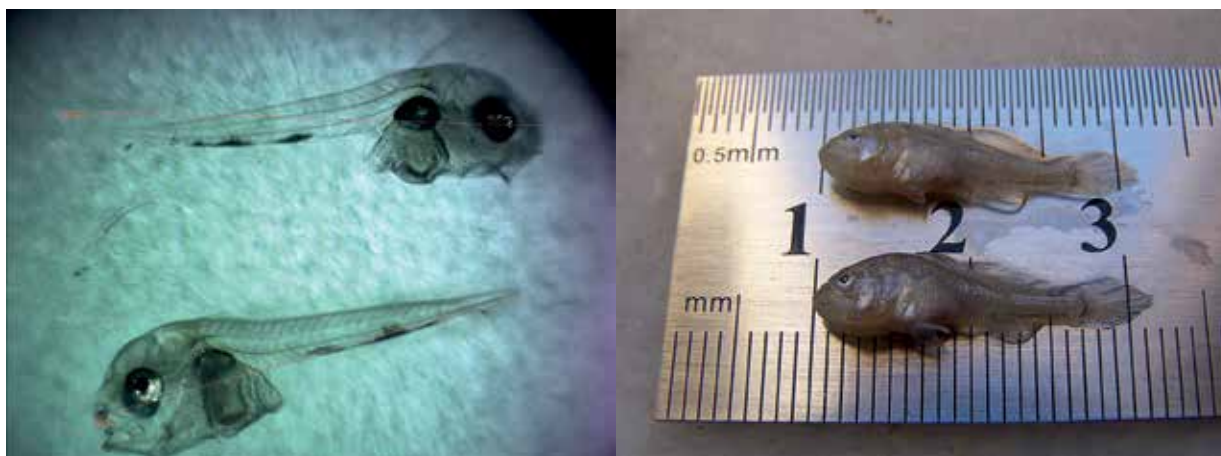
The important subjects in the feed formulation of aquaculture species are sustainability and economic of feed ingredient sources and also, substitution of economic and sustainability feed ingredients with the unsustainable feed ingredients as depending on cost of fish meal and fish oil. In this context, the species-specific feed formulation and the determination of nutritional requirements of marine fish larvae with traditional nutritional methods are the methods that require a lot of time, is expensive and can be effected by environmental factors, which are called *in vivo* methods. For this reasons, the use of *in vitro* techniques have many advantages according to the *in vivo* techniques. *In vitro* assays can provide opportunity to the production of the species-specific feeds for marine fish larvae cultured in the world due to the practical, easy and repeatable with small amounts of feed ingredients. Furthermore, *in vitro* assays or in researches which the ontogenetic development were followed due to enzymatic developments will make the results of the samples significant from high hatcheries with intensive production and strong feeding protocol and successful



**Figure 1.** 0 DAH meagre larvae (2.15-2.93 mm total length and 0.23-0.25 mg wet weight)

larval survival and weaning. In this sense, this thesis, will make the meagre larvae *in vitro* assay EMD production important due to larval sampling (material) in Egemar Hatcheries in which the commercial meagre larvae feeding protocol success and production's inferiority is determined. The results of thesis show that Egemar Hatchery has a high level of brand equity production in the Mediterranean Basin of meagre know-how value.

In current Ph.D. thesis, microdiets having the different sizes such as **meagre XS** (75–100  $\mu\text{m}$ /10–15 days after hatching-DAH), **meagre S** (100–200  $\mu\text{m}$ /15–25 DAH), **meagre M** (200–300  $\mu\text{m}$  /17–27 DAH ), **meagre L** (300–500  $\mu\text{m}$ /20–32 DAH) as species-specific according to the feed ingredient/inhibition status determined *in vitro* methods as depending



**Figure 2.** Age range of larvae of meagre in which the microdiets production is made 10 DAH meagre larvae (5.17-5.46 mm total length and 1.13-1.85 mg wet weight) and 32 DAH meagre larvae (20.65-21.83 mm total length and 88.30-119.09 mg wet weight)

on larval ontogenetic stages were produced according to the Na-alginate method of Yúfera (2005). To meet the nutritional requirements of meagre larvae in the present study, protease activities of the eggs and larvae (0–32 DAH), larval development (length–weight), proximate analysis of feed ingredients (**animal**; fish meal, fish hydrolysate, squid meal, shrimp meal, krill meal, chicken meal and feather meal, **vegetable**; wheat gluten, corn gluten, soybean meal, sunflower meal–sunflower, soy protein concentrate–SPC, vegetable protein concentrate–VPC, dried distilled grain (maize)+soluble substances DDGS, yeast and **micro/macro algae**; *Chlorella* sp. meal, *Schizothyrium* sp. meal, *Spriluna* sp. meal, *Sargassum* sp. meal and *Ulva* sp. meal), the inhibition effects of feed ingredients on the protease activity of meagre larvae were determined (Figure 1. and 2.) (Figure 3).

The results of the inhibition of feed ingredients on protease activities of meagre larvae (10–32 DAH) as in *vitro* had an important role in the formation of EMD formulations. Depending on the inhibitions of feed ingredients of animal (fish meal, fish hydrolysate, squid meal, shrimp meal, krill meal, chicken meal and feather meal), vegetable (wheat gluten, corn gluten, soybean meal, sunflower meal–sunflower, soy protein concentrate–SPC, vegetable protein concentrate–VPC, dried distilled grain (maize)+soluble substances DDGS, yeast) and micro/macro algae (*Chlorella* sp. meal, *Schizothyrium* sp. meal, *Spriluna* sp. meal, *Sargassum* sp. meal and *Ulva* sp. meal) in the formulation, fish meal, fish hydrolysate, squid meal, krill meal, chicken meal, feather meal, wheat gluten, corn gluten, sunflower, yeast, *Schizothyrium* sp. meal, *Spriluna* sp. meal, and *Ulva* sp. meal were used. Also the replacement with unsustainable fish meal of selected feed ingredients in the mentioned ratios such as (fish meal/feed ingredient) 100/0%, 75/25%, 50–50%, 25–75% and 0/100% and protein molecular weight distributions of feed ingredients were evaluated. And also the hydrolysis (pH hydrolysis stat) degrees of the formulation feed ingredients were determined. The effects of EMD's coating with Na alginate with the hydrolysis degrees were revealed.

Finally, by analyzing EMD's inhibition degrees on protease activity of meagre larvae, protein molecular weights, proximate and fatty acids, the costs of EMD were determined. Results showed that there was no effect of Na-alginate used in the coating of EMD. The inhibitions of EMD was found to be low. On the other hand, the distributions of 2.532 Da $\geq$  (free amino acid+di/tri/oligopeptide) of the EMD were similar to those of the commercial microdiets. In addition, the EMD  $n-3/n-6$  1, DHA/EPA 2 and DHA/EPA/ARA 7/4/1 were calculated.

Results indicated that species-specific microdiets should be produced for marine fish larvae, for this goal, inhibition degrees of feed ingredients on the protease activities of larvae can be sufficient and also, depending on the ontogenetic development of larvae, species-specific/nutritional(feed ingredient)–inhibition *in vitro* assays were determined to be on evaluation criteria and recommended for marine fish larvae. In addition, in present study indicated that protein molecular weight distributions in the formation of EMD were an important role. The Ph.D. thesis presents a potential approach to assessing “sustainable feed production”, one of the relevant thematic areas of the European Aquaculture Technology and Innovative Platform, as it determines which feed ingredients and how much of these feed ingredients should be used in larvae feeds. Also, the thesis revealed alternative solutions to the fast and reliable method of nutrient estimation for feed ingredients and feeds of today's world feed industry sector. At the same time, the study has the potential to be evaluated in the formation of ontogenetic feed formulations in the world aquaculture aquafeed industry sector's production of marine fish larva microdiet. The method used in the present thesis fulfills the literature expectations in terms of application and statis-



Figure 3. Meagre larva microdiets

tical errors and the determination of the inhibition levels as *in vitro* feed ingredients based on digestive enzyme (protease) activities of larvae. Finally, the present study showed that *in vitro* techniques were the potential application for the species-specific feed formulation and the determination of nutritional (feed ingredient) requirements of fish larvae.

I would like to thank to the my Ph.D. thesis supervisor Assoc. Prof. Dr. Orhan DEMİR and Dr. Instructor Mehmet

NAZ (Faculty of Marine Sciences and Technology, Iskenderun Technical University), the general manager hydrobiologist Metin NEKE and assistant general manager aquaculture engineer Doğan NEKE who supported all kinds of facilities at Egemar Hatchery (Akbük-Didim/Aydın-TURKEY) at Egemar Aquaculture Food Industry and Trade Incorporated Company and Süleyman Demirel University Scientific Research Projects Management Unit which supported my Ph.D. thesis with project number 3453-D-13.

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Note: This article also appeared in the July-August 2018 issue of Yeni Su Dünyası



**FISHBOOST**  
The next level of aquaculture breeding



## Advanced Aquaculture Breeding training workshop

**6-8 November 2018, Montpellier, France Hotel le Clos de l'Aube Rouge**



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For more information and registration visit [www.fishboost.eu](http://www.fishboost.eu)

Selective breeding in aquaculture is moving from simple selection for production traits like growth to selection for traits which are more difficult to approach, e.g. **disease resistance, fillet percentage and feed efficiency**. Genomic resources are developed for more European species, which can be used for **gene mapping** and **genomic selection**. This new information requires **improved designs of European aquaculture breeding programmes**. In this workshop, results will be presented from EU funded FISHBOOST project on advances in these topics and the economics of breeding programmes. The training will finish off with a **technical visit to Ifremer experimental platform** located in Palavas-les-Flots.

FISHBOOST received funding from the European Commission under the 7th Framework Programme for Research and Technical Development under grant agreement No 613611.







## Fish vet appointed Chairperson of Scotland's animal welfare charity

The Scottish SPCA has elected Ronnie Soutar, Head of Veterinary Services at Scottish Sea Farms, as its new Chairperson. The appointment makes Soutar the Scottish SPCA's first Chairperson to specialise in fish health and welfare, as well as the first in-house company veterinarian to take up the role.

With a degree in Veterinary Medicine & Surgery gained at The Royal (Dick) School of Veterinary Studies at the University of Edinburgh, Soutar worked at a variety of veterinary practices for several years before returning to study for an MSc in Aquatic Veterinary Studies at the University of Stirling's world-renowned Institute of Aquaculture. In the years since he has gone on to become one of the country's most respected fish veterinarians, working with salmon farmers at home and abroad to advance health and welfare. This includes two terms as President of the Fish Veterinary Society and a key advisory role on the recently announced Farmed Fish Health Framework.

Commenting on his new appointment, Soutar said: "To be elected Chairperson of the Scottish SPCA is a huge honour. The charity provides a lifeline service to vulnerable animals the length and breadth of Scotland – domestic, farm and wildlife – all of which is only made possible through charitable donations. I look forward to playing my part in ensuring those donations are put to the very best use, helping the Society achieve its core purpose of improving animal welfare in Scotland."

Soutar, who succeeds former Chairperson Harry Haworth, previously served as a Scottish SPCA Board member from

2013 then Vice-Chairperson from 2015.

Scottish SPCA Chief Executive Kirsteen Campbell said: "Everyone at the Scottish SPCA is delighted to welcome Ronnie as our new Chairperson. While serving as a Board member for the past five years, Ronnie's expert animal welfare knowledge, business acumen and strategic thinking has been of real benefit to our team. We look forward to continuing to work together to help animals and people across Scotland."

The unremunerated role is expected to be for four years, during which time Soutar will continue both his role as Head of Veterinary Services at Scottish Sea Farms and in small animal practice management.


Said Soutar: "Small animal practice is similar to human medicine in that it focuses on what can be done to improve the health of that one individual. Salmon farming, in contrast, is about food production; it's part of a drive to feed the world in a way that is as responsible as it is sustainable in terms of animal welfare and the environment.

"It's a new and expanding sector, and there are still lessons being learned about dealing with animals on such a scale. However, the focus is very firmly on how to keep the salmon happy and healthy throughout their lifecycle – something I'm proud to play a role in."



Ronnie Soutar


©SSF CS Ronnie Soutar[1]


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# THE 2018 GENERAL ASSEMBLY OF THE EUROPEAN AQUACULTURE SOCIETY

The 2018 General Assembly of the European Aquaculture Society was held on Sunday, August 26, 2018 at Le Corum Congress Centre in Montpellier, France during the AQUA 2018 event.

30 EAS members (and 2 non-members) attended the GA and 8 procuration forms were received prior to the meeting – in the name of the President or other members. Hence a total of 40 EAS members were represented.

## 1. Welcome, apologies and approval of the agenda

EAS President 2016-2018 Bjorn Myrseth opened the meeting at 17h15 and welcomed those present. He informed members of the procurations received. Copies of a compilation of GA material, containing EAS membership status and activity report and the audited financial report for 2017, had been sent to all members prior to the assembly and further copies were made available to those present. In accordance with the statutes, the agenda had been circulated to EAS members at least three weeks before the assembly.

He informed members of the agenda of the Assembly, including the required approval for accounts and also of the new Board members, and also including an update on the implementation of the EAS Strategy for development.

He noted that no additional items to the agenda had been requested by members and hence asked the Assembly to approve the agenda.

**The GA unanimously approved the agenda with no additional items.**

## 2. Adoption of the minutes of the 2017 General Assembly

The minutes of the last General Assembly (held in Dubrovnik, Croatia at AE2017) were published in the Aquaculture Europe newsletter, November/December 2017, pp. 11-18.

**The GA unanimously approved the adoption of the minutes of the 2017 General Assembly.**

## 3. EAS Membership & Activity Report

Executive Director, Alistair Lane presented the current membership status and recent trends:

Observations:

- Membership to date in 2018 is based on July figures and made up of 265 renewals from 2017; 56 new and past members and just 2 new and renewals with registration to AQUA 2018. This last figure is expected to increase by around 55, giving a year-end estimate of 378, compared to budget estimate of 390. It is still, however, lower than the last 4 years, where new registrations with the AE events have been numerous.
- Separate category for student members (with registration fee of just €30), that was previously included in the Individual category. No more e-membership category.
- 187 members paid their fees online and the percentage continues to increase.
- EAS had three Premium Sponsors in 2017 – MSD, Marine Harvest and Evonik. However, at the start of 2018, MSD

Category	2012	2013	2014	2015	2016	2017	2018 to date
Individual	395	336	452	381	407	351	186
Institutional	32	29	42	36	38	43	38
Students						56	51
Life Member (paid)	9	9	11	16	18	21	24
Premium Sponsors	2	2	3	3	3	3	1
Hon. Life & Life (Past Presidents)	23	25	24	24	25	24	23
E-members	15	25	13	13	15		
<b>TOTAL</b>	<b>476</b>	<b>426</b>	<b>545</b>	<b>473</b>	<b>506</b>	<b>498</b>	<b>323</b>

Note: 2018 figures are to July 2.



and Marine Harvest decided not to continue, having supported EAS for several years. Evonik renewed, as did Sparos as sponsor of the EAS Student Group

### Principal EAS activities in 2017/8

#### Home office

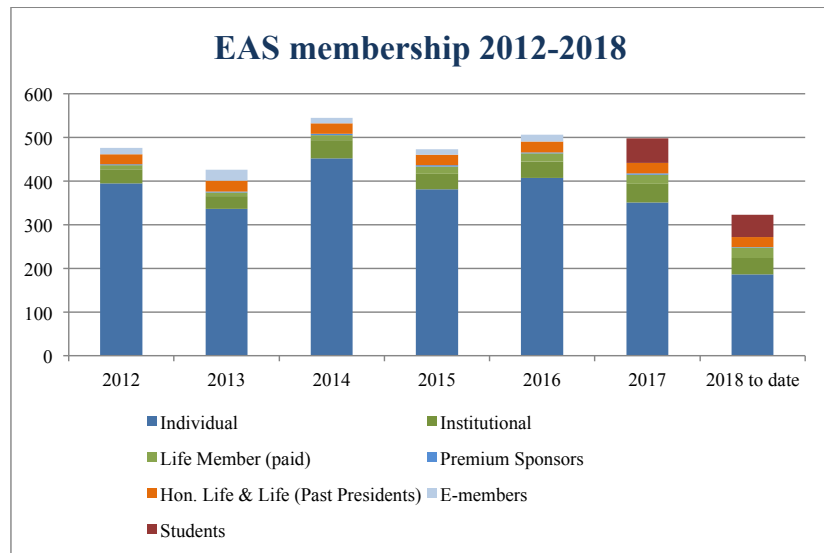
- Follow-up of EAS Strategy and putting in place new tools
  - Membership and benefits
  - AE event management
  - Partnerships & alliances (regarding meeting organisation)
- Important changes to EAS databases
  - New fields for activities & interests
  - GDPR issues
  - New template for EAS website
- 2018 Elections
- Incorporation of Student representative to the EAS Board

#### AE events

- Highly successful AE2017 event in Dubrovnik
  - Total participation 1688
  - Full conference delegates 1294
  - Industry Forums participants 210
  - Abstracts received 714
  - Trade show booths 92
  - Financial support €85k
- Planning and execution of the AQUA 2018 event in Montpellier
- Initial planning for AE2019 “Our Future: Growing from Water” in Berlin
- Approval of Cork, Ireland for AE2020

#### Projects

- Closing up COLUMBUS (Monitoring, Managing and Transferring Marine and Maritime Knowledge for Sustainable Blue Growth) <http://www.columbusproject.eu/>
- First year of EURASTiP (Promoting multi-stakeholder contributions to international cooperation on sustainable solutions for aquaculture development in South-East Asia) <http://eurastip.eu/> with EAS acting as a third party to EATiP.
- First year of VALUMICS (Understanding food value chain and network dynamics) <http://valumics.eu/> The key goal of VALUMICS is to provide decision makers throughout food value chains with a comprehensive suite of approaches and tools that will enable them to evaluate the impact of



strategic and operational policies to enhance the resilience, integrity and sustainability of food value chains for European countries.

- Member of the External Advisory Board of CtrlAQUA (Centre for Research Based Innovation in Controlled-environment Aquaculture) funded by the Research Council of Norway.

Bjorn Myrseth then invited questions and comments from the members on the membership status and activity summary.

One member asked if we knew why 2 of our Premium Sponsors had decided to end their support in 2017. AL replied that one of them (Marine Harvest) had decided to give other organisations and initiatives support, and the other (MSD) after many years support of EAS and following staff changes for global marketing decided that they had no strategic focus in Europe.

No other questions were asked.

**The GA unanimously approved the membership status and activity report.**

## 4. EAS Financial Reports for approval by the GA

EAS Treasurer, Margriet Drouillon, presented two items to the GA for approval.

These were the audited financial report for 2017 and the EAS 2019 Budget.

### Audited financial report for 2017

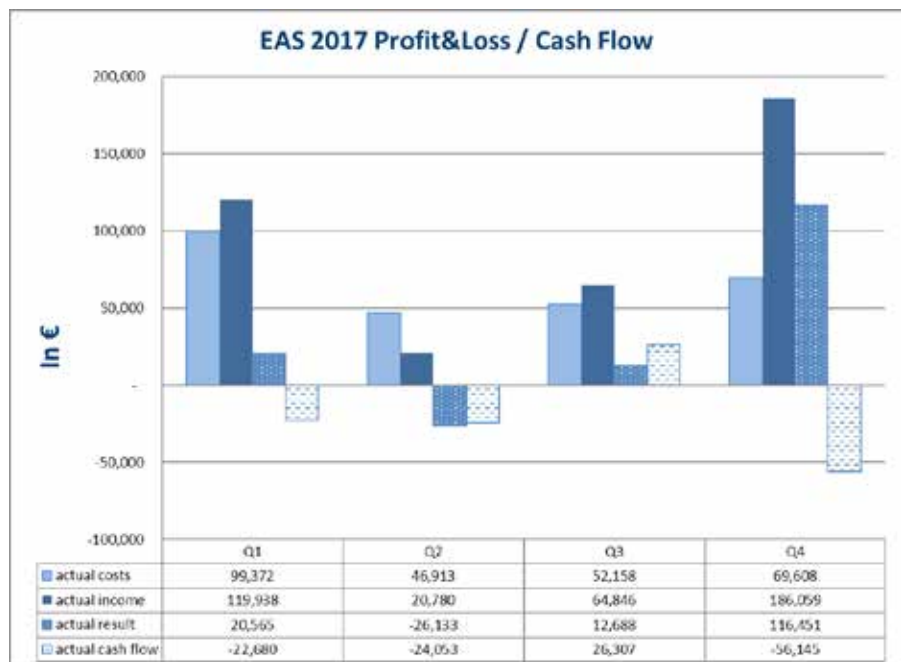
The 2017 EAS net result was €123.571 (against a budget of -€23.992) with a balance total of €553.384 (against 2016 balance of €441.556).

A summary table, with figures in k€, shows the result against budget for each of the three principal activities – home office, AE events and Projects.

Total receipts were 392k€ (budget 263k€) against expenditure of 268k€ (budget 287k€).

EAS Whole Year 2017						All figures in k€		
	Home Office		AE congress		Projects		Total	Total
EXPENDITURE	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget
PERSONNEL	-113	-127	-30	-23	-21	-19	-164	-168
OFFICE COST	-13	-17	-1	-1	0	0	-13	-18
PRINTING / POSTAGE	-8	-8	-2	-3	-1	0	-11	-12
ITC COST	0	-1	-13	0	0	0	-13	-1
TRAVEL	-8	-12	-12	-7	-3	-8	-23	-26
WEBSITE/MARKETING	-2	-1	-1	-1	0	0	-3	-2
PROJECT ADVANCE COST	0	0	-27	-29	0	0	-27	-29
EAS SUPPORT TO OTHER INITIATIVES	-3	-3	0	0	0	0	-3	-3
FINANCIAL COST	-1	-1	0	0	0	0	-1	-1
OTHER COSTS	-4	-28	0	0	-7	0	-11	-28
<b>TOTAL EXPENDITURE</b>	<b>-151</b>	<b>-198</b>	<b>-85</b>	<b>-63</b>	<b>-31</b>	<b>-26</b>	<b>-268</b>	<b>-287</b>
<b>RECEIPTS</b>								
MEMBERSHIP DUES	53	50	0	0	0	0	53	50
PUBLICATIONS	9	11	0	0	0	0	9	11
GRANTS	0	1	40	0	0	0	40	1
SPONSORING	26	26	25	25	0	0	51	51
PROJECT ADVANCE INCOME	0	0	208	124	30	26	238	150
FINANCIAL INCOME	0	0	0	0	0	0	0	0
MISCELLANEOUS	0	0	0	0	0	0	0	0
<b>TOTAL RECEIPTS</b>	<b>89</b>	<b>88</b>	<b>273</b>	<b>149</b>	<b>30</b>	<b>26</b>	<b>392</b>	<b>263</b>
<b>RESULT</b>	<b>-62</b>	<b>-110</b>	<b>188</b>	<b>86</b>	<b>-2</b>	<b>0</b>	<b>124</b>	<b>-24</b>

In general, quarters 2 and 3 have fixed costs with very little revenues and usually leading to significantly negative cash flow. However, in 2017 cash flow was only slightly negative in Q2 with revenues for sponsorship collected early by EAS and positive in Q3 with an advance payment received from MF Cooksey for the AE2017 event, as recommended by the EAS Treasurer, Margriet Drouillon. However, the cash flow remained negative in Q4, as although the payments to receive from MF Cooksey for AE2017 were booked, they were not actually received in 2017 and appear as (short-term) accounts receivable on the balance sheet.





## Home Office

Total membership in 2017 was 498 (compared to 506 in 2016 and 473 in 2015), generating fee revenues of €52.991 (budget €50.118). While member renewals were slightly higher than in 2016, the re-recruitment of previous members (66) was significantly lower than last year. New and previous members joining with registration for AE2017 was 142, compared to 152 for AE2016.

EAS Premium sponsorship was exactly on budget (22.5k€) with Marine Harvest, MSD and Evonik as Premium Sponsors and Student Group Sponsorship slightly higher than budget, with Sparos as sponsor and Spranger providing travel grant support. The grant of €1.501 from the Provincial Government of West Flanders was not received and no reason was provided despite several requests for information.

The overall expenditure on Home Office was 47k€ lower than budget, with all cost categories coming in lower than anticipated, except for additional website costs on transferring over to the new domain name and hosting arrangements.

Home office personnel cost allocation was 14k€ lower than budget, with slightly more time being allocated to future meetings. Time allocated to project participation was slightly over budget.

The reduction of social liabilities on the balance sheet from €100k to €90k gave an extraordinary income of the same amount.

## AE events

Conference costs in the EAS bookkeeping are only those actually incurred by EAS over the year, and not the full costs of the event, as much of these are paid by our conference director, John Cooksey (MFC), from revenues collected for registration and booth sales.

Overall expenditure on AE events was 23k€ higher than budget and especially so for preparation of AQUA 2018 – including significant time on successful applications for grant support – and AE2019, where 17k€ of expenses occurred in 2017 by MF Cooksey were invoiced back to EAS. This amount includes the first payment to the Estrel Congress Centre on contract signature (€12.500) plus costs for the first SC meeting.

For AE2017, the EAS Bookkeeping contained total receipts of 227k€ (from grants, sponsorship and especially from settlement payments from MFC) against expenditure of 40k€ (mostly personnel and travel costs) and leading to a result of 188k€ against budget of 86k€. A 40k€ grant from the EU EMFF funds was obtained with our Croatian partners and this had a significant impact on the result. The 2017 accounts



show only 12.5k€ of the 25k€ Biomar Gold Sponsorship for AE2017, but the other half of the total amount had already been collected in 2016. Likewise, half of the AQUA 2018 Gold Sponsorship was collected in 2017 and hence appears here.

For the fourth consecutive year, the Aquaculture Europe result has greatly exceeded expectations and attracted attendance of 1688 in Dubrovnik for AE2017 (1700 in Edinburgh in 2016, 1060 in Rotterdam in 2015 and 1450 in San Sebastian in 2014).

## Projects

During 2017, EAS continued work on the Horizon 2020 project – COLUMBUS – Monitoring, Managing and Transferring Marine and Maritime Knowledge for Sustainable Blue Growth and started two new projects – EURASTiP – Promoting Multi-Stakeholder Contributions to International Cooperation on Sustainable Solutions for Aquaculture Development in South-East Asia (3 years) and VALUMICS – Understanding food value chains and network dynamics (4 years).

Expenditure on ongoing projects is usually brought back to zero in the bookkeeping, with the adjustment in revenue being carried over to the balance sheet against receipt of the final payment for that project.

Personnel cost allocation to Columbus was very close to budget, although allocation to EURASTiP somewhat lower. Personnel costs were also incurred for the EAS contribution to a new project proposal on the application of open science to IMTA, but which was not successful.


*continued on page 30*

**The 2019 EAS General Assembly will take place in Berlin, Germany on Wednesday, October 9th during our Aquaculture Europe 2019 event.**

**We very much hope to have you with us!**

**Balance sheet**

The overall balance of EAS accounts in 2017 was €553.385 against the 2016 balance of €441.556.

 <b>European Aquaculture Society (EAS)</b>		
Annual account in EUROS for the financial year from 01/ 01/ 2017 to 31/ 12/ 2017		
<b>BALANCE SHEET</b>		
	<b>2017</b>	<b>2016</b>
<b>Assets</b>		
Tangible fixed assets (office equipment)	-	324
Financial investments	-	-
<b>Total fixed assets</b>	<b>-</b>	<b>324</b>
Publication stock value	-	-
AQUI royalties	-	-
EU project payments	-	-
Grant/ MFC payments	182,961	-
Other receivables	1,074	1,731
Total accounts receivable (less than one year)	184,035	1,731
Bank savings account (cash reserves)	329,150	375,901
Bank current accounts plus cash in hand	6,834	36,655
Pre-paid expenses (conferences)	33,365	26,944
Other current assets	-	-
<b>Total current assets</b>	<b>553,384</b>	<b>441,232</b>
<b>TOTAL ASSETS</b>	<b>553,384</b>	<b>441,556</b>
<b>Liabilities</b>		
Organisation's funds	218,509	218,509
Accumulated result (previous years)	- 31,642	- 96,519
Result (current year)	123,571	64,876
<b>Total equity</b>	<b>310,437</b>	<b>186,866</b>
Provisions for social liabilities	90,000	100,000
Provisions for exceptional charges	70,000	70,000
<b>Total provisions for liabilities and charges</b>	<b>160,000</b>	<b>170,000</b>
Accounts payable (less than one year)	6,926	37,334
Taxes, remuneration and social security	19,577	19,352
<b>Total accounts payable</b>	<b>26,503</b>	<b>56,686</b>
Membership fees/ advertising received for following year	5,753	8,273
EU project payments received for following year	50,692	19,732
<b>Total deferred income</b>	<b>56,445</b>	<b>28,004</b>
<b>TOTAL LIABILITIES</b>	<b>553,384</b>	<b>441,556</b>



Total cash assets were €335.984, compared to €412.556 in 2016. However, the short-term receivables of €184.035 represent the AE2017 reconcile payments to be received in January 2018 and this significantly boosts the current assets. Deferred income is 56k€ from 2018 membership fees already paid in 2017 from the renewals process and EU project (down)payments received in 2017 for 2018 activities.

The social liabilities were reduced from €100.000 to €90.000 to reflect the sum paid into the EAS Pension Plan during 2017.

The remaining tangible fixed assets (office equipment) is now fully depreciated, hence removed from the balance sheet.

## Certification of accounts

The 2017 accounts and financial statements were controlled and certified by the EAS accounts commissioner Mr. Ludo Quirijnen on February 23, 2018.

EAS Whole Year 2019		All figures in k€								
	Home Office		AE congress		Projects		Total		Total	
EXPENDITURE	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget
PERSONNEL	0	-139	0	-22	0	-11	0	-172	0	-172
OFFICE COST	0	-16	0	-1	0	0	0	-17	0	-17
PRINTING / POSTAGE	0	-8	0	-5	0	0	0	-13	0	-13
ITC COST	0	-1	0	-54	0	0	0	-55	0	-55
TRAVEL	0	-13	0	-10	0	-8	0	-31	0	-31
WEBSITE/MARKETING	0	-3	0	0	0	0	0	-3	0	-3
PROJECT ADVANCE COST	0	0	0	-33	0	0	0	-33	0	-33
EAS SUPPORT TO OTHER INITIATIVES	0	-3	0	0	0	0	0	-3	0	-3
FINANCIAL COST	0	-1	0	0	0	0	0	-1	0	-1
OTHER COSTS	0	-1	0	0	0	0	0	-1	0	-1
<b>TOTAL EXPENDITURE</b>	<b>0</b>	<b>-185</b>	<b>0</b>	<b>-124</b>	<b>0</b>	<b>-20</b>	<b>0</b>	<b>-328</b>	<b>0</b>	<b>-328</b>
<b>RECEIPTS</b>										
MEMBERSHIP DUES	0	45	0	0	0	0	0	45	0	45
PUBLICATIONS	0	10	0	0	0	0	0	10	0	10
GRANTS	0	0	0	0	0	0	0	0	0	0
SPONSORING	0	18	0	25	0	0	0	43	0	43
PROJECT ADVANCE INCOME	0	0	0	180	0	20	0	199	0	199
FINANCIAL INCOME	0	0	0	0	0	0	0	0	0	0
MISCELLANEOUS	0	0	0	0	0	0	0	0	0	0
<b>TOTAL RECEIPTS</b>	<b>0</b>	<b>74</b>	<b>0</b>	<b>205</b>	<b>0</b>	<b>20</b>	<b>0</b>	<b>298</b>	<b>0</b>	<b>298</b>
<b>RESULT</b>	<b>0</b>	<b>-111</b>	<b>0</b>	<b>81</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>-30</b>	<b>0</b>	<b>-30</b>
adjustments future meetings projects			0	33	0	0	0	33	0	33
Result after adjustment					0		0	2	0	2

## 2019 Budget

The EAS 2019 Budget provides a net result (after adjustment for projects & future events) of €2.630, with receipts of €297.838 against expenditure of €328.008. (see table above)

### Home office revenues

Membership revenues (45.3k€ from 471 members) are based on an increase compared to 2018 (378), but lower than in previous years (498 in 2017 and 506 in 2016). The Board has considered several options to increase member numbers (further empowering thematic groups, assessing membership with AE registration) and these are currently being enacted. Membership is now on a 12-month basis with direct debit each year as a payment option.

Publications include advertising revenues of €1.500, magazine subscriptions and AQUI royalties of €8k as per agreement.

EAS Premium sponsorship is based on the renewal of the one existing agreement with Evonik and one new. The EAS\_SG grant of 3k€ from Sparos is included in Q1.

No provision has been made for EAS grants.

### Home office costs

Personnel costs include a provision for the 'standard inflation rate' of 2%. Pension Plan payments as per contract.

Printing and postage costs as per previous years (magazine & newsletter).

Travel costs include one statutory Board AE2019 and a second in the spring. Total cost for the two Board meetings is capped at €10k.

Software and web hosting costs include subscriptions to software and https certification that shows EAS as a secure site for members' data and financial transactions.

Costs for organising Thematic Group activities at AE2019 are included in the AE2019 budget (total 3k€).

### AE events

AE2019 is included for EAS costs/revenues only in our accounts. Costs include meeting preparation and down-payments as per contract with the convention centre.

Revenues include sponsorship from Biomar and the over-

all settlement from MF Cooksey to achieve the adjusted AE2019 result (€53.751) and the EAS Contribution (60k€). The settlement is split into two - with an advance payment of 60k€ to ease cash flow in Q3 and settlement of outstanding balance in Q4.

AE2020 expenditure is cttee travel and congress pre-payments.

AE2021 expenses include a potential site visit in Q4 prior to final selection of location.

Costs for all future events are offset in the 'adjustments for future meetings' on the line below the result for each event.

## Projects

Second years of two projects - EURASTiP and VALUMICS at budgeted levels. A new proposal is not budgeted in 2019.

Bjorn Myrseth then invited questions and comments from the members on the EAS financial reports. No questions were forthcoming.

Outgoing EAS Treasurer Margriet Drouillon expressed her gratitude and pleasure of having served 6 years as EAS Treasurer. She thanked the Assembly, the EAS Board and the home office staff for their friendship and support over the years. She also expressed her sincere thanks for the EAS Distinguished Service Award presented at the AQUA 2018 Opening Plenary session, saying how surprised and honoured she felt to have received this award.

**The GA unanimously approved the EAS 2017 Audited Financial Report and the EAS 2019 Budget.**

## 5. Update on the actions of the new EAS Strategy regarding membership, new networking tools and conference organisation

Bjorn Myrseth provided an update on the status of actions to support the EAS Strategy. These had been presented to the Assembly at its meeting in 2017 and were briefly commented upon by the President:

**AE events:** The Board is concentrating on enacting the proposals of the working group on conference management, with several key actions already having been implemented for the preparation of AE2019 in Berlin.

**Adopt a Student:** This was launched earlier this year and several students and mentors have expressed their interest in taking part. The first two pairs have already had initial contacts and are meeting at AQUA 2018 to decide how they will work to achieve their objectives.

**Webinars:** The EAS Thematic Groups have been asked to prepare a plan for topics and presenters, so that a calendar of webinars can be presented to EAS members. The home office has been looking into several tools to conduct the webinars and a test webinar will be made in September.

**Data and statistics:** The home office has been working with our web developers to see how statistics may be derived automatically from our membership database. Members are encouraged to complete their interests/subject data in their online profile, so that the objective of better online networking between EAS members can be achieved.

**EAS Community:** After lengthy discussion within the Board, several options are being discussed that will require professional help and more resources to enact actions under consid-

eration. The underlying idea is to grow the EAS network and enable better and wider networking. The Board decided that if the AQUA 2018 result is good (financially), then we will move forward on this.

**Deep Dive meeting:** The original idea here was for EAS to organise or propose organisational support to others for short focussed events that allow to go in more depth into a priority topic for the aquaculture sector. However, after considering various elements of this proposal, the Board have decided not to go ahead with this development, but to focus on other strategic actions.

## 6. Elections 2018 – changes approved by the Board to the EAS Bye-laws

Alistair Lane explained that a significant change was introduced prior to the call for candidates for the 2018 elections, that allowed (for the first time) a place on the EAS Board of Directors for a representative of the EAS Student Group. This was to better integrate the EAS\_SG into the management of the society. Rather than increasing the size of the Board, it was also decided not to have a separate election for the post of Treasurer, but for the elected Board to name a Treasurer from its elected members.

**This did not imply changes to the EAS Statutes (that mention the Treasurer but not the voting mechanism) but lead to several changes to the Bye-laws (that have been approved by the Board and do not need GA approval).** The changes are therefore presented here for information:

## TITLE II THE GENERAL ASSEMBLY

### Article 7. Election of Board Members

Elections are organised every two years for the roles of EAS President-Elect, **EAS Student Representative** and EAS Board Members.

The EAS Elections Committee is responsible for overseeing the elections process. The Committee is made up of the President (acting as Committee Chair), the President-Elect last two Past Presidents.

...

Once the Board members are elected, they will **nominate the EAS Treasurer** from within the elected Board.

...

The following rules apply at the end of each term of the EAS Board:

- The President-Elect automatically becomes EAS President for the following two years
- At the end of her/his term, the EAS President becomes EAS Immediate Past-President for the following two years, during which she/he will attend meetings of the Board but will not have a vote.
- At the end of her/his term, the EAS Treasurer may run for a second term in that position or offer her/his candidature for President-Elect.**
- Under no circumstances may any EAS Member remain in a voting position on the Board for more than six consecutive years.

The new Board Members will be approved by the General Assembly.

The election results will be communicated in an official EAS publication.





## TITLE III THE BOARD OF DIRECTORS

### Article 9. Replacement of members – ORIGINAL TEXT

In case a position of Board member becomes vacant, this vacancy will automatically be filled by the non-elected candidate having the most votes. If two or more non-elected candidates have the same number of votes, the Election Committee will assign this office.

### Article 9. Replacement of members -- TEXT RE-DRAFTED FOR CLARITY

In case a position of Board member becomes vacant the President shall appoint a substitute to fill the remainder of the term, except for the vacancy created by the election of Vice-President, who is automatically substituted by the candidate ending ninth in the elections for Board Member. If two or more candidates for the office of this ninth Director tie, the Election Committee will assign this office.

## 7. Transfer of the EAS Presidency from Bjorn Myrseth to Gavin Burnell (President 2018-2020)

Bjorn Myrseth asked Alistair Lane to proceed with the transfer of the EAS Presidency and the introduction of the 2018-2020 Board members.

As is the tradition, the outgoing President, Bjorn Myrseth presented the conference badge President ribbon to new President Gavin Burnell. In return, Gavin removed the President ribbon from Bjorn's badge and replaced it with a Past President one.



Bjorn Myrseth, EAS President from 2016-2018, but also from 1992-1994

He also presented a plaque to Bjorn to commemorate his second term as EAS President. He noted that Bjorn is the only President to have served twice, the first being from 1992 – 1994, and that he was one of the founding members of EAS back in 1976.

He warmly thanked Bjorn for his very long service and support to EAS adding that he remains on the 2018-2020 Board as Past President.

## 8. Introduction of the newly elected Officers and Board Members for 2018-2020 for approval by the General Assembly

Alistair Lane continued with the introduction of the newly elected Board members. As in previous years, the ballot was conducted online. Of the 209 EAS ((renewed and new)

members that were eligible to vote, 187 exercised that right, giving a rate of 63.4%. This compares to figures of 43.1% in 2016 and 55.2% in 2014. One candidate presented himself for the post of President-Elect. Ten candidates for the post of Board Member. Three candidates for the post of EAS Student Representative. All candidates were approved by the Elections Committee, made up of the President, the President-Elect and two most recent Past Presidents.

### The newly-elected Board members for 2018-2020 are as follows:

- *President Elect (becoming President in 2020)*  
Herve Migaud, UK

- *Board members*  
Henrice Jansen, Netherlands  
Constantinos Mylonas, Greece  
Bente Torstensen, Norway  
Luisa Valente, Portugal  
Marc Vandeputte, France

- *Student Representative*  
Kathrin Steinberg, Germany

The Board is completed by President Gavin Burnell and Past President Bjorn Myrseth.

The GA was also informed that Bente Torstensen, Norway is the 2018-2020 EAS Treasurer.

The GA unanimously approved the 2018-2020 Board of Directors

## 9. Statement by the EAS President 2018-2020.

Gavin Burnell thanked the EAS membership for having elected him as President-Elect in 2016. Being officially retired from University College Cork, he has more time now to devote to EAS and maintains his Editor-in-Chief position for our Aquaculture International journal.

He is also chairing the Steering Committee of the Aquaculture Europe 2020 event that will be in Cork end-September of that year.

He asked members to continue their support of EAS and encourage others to join us.

## 10. Any other business and closure.

No other official agenda items had been proposed by EAS members, although one member had a request for EAS to look into other time/day during the AE event to hold the Assembly, that might encourage more EAS members to attend. Gavin replied that we will indeed look into this.

With no other business on the agenda, and with no further questions or comments, Gavin Burnell closed the 2018 General Assembly at 18h20.

Minutes approved by EAS President 2016-2018 Bjorn Myrseth and by Gavin Burnell EAS President 2018-2020. September 9<sup>th</sup> 2018.

# EAS Mentoring: “Adopt a Student”

EAS members have a collective knowledge and experience that runs into thousands of years! ‘Senior’ members of EAS that have supported the society ‘since the beginning’ are also in many cases leaders in their fields of expertise and highly-cited authors.

Over recent years, our EAS Student Group has re-invigorated and strengthened our student membership and students that follow us on social media. Student participation at recent Aquaculture Europe events has also been impressive and an ideal chance to meet and have a chat with these ‘seniors’.

**We therefore have the basis to put in place a mentoring activity, where students and seniors can interact informally and not just at AE events. We are calling this activity “Adopt a Student.”**



## WHAT'S IN IT FOR



### For students

- Providing you a wealth of knowledge and experience
- Giving you the chance to interact informally with a ‘key reference’ in your area
- Giving you the chance to interact outside ‘the normal university structure’.

### For mentors

- Providing you an opportunity to share your knowledge
- Keeping you ‘up to speed’ with new approaches and new ways of thinking
- Honing your social media skills

### For EAS

- Spreading knowledge among the network
- Strengthening the bond between students and seniors
- Showing our desire to maximise the networking that EAS membership offers.

## HOW DOES IT



The best mentoring relationships have clearly defined ‘rules of engagement’. It is therefore necessary for the pair to agree on reasonable objectives, an agenda for their meetings and how frequently they will meet. This could include:

- How you will meet - in person, by phone, by skype...
- How often you will meet - once a week, once a month
- How long meetings (and the actual mentoring itself) will last.
- What are your goals and what will be the agenda for each meeting.

It’s important to set expectations upfront – and both mentor and mentee should be realistic about what you expect, what you can offer and what you need.

Subjects for the mentoring might include providing advice on how to approach tasks, suggestions on people to contact, support in proof-reading of manuscripts, discussion on possible career options, finding funding.... But there are many others too!



## SPREADING THE WORD



To enable others within the EAS membership to be informed and hopefully inspired, we would ask the pairs to communicate their activities and approaches to everyone else.

This would include:

- Writing short 'stories' for the EAS newsletter and the EAS\_SG social media channels on what you are up to, how you are working, what your goals are and how you are progressing towards them.
- Writing a short annual summary report that brings together the above over the whole year for the EAS magazine and to let the EAS Board have an idea of the impact of the initiative.
- Meeting up at our Aquaculture Europe events and using the meeting to make a short film together to post online.
- Meeting other pairs at AE events and presenting your experiences as part of the EAS\_SG workshop or other sessions.



## I'm interested! How do I sign up?



We welcome your 'candidature' as either mentor (a senior) or mentee (a student).

The EAS secretariat will coordinate "Adopt a Student" so please send us some information about yourself.

This should include name and contact details, interests (species, environments, technologies, etc), level and place of education (for students), your initial ideas on what might be your incentive to take part and any preferences for the nationality or place of work of your partner.

EAS will then look at the best pairings and we'll put you in contact.

That's it! You'll then be up and running and you can both plan your first meeting!

**And how about this? EAS will provide both mentor and mentee FREE MEMBERSHIP while they are active and fulfilling the Adopt a Student activities!**



## Major European Research Project Launched to help eco-intensification of the European Aquaculture Sector

The GAIN research project, funded by the H2020 European Union (EU) programme, will support the ecological intensification of aquaculture in the European Union (EU) and the European Economic Area (EEA) over the next three and a half years. Eco-intensification of European aquaculture requires the integration of scientific and technical innovations, new policies and economic instruments, as well as the mitigation of social and regulatory constraints, in order to promote the implementation of the principles of circular economy in Aquaculture (see Table 1). GAIN will take up this challenge, by pursuing two main objectives, i.e. increasing production, efficiency and competitiveness of the industry, while ensuring industry and environmental sustainability as well as food safety and responsible production.

GAIN will support aquaculture production and communities by providing cost-effective innovative solutions and technologies, based on the principles of circular economy. Leveraging innovative processes, GAIN will integrate aquaculture production systems and also other sectors which can benefit from the re-use of aquaculture side-streams, as well as from that of by-products of fish and shellfish processing.

GAIN will implement new/emerging technologies and innovations in nutrition, inter-connected sensor monitoring and data-driven management of aquafarms, supported by Big Data analytics and Artificial Intelligence technologies. This approach will lead to the reduction of operational costs while enhancing fish health and welfare. GAIN will assess the sustainability of the innovative production processes, applying a systematic approach incorporating the “typical farm” framework and other resource accounting methodologies, to provide an *ecological and economic intensification of aquaculture* (see, Fig. 1).

GAIN brings together a multidisciplinary consortium of 20 partners, coordinated by Roberto Pastres from Ca' Foscari of Venice, (Italy). The Consortium includes 8 Industry partners: IBM Ireland Limited (IE), Longline Environment Limited (IE), SPAROS Lda (PT), Salten Havbrukspark AS (NO), Multivector AS (NO), Gildeskal Forskningsstasjon AS (NO), Lebeche Spain SLU (ES), Sagremarisco-Viveiros de Marisco Lda (PT); 10 partners from research institutions, including Canadian and Chinese: Ca' Foscari University of Venice (IT), University of Stirling (UK) AWI - Alfred-Wegener-Institut (DE), CSIC - Consejo Superior de Investigaciones Científicas (ES), Wageningen University (NL), Thünen-Institut:



(Photo courtesy GIFAS)

Photo 1: Oldervika salmon cage farm, GIFAS, Norway

Startseite (DE), ABI - Agrifood and Biosciences Institute (UK), ZUT - Zachodniopomorski Uniwersytet Technologiczny w Szczecinie (PL) Dalhousie University (CA), South China Sea Fisheries Research Institute, CAFS (CN); 2 NGOs partners: ANFACO – CECOPESCA (ES), FEM - Fondazione Edmund Mach (IT); NOAA -National Oceanic and Atmospheric Administration (US) also participates to GAIN as UNIVE third party.

### Results that GAIN expects to achieve include:

- 1 Bring to the market new feeds and products, based on aquaculture side streams and by-products as well as cost effective commercial applications for optimizing the management of finfish and shellfish farms, based on an inter-connected sensor network and Artificial Intelligence technologies.
- 2 Secure EU markets by increasing the offer of high quality fish and seafood products from a sustainable supply of EU aquaculture products, contributing to reducing the dependency of the EU on imports of this products from international markets;
- 3 Improve the sustainability of the European aquaculture by optimizing production systems and minimizing environmental impact;



(Photo courtesy Longline Ltd.)



(Photo courtesy IM-CSC)

Photo 2: Oyster farm, Northern Ireland

Photo 3: Fisheries discards to be used to produce fish hydrolisates to be used in GAIN feeds.

- 4 Consolidate eco-efficient aquaculture practices to ensure access to high-value niche markets;
- 5 Improve the professional skills and competences of those working and being trained to work under circular economy principles within the blue economy.

## Table 1 GAIN project objectives

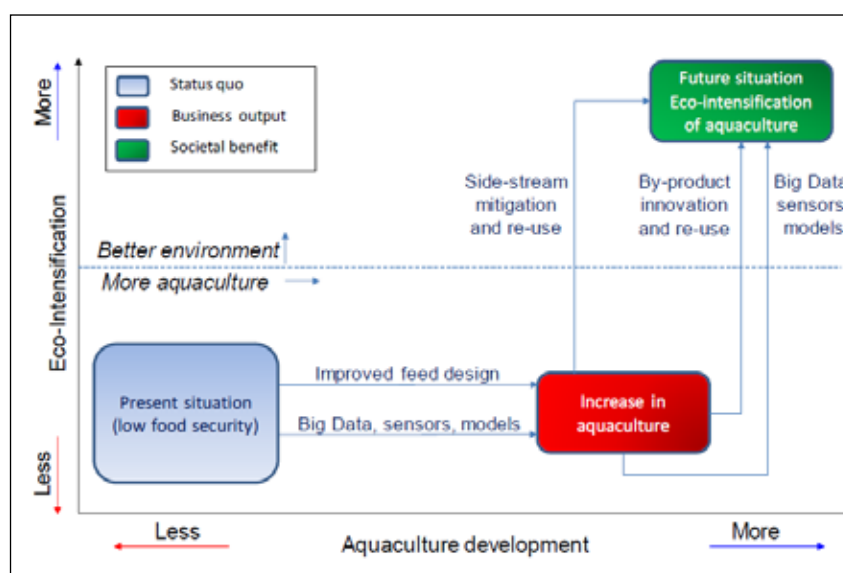


Fig 1. The GAIN project approach on supporting aquaculture development through eco-intensification, while bringing societal benefits.

**This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773330 (GAIN).**

**More info:**

<http://www.unive.it/gainh2020project>

twitter

<https://twitter.com/gain2020>

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Develop and optimize sustainable feeds, without increasing the pressure on land and fish stocks;

Increase volume and add value to cultivation through innovation in both by-products and side-streams ensuring improved secondary materials, increase profit and minimization of the environmental footprint;

Improve the management of finfish and shellfish farms, in terms of feed conversion (FCR), fish welfare and reduction of wastes, by combining sensors, biomarkers, machine learning and predictive mathematical models;

Support integrated policies and address current barriers to the implementation of the principles of circular economy in aquatic production.



# MEMBERSHIP

## The European Aquaculture Society

Since 1976, EAS has brought together individuals and companies in the sustainable development of European aquaculture - to make contacts, share information and promote multi-disciplinary research



As a member of EAS, you are part of a network of more than 500 important aquaculture stakeholders in 40 countries that promotes multidisciplinary research and communication of research outcomes and supports young people and those from lower income countries to be a part of EAS.

Furthermore, your membership gives you the benefits of

- requesting and sharing information and contacts;
- finding partners for actions, initiatives and projects;
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- having discounts on other aquaculture press;
- having discounts to aquaculture events that are supported by EAS.

Our annual Aquaculture Europe events allow the chance to

- have discounts on attending the most well-attended annual European aquaculture conference and trade show;
- present and hear the latest research in all aspects of European aquaculture;
- meet old friends and make new ones.

EAS is comprised of institutional, individual and student members.

No professional qualifications are required for any of the membership categories – simply an interest to participate in the development of sustainable aquaculture in Europe.



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A membership period is 12 months.

See the membership benefits and join online at

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## Smart glasses enable new health management benefits

Over the past decade, the integration of new technologies has significantly changed the way we communicate, consume or work. We use them every day, without even realizing it.

The potential of these technologies was quickly assimilated by the agriculture sector to gain in technicality, profitability, traceability and to respond promptly to the expectations of manufacturers and consumers. The use of specific business software, remote tracking sensors and digital services forces their partners to evolve at the same pace and to offer new services.

In aquaculture too, technology to improve efficiency is widely used. In health management, innovative technical solutions are coming to light for biosecurity, nutrition and vaccination. Anticipation and responsiveness are essential to implement new working methods – and this requires training in the use of the technology for producers, as well as follow-up for implementation and corrective action if needed.

To enact these, players and partners must be easily available. Yet this availability is not always easy, given the geographical distance between farms and limited reachability of trainers

(often experts of their areas). Adapted solutions were therefore sought by the Vet'Eau company (an aquaculture veterinary cabinet created by Dr. Alain Le Breton and established in Toulouse, France) and the company is now providing **new services based on smart glasses technology**.

*« We are currently 4 veterinarians within our company and we travel worldwide over half of our time. Our activity expands into the international market and our farmers need a real presence. We sought a solution which could decrease our intervention costs for our customers while maximizing our time of work and our availability, by remote monitoring implementation »*

The chosen technical solution is simple. Vet'Eau offers a smart glasses kit on site. Smart glasses are linked to a dedicated smartphone (also supplied). Thanks to an interface on his computer, the veterinarian can reach the aquaculture farm. The technician's intervention can be followed in real-time and the veterinarian can take pictures and videos to record the intervention tracking.

During the intervention, the veterinarian will be able to forward those images to the on-site participant who can visual-



Caption: See how Vet'Eau is using the technology [https://www.youtube.com/watch?v=-MdrecPsNIU&index=14&list=PL\\_JBRWQZGgT\\_Uq0A7O8BtaDVgb9hiFuXk](https://www.youtube.com/watch?v=-MdrecPsNIU&index=14&list=PL_JBRWQZGgT_Uq0A7O8BtaDVgb9hiFuXk)





ize them directly on the smart glasses' little display. Thus, the technician can be guided in real-time.

The smart glasses wearer is hand free while being mobile on his exploitation site. Thanks to this technical solution, the doctor is able to quickly answer his customers' questions and evaluate the situation. This can therefore be used for regular control of fish batches for certification requirements, or for more rapid intervention or specific diagnoses.

The smart glasses solution, called XpertEye, has been created and developed by AMA and has already proven its value. XpertEye is currently used by Emergencies and Paramedics services, by doctors for remote consultancy or by industries for remote maintenance.

Vet'Eau is using the technology to provide many different services, including:

- Remote training, integrating initial training and follow-up with users
- Remote expertise & validation of on-farm protocols
- Certification of batches before delivery and transportation
- Remote supervision of new therapy processes
- Supervision of on-farm clinical trials
- Remote audit
- Vaccination practice
- Biosecurity

**These solutions were presented during the recent WAS/EAS AQUA 2018 trade show seminar in Montpellier.** « *We propose to accompany our customers on their developments and needs. Thanks to this offer, our recommendations can be applied without any geographical distance issues. We control all trials implemented with our partners in diverse countries.* »

Remote technologies can play an important role in the sanitary supervision of farms and the key objective of reducing health risk through improved health management. Other remote management tools such as sensors, fast tests, cameras, etc present an opportunity for aquaculture farms to face up to new challenges and the use of collected farm data and block chain technologies will contribute to adding value in the coming years.

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# AQUACULTURE MEETINGS

Direct links, brochures, registration form etc are linked to this information in the EAS website calendar module

This AQUACULTURE MEETINGS calendar is a summary of the new events module of the EAS web site...

To add information on aquaculture meetings that are of relevance to European aquaculture, please send the details to [eas@aquaeas.eu](mailto:eas@aquaeas.eu) and we will then add them to this column.

## OCTOBER 2018

### High Energy Mariculture conference

Corfu, Greece, October 17-19, 2018  
High Energy Mariculture, the European edition of Offshore Mariculture, will provide an invaluable platform addressing all components involved in a successful medium to high volume production of marine finfish within the European waters.  
Info: Tel. +44 1329 825335; E-mail: [conferences@offshoremарiculture.com](mailto:conferences@offshoremарiculture.com). Web: [www.offshoremарiculture.com/europe](http://www.offshoremарiculture.com/europe)

## NOVEMBER 2018

### HydroMediT 2018

Volos, Greece, November 8-11, 2018  
HydroMediT 2018 will focus on research and innovation technology applied mainly in the Mediterranean and its adjacent waters, but interesting solutions from other parts of the world will also be accepted. Main topic of the Congress will be: Blue Biotechnology in Aquatic Living Resources. Email: [hydromedit@artion.com.gr](mailto:hydromedit@artion.com.gr); Web: <http://hydromedit.gr/>

## JUNE 2019

### Victam International 2019

Koeln, Germany, June 12-14, 2019  
Event for the animal feed processing, grain processing, ingredients & additives, aquafeed, petfood and biomass pelleting industries.  
More info: [www.victaminternational.com](http://www.victaminternational.com)

## OCTOBER 2019



### Aquaculture Europe 2019

Berlin, Germany, October 7-10, 2019

**Contact for abstracts and registration:** EAS Conference Organiser, John Cooksey, MF Cooksey Conference Management, AE2019 Conference, P.O. Box 2302, Valley Center, CA 92082, USA. Tel: +1 760 751 5005; Fax +1 760 751 5003; E-mail: [worldaqua@was.org](mailto:worldaqua@was.org)

**Contact for industry and media sponsorship opportunities:** Mario Stael, MAREVENT, Begijnengracht 40, 9000 Gent, Belgium. Tel/Fax: +32 9 2334912; E-mail: [mario@marevent.com](mailto:mario@marevent.com); Web: [www.marevent.com](http://www.marevent.com)

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