

	EUROPEAN COMMISSION RE SEARCH AND INNOVATION DG	Final Report
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Final Report

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Final Report

PROJECT FINAL REPORT

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Final Report

Please note that the contents of the Final Report can be found in the attachment.

4.1 Final publishable summary report

Executive Summary

The European Union (EU) is the largest importer of fisheries and aquaculture products in the world. However, aquaculture provides only 20% of the seafood produced in the EU, while the worldwide contribution of aquaculture towards seafood production is already >50%. An efficient, sustainable and market-oriented expansion of the EU aquaculture sector based on new fish species and products will reduce the dependence of the EU on imports, reduce the pressure on over-exploited fisheries and explore new segments and tailor-made products for the EU market. This was the objective of DIVERSIFY, a consortium of a multidisciplinary group of 40 partners from 12 European countries, made up of research and academic institutions, as well as nine small or medium-sized enterprises (SMEs), three large enterprises, five professional associations and one consumer non-governmental organization (NGO). DIVERSIFY had a total budget of 11,8 million € and lasted for 5 years (2013 – 2018).

DIVERSIFY has identified six new/emerging finfish species, with a great potential for the expansion of EU aquaculture. These species are fast growing and/or large finfishes, marketed at a large size and can be processed into a range of products to provide the consumer with both a greater diversity of fish species and new value-added products. The selected fishes were meagre (*Argyrosomus regius*) and greater amberjack (*Seriola dumerili*) for warm-water marine cage culture, wreckfish (*Polyprion americanus*) for cool-water marine cage culture, Atlantic halibut (*Hippoglossus hippoglossus*) for marine cold-water culture, grey mullet (*Mugil cephalus*) a euryhaline omnivore for pond/extensive culture, and pikeperch (*Sander lucioperca*) for freshwater intensive culture using recirculating aquaculture systems (RAS). These species were selected based both on their biological and economical potential, and to cover the entire European geographic area and stimulate different aquaculture types. Research was carried out in the scientific disciplines of Reproduction and Genetics, Nutrition, Larval and Grow out husbandry, Fish health, Final product quality and Socioeconomics.

After 5 years of research, DIVERSIFY has completed successfully almost 150 scientific deliverables. The project produced broodstock management methods for the control of reproduction in captivity and production of high-quality eggs. The nutritional requirements of different life stages (larvae, juveniles and/or breeders) of the studied fishes were determined resulting in the production of species-specific diets. Larval husbandry methods were developed based on the ontogeny of development of the major organs responsible for feeding and digestion, by modifying fish larval rearing protocols that exist for other species, thus allowing the production of large numbers of juveniles adequate for commercial production. Grow out husbandry methods were developed for RAS, sea cages or earthen ponds, depending on the species studied, providing information on the required environmental parameters (density, depth, light, temperature, etc.) and feeding schemes. Significant knowledge of the major diseases and health-related issues of some of the studied species was also acquired. Technical Production Manuals for potential farmers have been made freely available for all six species, while Fish Health Manuals have been produced for greater amberjack and meagre.

Market research identified market potential in cross-cultural consumer segments, with increased-to-strong interest in new products in the main EU fish markets. Greater amberjack shows the most promising market opportunities, given its large size, processing potential and superior sensory char

acteristics. Grey mullet is a very interesting species due to the higher sustainability of its production methods, and the marketing of its roe (bottarga). Wreckfish has very firm flesh that discriminates it readily from other fish. The remaining species (Atlantic halibut, pikeperch and meagre) have certain advantages due to their biological and physical characteristics and are of interest to specific regions in Europe.

The acquired knowledge and developed methods of DIVERSIFY will enhance the production of the selected emerging species by the European aquaculture and will enable the incorporation of some new species, such as the grey mullet and greater amberjack.

Summary description of project context and objectives

The European Union (EU) is the largest importer of fisheries and aquaculture products in the world. Of the seafood produced in the EU, aquaculture provides only 20% and capture fisheries provide the rest (Eurostat 2018), while the worldwide contribution of aquaculture towards seafood consumption is already >50%. This situation can be attributed partially to a lack of diversity of aquaculture products in Europe, since European demand increases for a diverse range of fish products, especially for fish fillets and other processed products. Nevertheless, aquaculture is undertaken in all EU states, and plays an important role in the supply of high-quality seafood to the European consumer. The EU aquaculture is a modern industry providing direct employment for 85,000 people, producing 1.3 million tons worth €4 billion (<https://ec.europa.eu/fisheries/cfp/aquaculture/>). Many world-class researchers and facilities exist in research centers and universities throughout Europe, while the private sector employs highly skilled and educated personnel, with modern production facilities. Therefore, the sector is well positioned to become the world leader in the efficient and sustainable production of safe seafood of the highest quality and nutritional value, considering consumer preferences and life styles, and the immense diversity of aquatic products from the wild, to which the consumer is accustomed.

Even though some 35 aquatic species are cultured in Europe, fin-fish aquaculture production is dominated both in volume and value by a handful of species --such as Atlantic salmon (*Salmo salar*), rainbow trout (*Oncorhynchus mykiss*), common carp (*Cyprinus carpio*), European sea bass (*Dicentrarchus labrax*) and gilthead sea bream (*Sparus aurata*)-- that in turn limit the number of aquaculture processed products available in the market. In fact, the 10 most common species account for up to 90% of the production and 87% of its value (Eurostat 2018). An efficient, sustainable and market-oriented expansion of the EU aquaculture sector based on new species and products will reduce the dependence of the EU consumer on imports from countries of questionable production, health, environmental and social standards, and it will reduce the pressure on over-exploited fisheries in the EU.

The objective of DIVERSIFY was to support the EU aquaculture industry in diversifying its production with new/emerging species with important advantages over the ones cultured currently, such as fast growth, large size or low requirement in fish-meal and oil. In addition, the project identified the drivers for market acceptance of the new food prototypes in order to position the EU aquaculture sector in relation to imports from outside the EU. Although the emphasis of DIVERSIFY was on Mediterranean cage-culture, fish species suitable for cold-water, pond/extensive and fresh water aquaculture have been included as well. The fish species studied were meagre (*Argyrosomus regius*) and greater amberjack (*Seriola dumerili*) for warm-water marine cage culture, wreckfish (*Polyprion americanus*) for warm- and cool-water marine cage culture, Atlantic halibut (*Hippoglossus hippoglossus*) for marine cold-water culture, grey mullet (*Mugil cephalus*) a euryhaline herbivore for pond/extensive culture and pikeperch (*Sander lucioperca*) for freshwater intensive culture using Recirculating

Aquaculture Systems (RAS).

A strong socioeconomic component was included in DIVERSIFY, in order to address important bottlenecks in aquaculture development, beyond biological/production issues. The socioeconomic part of the project had a science based applied market development approach, with a lot of components. These included the perception of aquaculture products in general and processed products specifically, market potential and demand factors, consumer and professional buyer preferences, new product development, creating added value in relation to raw products and market development. An important limitation in aquaculture consumption is that in many countries and/or segments of the EU market, aquaculture fish have a weaker image than wild fish. Parallel to technological improvement of production methods for the new species, expansion opportunities for the EU aquaculture sector have been identified.

The combination of biological, technological and socioeconomic research activities developed in DIVERSIFY are expected to support the diversification of the EU aquaculture industry and help in expanding production, increasing aquaculture products and development of new markets.

Description of main S & T results/foregrounds

The fish species that were included in DIVERSIFY were selected based both on their biological and economical potential, and to cover the entire European geographic area and stimulate different aquaculture types. In collaboration with 12 SMEs and large enterprises, DIVERSIFY has built on recent/current national initiatives for species diversification in aquaculture, in order to overcome a series of documented bottlenecks in the production of these species and to identify possibilities to improve the competitiveness of the EU aquaculture sector. Therefore, research was carried out in different scientific disciplines, including Reproduction and Genetics, Nutrition, Larval and Grow out husbandry, Fish health, Socioeconomics and Final product quality. The project was comprised of a total of 25 Work packages (WP) each focusing on a species-scientific discipline combination, as well as four WPs on Socioeconomic issues. The presentation of Science and Technology results/foregrounds that follows is thus organized accordingly.

1.1 Reproduction

1.1.1 Meagre

The industrial bottleneck to implement genetic breeding programs for meagre was addressed by genetically sampling over 435 breeders from broodstocks in 13 breeding centres and 7 countries using 18 microsatellite markers. The broodstocks originated from a limited number of families from three wild populations or groups. Although broodstocks appeared to have sufficient variation for breeding program(s), the majority required an increase in the number of families. Both genetic tools and protocols to control reproduction for breeding programs were developed and provided. The muscle and liver transcriptome were determined and the first genetic linkage map for meagre was constructed using the ddRAD methodology, which identified 731 markers organized in 27 linkage groups. The model mapping identified five quantitative trait locus (QTLs) on two linkage groups, which exhibited significant evidence of linkage at the genome level and multiple QTLs were related to differences in body weight and length. Protocols for the induction of tank spawning in paired crossing had a 76% efficacy of spawning pairs with male rotation and produced a total of 61 families (full and half-sib) that had >200,000 eggs with >80% fertilization success. However, a decline in spawning success that was observed with repeated induced spawning with male rotation was a possible drawback that was highlighted. Protocols were also developed for in vitro fertilization for planned crosses. Meagre sperm had a mean sperm density of $3.21 \cdot 10^6 \pm 1.18$ spzoa/mL, motility duration was $1:43 \pm 0:18$ min, mean percentage of initial motility of spermatozoa was 48.17 ± 2.80 and the mean initial spermato

zoa velocity (VAP) was $90.69 \pm 5.76 \mu\text{m/s}$. Different sperm storage methods and cryopreservation techniques were modified to provide protocols for meagre sperm. The optimal period for stripping eggs was 38-39 hours after the application of gonadotropin releasing hormone agonist (GnRHa) and a ratio of 150,000 motile spermatozoa to egg was recommended. The results of DIVERSIFY provided the technology required to implement industrial breeding programs and scientific advances in the reproductive control of marine fish in general, as well as sperm characterisation and genetic resources for meagre and related species.

1.1.2 Greater amberjack

In order to facilitate the broodstock management of greater amberjack in aquaculture, important life history traits of wild fish were first determined. Fish are 35-40 cm in length (fork length, FL) and 1 kg in weight (body weight, BW) at age 1; 60-70 cm FL and 3-5 kg BW at age 2; 80-90 cm FL and 7-10 kg BW at age 3. Male greater amberjack are reproductively active at the age of 3 years and females reach the first sexual maturity at 3-4 years of age. The spawning season of the wild greater amberjack population from the western Mediterranean is extended from late May to early July. When greater amberjack reared in sea cages in the Mediterranean were handled as other captive species, they exhibited poor gonadal development, low pituitary gonadotropin gene expression, low gonadotropin and sex steroid plasma concentrations, atresia of vitellogenic follicles, reduced proliferation and increased apoptosis of male germ cell. As a consequence of the spermatogenesis impairment, greater amberjack confined in captivity showed low sperm quality, in terms of sperm density and motility and velocity as well as ATP content and membrane integrity. The observed reproductive impairments are likely related to the handling stress, the non-optimal conditions required for reproductive maturation and/or to nutritional unbalances caused by the lack of specific broodstock diet for the species. In fact, gonads of captive-reared greater amberjack had different lipid and fatty acid contents compared to wild individuals. An overall improvement of rearing technology, particularly as it relates to husbandry operations (e.g. fish handling and transferring) together with a better formulation of dietary ingredients is suggested to overcome the observed dysfunctions and improve greater amberjack reproductive performance.

Reproductive dysfunctions occurring in greater amberjack reared in sea cages in the Mediterranean were successfully treated with GnRHa administration through sustained-release polymer implants and injections. Treatments with GnRHa implants at the dose of $\approx 50 \mu\text{g kg}^{-1}$ body weight were more effective than injections in promoting the proper endocrine pathways leading to multiple cycles of oocyte maturation, ovulation and spawning and allowed producing more eggs without altering their quality in terms of fertilization, embryo survival, hatching and larval survival. This method helped minimizing the handling stress (i.e. one handling every two weeks as opposed to one handling every week) and was very effective in females maintained in cages during gametogenesis and moved to tanks after the administration of the hormonal therapy.

Greater amberjack caught from the wild in the eastern Atlantic (southwestern coast of Gran Canaria, Spain) when they were 3-5 kg in body weight and reared for two years in indoor tanks under appropriate environmental and nutritional conditions, were able to undergo normal gametogenesis, and spontaneously spawned large quantities of high quality eggs. In the same stock, hatchery-produced F1 greater amberjack (15-30 kg body weight) reared in outdoor tanks in Tenerife (Spain) underwent normal gametogenesis and were successfully induced to undergo maturation, ovulation and spawning through the administration of polymer implants containing GnRHa at the doses of 50 and 75 $\mu\text{g kg}^{-1}$ body weight. The repeated administration of GnRHa implants resulted in multiple spawns of high quality fertilized and viable eggs for an extended period lasting from May to September. Consistent egg production is now available for this species, and has enabled the further development of larval rearing methods within the project.

Therefore, thanks to the experimental work carried out within DIVERSIFY, a set of tools to reproduce greater amberjack reared under different conditions in the Mediterranean Sea and in the eastern Atlantic is now available and this represents a fundamental step towards the large-scale aquaculture production of this species.

1.1.3 Pikeperch

The primary objective for this species was to use genetic markers (microsatellite loci) in order to evaluate the genetic indices of captive broodstock in commercial recirculation aquaculture system (RAS) farms around Europe and compare them to those of some wild pikeperch populations. Thirteen cultured and eight wild populations with more than 950 fish in total were analyzed for a final set of 10 microsatellite genetic markers. Results showed that on average, and in contrary to what we theoretically expected, the thirteen domesticated populations exhibited a slightly higher number of alleles compared to the wild ones, whereas unbiased expected heterozygosity estimates were slightly higher in wild populations. The above, in conjunction with the FIS values, indicate that in general domesticated samples do not suffer from inbreeding, with the exception of few broodstocks with either small sample size or known past of stocks under selection.

Interestingly, in DIVERSIFY we provided evidence and confirmed results generated in previous studies indicating that pikeperch populations in Europe are part of at least two genetically differentiated groups: the first one is found in northern Europe from the Netherlands/Denmark to the West and Poland (at least) to the East, to the North of Finland and a second group which comprises all remaining populations in Central Europe to as south as Tunisia (and probably Spain, Italy and Northern Greece). These nuclear (microsatellite) data results seem to be confirmed by further mitochondrial data produced beyond the project's deliverables. In this second group, the Hungarian populations are having a key-position being different from those found geographically near, e.g. from Czech Republic and Germany. Taking the above two groups into account, the aquaculture broodstocks analyzed seem to contain in general fish of a single origin with only few exceptions.

1.1.4 Atlantic halibut

Wild-caught females were predictable spawners that produced eggs consistently of very high quality (>85% fertilization). Farmed females also produced eggs of high quality when their ovulatory cycles were identified and stripping was carried out close to ovulation. For commercial production, as well as breeding purposes, it is not practical to rely on wild-caught females. However, relatively few farmed females produced eggs consistently with fertilization rates >80-85%. As a consequence, it may be necessary to include wild-caught broodstock also in future breeding groups in order to ensure a broad enough genetic material.

Plasma concentrations of sex steroids in farmed breeders were similar to what has been reported previously in Atlantic halibut, with annual profiles following ovarian growth and maturation. Highest 17β -estradiol (E2) levels were recorded just prior to spawning, in the beginning of February, while both E2 and testosterone (T) remained elevated through the spawning period. No differences in average concentrations were seen between wild-caught and farmed females. Plasma concentrations of the gonadotropins follicle stimulating hormone (FSH) and luteinizing hormone (LH) were documented for the first time in Atlantic halibut. Mean Fsh concentrations were relatively stable during vitellogenesis, from October to early February, consistent with a constitutive release of FSH from the pituitary. Plasma FSH decreased to low levels during spawning, but increased again after spawning was completed. Plasma LH concentrations showed large individual variations through the reproductive cycle, but high levels were detected during spawning. This is consistent with previously reported results in other teleosts, including a number of flatfishes.

Implantation with GnRHa did not advance spawning time significantly in Atlantic halibut females, but an apparent synchronization in spawning time between individuals was seen, as treated females had completed spawning 1 month before control fish were spent. In commercial production, synchronization between individuals can be an advantage as staff efforts can be concentrated to a relatively short period. Atlantic halibut breeders need to be monitored for ovulation and stripped on a regular basis, and eggs are fertilized in vitro. Therefore, the use of GnRHa implantation offers a logistic advantage to the commercial broodstock management of the species, by reducing the spawning season.

1.1.5 Wreckfish

The main objective in terms of wreckfish reproduction was to describe the reproductive cycle of this species in captivity and obtain fertilized eggs. DIVERSIFY efforts were focused at first to thoroughly understand the physiology and reproductive cycle of this species. Once this challenge was achieved, various methods to control reproduction in aquaculture situations were evaluated, such as in vitro fertilization by stripping, induction of maturation by hormones and tank spawning, and spontaneous spawning in the broodstock tanks without any manipulation. The work completed on in vitro fertilization demonstrated that this method is complicated to apply to large broodstock and that the manipulation has negative effects and caused some mortality. In addition, to successfully apply in vitro techniques it is necessary that the females reach advanced stages of maturity. In the initial stages of the project very few females have reached advanced stages of maturation and this has complicated the work with in vitro fertilization. Later in the project more females reached advanced stages of maturation and this coincided with these females spawning naturally and spontaneously. The overall aim of the project for the reproduction of wreckfish was to achieve large quantities of fertilized eggs and this was achieved with spontaneous spawning.

In terms of gamete quality, the results indicated a high fecundity of wreckfish females with multiple spawns during the season, while males were shown to remain in spermiating condition throughout the year. A computer assisted sperm analysis (CASA) method was developed specifically for wreckfish sperm and can be used to optimize sperm management and fertility potential in future spawning induction experiments. The analyses also demonstrated that sperm of captive wreckfish shares a common pattern of motility with both marine and freshwater fish. Finally, the incubation methodology was adapted to the special characteristics of these, achieving high percentages of hatching (80%).

The result of this intense work with four broodstocks from different facilities has been very rewarding, since, in addition to taking a step forward in the knowledge of biology, behavior and reproductive cycle, it has been possible to obtain fertilized eggs with a high quality regards fertilization and hatching.

1.1.6 Grey mullet

Lacking the natural spawning environment, captive grey mullet fail to reproduce spontaneously, largely due to a failure to undergo complete gametogenesis. In this respect, and within the framework of DIVERSIFY, considerable progress was made by optimizing hormonal treatments for alleviating reproductive dysfunctions among captive grey mullet broodstocks. Bio-potent yeast (*Pichia pastoris*) produced recombinant gonadotropins (r-FSH and r-LH) that were used as therapeutic agents in a series of in vitro and in vivo assays. The best performing treatment consisted of r-FSH and a dopamine antagonist (metoclopramide) that were co-injected during the onset of the reproductive season. The latter treatment demonstrated synchronized gonadal development within and between sexes, giving rise to stimulated spermatogenesis in males and follicle growth and maturation in females. Further spawning induction trials that timed the administration of GnRHa and metoclopramide with ad

vanced stages of gamete maturation were relatively successful. A basic breeding unit, comprising a single female and three males, was found to facilitate synchronization and in turn increase fertilization rate. Nevertheless, our results highlight an episodic fertilization rate ranging between 0 to 98% and point to a future need to fine tune and optimize the hormone-based breeding protocol for captive grey mullet. Broodstock diet containing fish oil (FO), which is relatively rich in n-3 long chain polyunsaturated fatty acids (LC-PUFA), positively affected hatching success and larvae survival. The established breeding protocol for captive grey mullet could be effectively applied during natural as well as artificially shifted spawning seasons. Over several consecutive spawning seasons, tens of millions of high-quality eggs were produced giving rise to mass production of robust fingerlings. A shipping protocol for grey mullet eggs was also established specifying the optimized conditions including egg developmental stage (gastrula) and packing density for short term (≤ 11 h) and long term (26 h) shipments.

The assessment of the effects of captivity on first sexual maturity of wild-caught and hatchery-produced grey mullet indicated that: (1) the rearing conditions established allow for a growth rate equivalent to that of wild grey mullet from the Mediterranean Sea; (2) the reduction of the rearing density from 90 to 45 fish per m³ has no effect on grey mullet growth and sexual maturity; (3) hatchery-produced grey mullet have a good potential to develop ovaries spontaneously up to a condition useful for bottarga production. Furthermore, the effects of fish origin (wild vs. domesticated) and culture conditions on advanced and spontaneous development of gonads comprising the required criteria for the production of high quality bottarga (i.e. minimal size of 100 g, bright yellowish color and chewy texture) were assessed and indicated that (1) traditional grey mullet farming procedure in freshwater ponds could be applicable, and also an advantage, for roe production; (2) Domestication appears to have a favorable effect on the spontaneous development of mullet ovaries up to a condition useful for bottarga production and (3) Pigment-enriched diets can enhance the roe coloration to meet the criteria for high quality bottarga (roe). However, two stumbling blocks that may impair the profitability of grey mullet farming for bottarga production are (1) extended grow out to a minimum of 3 years and (2) relatively low percentages (20-50%) of females developing ovaries at the appropriate size (≥ 100 g). Future studies, therefore, should focus on genetic improvement programs giving rise to advanced sexual maturity and spontaneous ovarian development in captive grey mullet females.

1.2 Nutrition

1.2.1 Meagre

Despite the interest of meagre for aquaculture diversification in the last decade, there is a lack of information on nutrition during larval development. The importance of highly unsaturated fatty acids (HUFA) and the antioxidants vitamin E and vitamin C has not been investigated in this species, despite the fact that the oxidative risk is particularly high in fast growing larvae. Dietary HUFA levels of 3% improved larval growth and lipid absorption and deposition. Besides, among fish fed 3% HUFA, increases in vitamin E and vitamin C improved significantly body weight, as well as lipid, 22:6n-3 and n-3 fatty acids contents in the larvae. Thus, weaning diets for meagre must be optimized increasing HUFA levels up to 3% and vitamins E and C >1500 and 1800 mg kg⁻¹, respectively, in order to spare these essential fatty acids from oxidation. A 0.4% dietary HUFA is not enough to cover the essential fatty acid requirements of larval meagre. It is also important to supplement meagre weaning diets with 2.4 mg/kg vitamin K, since the absence of this vitamin reduced markedly larval survival. Meagre seemed to be very sensitive to hypervitaminosis D and only mildly sensitive to hypervitaminosis A, since supplementation with these vitamins lead to a growth reduction. Taurine supplementation did not have any effect in meagre larvae performance.

The nutritional requirements and optimum levels of n-3 Long Chain (LC)-PUFA for meagre finger

lings were examined, evaluating its effects on survival, growth performance, feed utilization and fish composition. Meagre showed the ability to selectively conserve key fatty acids (FA), particularly Docosahexaenoic acid (DHA; 22:6n-3) and Arachidonic acid (ARA; 20:4n-6) over other FA, in response to essential FA-deficiency. Furthermore, meagre seems to have active $\Delta 6$ desaturases and Elovl5, but their activities were insufficient to produce DHA and Eicosapentaenoic acid (EPA; 20:5n-3) from PUFA precursors to sustain fast growth. The EFA deficient meagre in the present study also showed a higher incidence of granulomas than fish fed $\geq 2\%$ n-3 HUFA. Based on our results DIVERSIFY showed that the requirement for n-3 LC-PUFA for meagre fingerlings is at least 2.0% Dry Matter (DM) in diets containing 16.5% DM lipids, a ratio of 0.9 EPA/DHA and 0.4% ARA of total FA content.

1.2.2. Greater amberjack

To improve larval enrichment products for greater amberjack, the optimum levels and ratios of essential fatty acids and combined PUFA and carotenoids in greater amberjack enrichment products were determined. The highest greater amberjack growth was obtained when larvae (17-35 days after hatching, dah) were fed Artemia containing DHA in a range of 5-8% Total Fatty Acid (TFA), with a maximum around 7% (1.5 g 100 g⁻¹ DHA DM). The essential FA (EFA) requirements are similar during rotifer and Artemia feeding, as reported for larvae of other marine fish species. Requirements of amberjack larvae for DHA (1.5 g.100 g⁻¹ DHA DM) were higher than those found in other marine fish species and similar to those for other fast-growing species. Increases in DHA tend to improve larval resistance to handling. Even the highest DHA levels in the enrichment emulsion (70% DHA in TFA) resulted in reduced incorporation of DHA into Artemia lipids (11% DHA in TFA). Despite that EPA levels in Artemia increased from 0.87 to 6.81 % TFA, EPA levels in greater amberjack larvae were only increased up to 5.2% TFA, denoting a saturation process that could be associated with the fulfillment of the EPA requirements. On the contrary, DHA levels in greater amberjack larvae showed a linear increase. Dietary DHA was linearly related to skull anomalies, dietary DHA levels over 2 g per 100 g⁻¹ inducing a higher incidence of skeletal malformations, particularly those related with skull development.

It is well known that raising the ratio of Phospholipids (PL) to Total Lipids (TL) in larval feeds may enhance growth. Rotifers enriched with the marine lecithin (E1), displayed a fast incorporation of polar lipids particularly rich in DHA. Although the role of carotenoids in the embryonic development is not very well established, there is evidence that the presence of carotenoids mitigates deleterious oxidative damage to the developing embryo. Larvae fed diets with astaxanthin below 5.3 ppm were found to have marginal growth, whereas those fed levels above 5.3 ppm had a better performance and significantly higher lipid levels. Rotifers enriched with polar rich emulsion containing a marine natural lecithin LC60 combined with 10 ppm of Naturose also resulted in a significant advantage in larval growth, survival and welfare compared to rotifers enriched with other emulsions. Thus, DIVERSIFY established the following recommendations for enrichment products for greater amberjack larvae culture: DHA in enrichment products for Artemia 10-17% TFA, EPA 14-20% TFA, and DHA/EPA ratio 1-5. For rotifers, DHA in enrichment products 14% TFA, EPA 6% TFA, and DHA/EPA ratio 2.3. Carotenoids levels in enrichment products must be around 10 ppm.

Regarding greater amberjack juveniles, the dietary lysine requirements, based on the Broken-line model, which can support maximum weight gain of greater amberjack juveniles fed on a diet based mainly on plant ingredients, containing 45% protein, 18% lipid and 25% fish meal inclusion, was 2.11% of diet.

In broodstock diets, the requirements of essential fatty acids were determined to obtain improved spawning quality. Broodstock fed a diet containing 1.57% EPA+DHA showed high fertilization and

egg viability, higher number of eggs per spawn and kg of female, with the highest percent of fertilization, egg viability, hatching rate and larval survival. Egg fatty acid composition was shown to be influenced by broodstock diets. A diet containing 14-15 % EPA+DHA of total fatty acids (corresponding to 2.5-3 % in a dry diet) resulted in the best spawning performance in greater amberjack broodstock. Increasing dietary EPA+DHA contents did not improve spawning performance. Histidine contents in broodstock diets from 1 to 1.5% and Taurine in broodstock diets increased the reproductive performance of greater amberjack.

1.2.3 Pikeperch

The experiments conducted within DIVERSIFY have gained new insight into the nutritional requirements of pikeperch larvae until early juvenility. The studies performed focused primarily on the importance of PL and FA composition and dietary requirement of Ca/P, as well as their interactions. Lack of knowledge on these nutritional parameters has been considered as a bottleneck in commercial farming with large implications for survival and growth. In addition, rearing larvae at low salinities was examined, as it was hypothesized to have a possible positive influence on larval FA requirements, metabolism and physiology. Results confirmed the importance of high dietary PL levels for optimal performance of pikeperch, as well as reduced skeletal deformities by supplementation with DHA+ EPA in the form of concentrated Triacylglycerol (TAG) in otherwise identical formulated diets. It was observed that pikeperch larvae have a limited ability to elongate and metabolize shorter chain PUFAs to LC-PUFAs (essential FAs), while saline rearing conditions had no obvious positive effect on larval performance or development, but may cause improved FA metabolism and uptake and change eicosanoid (hormonal) activity). Digestive enzymatic activity seemed to be related to ontogenetic development more than nutritional composition, while live proteomic expression of some important proteins are clearly related to the availability and presence of LC – PUFAs especially DHA. The Ca/P, FA and their interaction seem to be key nutritional factors influencing pikeperch larval development. In addition, it appears that total P % content should be considered in determining the optimal Ca/P level. Lack of sufficient dietary LC- PUFAs from early larval ontogenetic development have severe effect on long-term stress sensitivity and may impair learning abilities and behaviour. Therefore, it must be included in early diets to ensure both short- and long-term fish robustness.

Based on the above, a final test at commercial farm conditions showed that it was possible to formulate a diet that was superior to the commercial diet “Otohime” in terms of larval growth until 52 days post hatching (dph). Thus, diets with high levels of PL and sufficient LC-PUFAs are recommended to obtain good performance and lower degree of malformations, and nutrients can be supplemented as vegetable lecithin and in the form of TAG.

1.2.4 Atlantic halibut

For the development of a protocol for early weaning of Atlantic halibut larvae, we found a large difference regarding the larvae’s feed intake on 3 different commercial diets at 28 days post first feeding (dpff). Larvae fed “Otohime» had full guts after 5 days of feeding. This diet was used in an experiment aimed to find the earliest time of weaning at 15, 22 and 28 dpff. Weaning at 15 dpff gave almost 100% mortality, at 22 dpff approximately 30% mortality and at 28 dpff, almost 0% mortality. The conclusion is that diet characteristics are important to ensure feed intake in Atlantic halibut larvae and that the larvae are ready to feed on a formulated feed only at 28 dpff. Further experiments are needed to evaluate if the early larvae grow and develop on these diets. Also, a protocol for production of on-grown Artemia was developed and the nutrient composition was analyzed. Artemia grown for 3 days on “Oriculture” and enriched with “Multigain” obtained an improved nutrient profile in many aspects. The protein, free amino acid and taurine contents increased, lipid and glycogen decreased, while the ratio of PL to TL increased. The FA composition improved at one experiment, but

not at the one carried out at the commercial partner. The micronutrient profiles were not negatively affected by culture of Artemia on “Oriculture”.

Since previous research had found that larvae fed on-grown Artemia developed into juveniles with better quality, larvae were fed these Artemia compared to conventional Artemia nauplii in DIVERSIFY. There were no differences in growth; pigmentation and eye migration between the two groups and the nutrient composition of the larvae after 3 weeks of feeding was very similar. The conclusion was that Artemia nauplii produced with modern methods have sufficient nutrient levels to cover the requirements of Atlantic halibut larvae. Also, the hypothesis that larvae reared in RAS would have another micro flora in the gut and therefore have different uptake of nutrients was examined. However, except for higher levels of the vitamin K derivative MK6, we found no differences in nutrient utilization between larvae reared in RAS or flow through systems. Finally, Atlantic halibut juveniles (1 g bodyweight) were fed diets with 5 PL levels varying from 9 to 32% of TL. There were no effects of PL levels on growth or lipid composition in intestine, liver and muscle, 24 hours after feeding. However, time after the meal affected the lipid composition of the intestinal tissue, with higher levels of neutral lipids 1 and 4 hours post-prandial, and higher levels of polar lipids, cholesterol esters and ceramide at 24 hours post-prandial, reflecting absorption of the lipids early after the meal. It appears that Atlantic halibut juveniles regulate their lipid species composition to be independent of the diet when a range of PL/TAG is applied, as in the present study.

1.2.5 Wreckfish

Nutrition studies performed in DIVERSIFY for wreckfish were focused mainly on the development of adequate live prey enrichments for larvae and the production of broodstock feeds for enhancing fecundity and gamete quality. These are the first steps for the development of proper nutrition and culture of this species. Enrichment products for live prey (rotifers and Artemia) were produced with two levels of ARA, being the nutrient less effective in Artemia compared to rotifers. No differences were found in FA composition of wreckfish larvae fed with the prey enriched with the two enrichment products. Enriched live prey exhibited a good FA profile and larvae of wreckfish exhibited, in general, a good acceptance of them. The FA profile of wreckfish larvae along larval development was described, showing large amounts of PUFA specially DHA, EPA and ARA.

Results obtained on the tissue composition of wild wreckfish showed that muscle and gonad have a large amount of proteins and low levels of lipids. These results and those obtained from eggs and larvae were very useful for the formulation of a specific dry food for wreckfish broodstock. The comparisons between wild and reared wreckfish composition showed that fish from intensive culture have more lipids in muscle and liver than those obtained in the wild. In contrast, protein content is higher in the muscle of wild wreckfish than in reared fish and some differences were also observed in the FA profile with higher values of PUFA and n-3 PUFA in wild than in reared wreckfish. Gonads from females of wild wreckfish have a high level of ARA (7-10%TFA) and a ratio of EPA/ARA of nearly 1. Regarding wreckfish broodstock feeding regimes, most of commercial dry food has too much fat for wreckfish and a clear relationship between FA profile of broodstock diets and FA profile of oocytes and eggs was found. A new dry food was specifically formulated for wreckfish broodstock with a high amount of protein, low level of lipids, a high amount of n-3 PUFA and an EPA/ARA ratio similar to the one obtained in wild female gonads. Finally, the first data of FA profile of sperm from wreckfish males of different broodstock were obtained. A relationship was found between broodstock diets and fecundity and number of spawnings of the females. Relative fecundity (n° of eggs/Kg of female) and number of spawns per female increased in females fed with dry feed over the duration of the DIVERSIFY, from 2015 to 2018.

1.2.6 Grey mullet

The results suggest that grey mullet >89 dph grown in low salinity (15‰) have the capability to synthesize DHA from shorter carbon chain precursors while there is little or no biosynthesis of LC-PUFA in fish exposed to high salinity (40‰). This follows as grey mullet juveniles in nature would be moving to the lower salinity waters of river mouths and estuaries, which are characterized by an environment less rich in LC-PUFA and more abundant in smaller chain PUFA precursors. Low salinity upregulated the gene expression of the rate-limiting enzyme of LC-PUFA biosynthesis ($\Delta 6$ desaturase) but was independent of DHA dietary level. On the other hand, both low salinity and DHA level upregulated the gene expression of elongase. The two transcription factors, sterol regulatory element binding protein (SREBP1) and peroxisome proliferator activated receptors (PPAR) are involved in the regulation of fatty acid biosynthesis. Although both SREBP1 and PPAR expression were highest in 15‰ water, PPAR expression was inversely regulated by dietary DHA at both salinities, while SREBP1 was inversely regulated by DHA only in the low salinity. These findings suggest that dietary levels of DHA can be decreased when feeding older juvenile mullet, provided that the salinity is reduced to levels found in estuarine waters. This would translate to a significant savings for farmers as the purchase of feed for the grow-out of fish to market weight can represent 60% of production costs and DHA is costly as a feed ingredient.

Also, regarding the cysteine sulfinic acid decarboxylase (CSD), a key enzyme in taurine synthesis pathway, DIVERSIFY found that it is active in the absence of dietary taurine and that the expression of this key gene increases with increased levels of dietary taurine until 1% where CSD expression decreases rapidly possibly due to a negative feedback mechanism. The increased taurine in the blood circulation of the liver, due to higher dietary taurine, may stimulate increased endogenous synthesis within liver cells to reduce osmotic pressure across the membrane and prevent cell shrinkage and changes in intracellular hydro-mineral balance. Cholesterol 7 α -hydroxylase (CYP7a1) is the key enzyme in the synthesis of bile salts and was not affected by increased levels of dietary taurine. This suggests that endogenous taurine synthesis was sufficient for bile salt synthesis. Taken together, it appears that grey mullet juveniles have the capacity for endogenous taurine synthesis that may be sufficient for cell volume homeostasis and bile salt production, but may fall short in optimizing skeletal muscle function and growth, thereby requiring a minimum of 0.5% of taurine in the diet.

In grey mullet broodstock the mobilization of energy reserves in terms of lipids and proteins was quite similar between wild and captive mature females. Moreover, in fatty acids and fatty acid groups, there were no conspicuous differences, independent of age, between female gonads from domesticated and wild captive broodstock fed fish oil-based diets or broodstock fed soybean oil-based diets. This suggests a gonadal biosynthetic capability for biosynthesis of LC-PUFA from shorter chain precursors. Nevertheless, when comparing the FA and lipid class profiles between female and male gonads, there were highly marked differences. In female gonads, the TA, TAG, wax and sterol esters were higher compared to male gonads while the male gonads had higher quantities of the PL phosphatidylcholine, phosphatidylserine and phosphatidylethanolamine, as well as cholesterol compared to female gonads. Noteworthy were also the very high levels of DHA in the male gonads compared to the female gonads. Interestingly, the male gonads from the soybean-fed group were higher in DHA than the fish oil group despite the fact that soybean oil does not contain this essential fatty acid. The fish oil diet resulted in better egg hatchability, as well as larval tolerance of food deprivation and improved swim bladder inflation. These benefits may be due to another fish oil component, possibly carotenoids.

Fish acceptability of the developed DIVERSIFY grey mullet diet appeared enhanced by replacing poultry meal with fish meal, suggesting that the inclusion of other nutrients may be necessary in order to maintain a fish meal free diet. The fatty acid profiles of the tissues generally resembled those of the diets. Feeding the developed diet resulted in fish displaying a more balanced lipid profile than

fish fed the commercial carp diet. For instance, the fillets from the DIVERSIFY diet were poorer in 18:2n-6, but also exhibited a higher absolute content of n-3 LC PUFA (EPA+DHA). On the other hand, the female gonads, unlike the flesh, displayed a selective retention of the essential fatty acids EPA, DHA and ARA independent of dietary regime, which was also demonstrated in another deliverable. The surprisingly high levels of ARA in the tissues compared to the poor amount supplied by the diets highlights the physiological relevance of this FA in this species' reproductive performance and suggests the potential capacity for its endogenous production from the 18:2n-6 precursor. The sensory analysis found no differences in selected sensory categories between the carp diet and the DIVERSIFY diet.

The use of excessive levels of soybean in fish diets can cause inflammatory responses in the distal intestinal epithelium, which affects fish health, reduces intestinal nutrient absorption and somatic growth. Inflammation is frequently associated with oxidative stress and the up regulation of the genes involved in the innate anti-oxidation system. In the DIVERSIFY studies, there was no indication of inflammation. In fact, digestive tract samples from all fish exhibited healthy tissue with no signs of disease and presumably oxidation stress. Although there was a significant improvement in the performance of fish fed the diet that included poultry meal instead of increased soybean meal, it was likely due to a taurine deficiency. Taken together, the results suggest that there is a significant improvement in grey mullet juvenile performance when using animal-based proteins, such as poultry meal, at about 13% DW diet. On the other hand, this advantage may be modulated by the supplementation of essential amino acids such as methionine and taurine.

1.3 Larval husbandry

1.3.1 Meagre

The main task for meagre larvae research in DIVERSIFY was to provide the industry an early weaning protocol for this new species, that included co-feeding live prey with artificial micro diets. It is well documented that the cost and quality of live feed, especially Artemia, is very high and fluctuates over time because it is dependent on the worldwide aquaculture demand and the weather patterns affecting the pelagic fish harvesting areas. Furthermore, the percentage of hatchery costs attributed to Artemia is substantial and for quite a long time researchers and feed producers have been looking for alternative feeding strategies and/or new formulations to reduce larval production costs. The standard method for meagre larval production is to start weaning the larvae around 20 dph. In the trials carried out in DIVERSIFY we showed that weaning time can be advanced successfully to 15 and 12 dph using a commercial micro diet with a gradual transfer from live prey to the artificial diet over a minimum period of 5 days. However, larval survival was low due to cannibalism, a major problem in the culture of many marine fish larvae. Size variation is the primary cause of cannibalism in larval fish, together with factors such as food availability, larval density, feeding frequency, light intensity, water turbidity and shelter. This project demonstrated that meagre larvae have the same capacity to digest live prey and micro diets and they can be weaned earlier reducing the production costs if some measures to reduce cannibalism are in place. These measures include increasing feeding frequency, removing dominant individuals and keeping the larvae in the dark when the food was unavailable or in short supply.

1.3.2 Greater amberjack

The objectives of this WP were to study the (1) Effects of different feeding strategies on larval performance in intensive systems, and (2) Develop feedings protocols and rearing methodologies in mesocosm semi-intensive systems for the industrial production of greater amberjack. Starting with the ontogeny of the digestion and the vision system to acquire the basic biological information, our studies focused on the prey enriching diet and feeding regime and finally to critical parameters (tank

type-shape, duration of the photo phase, tank background color and light conditions, stocking density) of the rearing process. The results were evaluated in terms of growth, survival, skeletal deformities, biochemical composition, stress and larval condition.

The results of DIVERSIFY indicated that larval rearing in large tanks and low initial stocking of eggs-larvae improves the growth performance and survival of greater amberjack. Egg stocking densities > 25 eggs l⁻¹ affects negatively the results. The recommended photo phase is 24 L:00 D from 1 to 20 dph and 18 L: 06 D between 21 and 30 dph, with light intensities of 800, 1200, 1000 and 500 lux at 3, 6, 12, and 20 dph, respectively. A renewal of filtered seawater (5 μ m) at an increasing rate ranging from 15-40% day⁻¹ at 1 dph, 30-40% at 10 dph, 100-120% at 20 dph, and 200-240% at 30 dph ensures a good quality of the rearing environment. Dissolved oxygen ranged between 4.9 and 8.2 mg l⁻¹, but must be preferably > 6.0 mg l⁻¹, salinity between 35 and 40 psu, pH between 7.8 and 8.5, and temperature between 23.5 and 25.0°C. The feeding protocols used have to be coordinated with the rearing conditions and the larval development. The larva has to be able to see, ingest and digest the food, and therefore needs the coordinated development of vision and digestive system. Larval rearing developed under conditions that allow faster growth have to consider the time of beginning and duration of the feeding periods with the different food items. In general, the addition of live microalgae at 150-300 x 10³ cell ml⁻¹ from 1 dph, enriched rotifers (*Brachionus* sp.) two times a day, from 3 to 25 dph, at densities between 3 and 10 rot ml⁻¹, *Artemia* nauplii at 12 dph, during 5-7 days and enriched *Artemia* EG 1-day at 14-18 dph, and weaning diet (200-800 μ m) from 18 dph can be a good sequence. Moreover, the enriched emulsions of prey supplemented with PL, carotenoids, ARA and immune modulators such as Echium oil and black cumin oil improved the larval rearing of greater amberjack, so enriching that tend to have these characteristics would give better results in the larval performance of greater amberjack.

During larval rearing, and especially following 20 dph, high size variability occurred in all rearing systems tested until today. This high variability is managed until now with early sorting of the reared groups to appropriate size classes. Applying standard methods and equipment available in all hatcheries, the sorting procedure resulted in significantly higher survival compared to unsorted groups. Unsorted groups between 20 and 30 dph had $>90\%$ mortality, while for the sorted groups it was limited to approximately 10%. During sorting, transport of the individuals is also a requisite. Individuals of less than 15 mm do not tolerate netting and transfer should be performed with care and avoid air exposure of the larvae. After reaching 20 mm in total length individuals can be netted normally. Husbandry practice with larger individuals (>0.5 -1 gr) is easier although in some cases light anesthesia may help.

1.3.3 Pikeperch

The overall aims of this WP were to establish an optimal combination of factors that could give the best performance of pikeperch larval populations, and to develop an industrial protocol for pikeperch larval rearing. The protocol should reduce the high mortality caused mainly by cannibalism, the high rate of deformities and the large size heterogeneity between larvae cohorts. Using a pilot scale RAS (10 x 700-L tanks) and multifactorial designs, three successive experiments were conducted to study the effects of twelve environmental, feeding and population factors (four factors per category). For each experiment, the choice of factors was a trade-off between data available in the literature and the constraints of the SME partners of the project for this species. From each experiment, according to results obtained, the most influential factors and modalities were conserved and integrated in the following experiment in order to optimize progressively the protocol. At the end of this first step, an optimal combination of factors was identified and proposed to improve pikeperch larval rearing. The combination was mainly based on an initial larvae density (100 larvae L⁻¹), no size grading, the use of larvae from large females, a discontinuous feeding, a constant light intensity (50 lux) with a fixed

photoperiod (L:D 12:12), a weaning applied at day 16 with a duration of 9 days (progressive feeding transition from live preys to artificial diet), a fixed water renewal rate (tank volume per hour) and tank current direction (bottom to top) and finally a tank cleaning period during morning. This optimal combination of factors allowed the production of 0.8 g juveniles in 52 days with a swim bladder inflation >90%, a survival between 14 and 19%, a final biomass of 9.5 kg per tank, a food conversion rate of 0.6 and a production cost of 0.2 euro per juvenile. A fourth experiment was done to confirm the efficiency of the combination (7 repetitions), the results obtained were very homogeneous and validated the reliability of the protocol proposed.

1.3.4 Atlantic halibut

A protocol for on growing of *Artemia nauplii* was developed and described. Use of on-grown *Artemia* during the critical period of metamorphosis in Atlantic halibut larva did not differ from use of *Artemia nauplii* with regard to growth, mortality and fry quality. In addition, the production of on-grown *Artemia* is labor-intensive, and high personnel costs may be prohibitive in implementation of this live feed source in commercial larviculture.

The commercial production of Atlantic halibut fry is currently carried out in flow through systems (FT), while there is a growing consensus that a RAS would offer more stable environmental and chemical water parameters that would lead to improved larval performance. Production protocols for yolk sac and first feeding larvae in RAS were developed in DIVERSIFY. No differences in survival were detected between RAS and FT rearing during yolk sac incubation. When systems were primed for one month, larval growth was significantly higher in the RAS group during first feeding. High mortality occurred in one of the FT tanks. Taken together, results suggested that with adequate conditioning of the RAS, a stable system is established where growth and survival of larvae is as good as, or better, than in FT systems with optimal conditions. The RAS was a more stable rearing system for Atlantic halibut larvae compared to the FT system.

Metagenomic characterisation of the bacterial communities in rearing water and larvae revealed that at least 300-400 different bacterial genera were present in the rearing systems. Significant differences were detected in the micro biota composition of the RAS and FT systems: both in silos and tanks, and in the water and the larvae. No obvious correlation was seen between the micro biota in the water and the micro biota of the larvae. Characterization of the micro biota composition provides important information for development of probiotic treatment of Atlantic halibut larvae.

1.3.5 Wreckfish

The efforts in this area were focused on the development of a methodology for larval rearing and to define the optimal conditions, both in terms of water temperature, as well as in terms of a rearing system (RAS or FT). More advances in achieving natural spawns and in larval husbandry have been done in the three Galician wreckfish stocks. This was the first time ever that a project succeeded in producing a significant number of juveniles weaned to inert food, and it signifies a milestone in the efforts to produce wreckfish under aquaculture conditions. The work implemented in DIVERSIFY acquired important data on growth and increased our knowledge about the feeding protocol and the specific behavior and metamorphosis of wreckfish larvae. Technical changes have been made in incubation and larval husbandry that can be decisive to avoid the problem of malformed larval and achieve greater survival. During the first stages of egg development, vulnerability to external conditions is higher; nowadays the incubation parameters were adjusted and the facilities and systems were optimized in order to increase the quality of embryogenesis, resulting in larvae of the best conditions, and increased survival. The work also advanced the knowledge of the optimal incubation temperature and the adequate parameters regarding aeration, water flow and form of creating an adequate water circulation. Important observations were also made about larval behavior and feeding sequence.

Very important results were achieved in larval feeding sequence in RAS culture. These data could be the starting point for future experiments and a reality to propose the cultivation of wreckfish as a possibility for the diversification of aquaculture.

1.3.6 Grey mullet

The WP on grey mullet larval husbandry determined that the most effective concentration of microalgae daily added to the larval rearing tanks of grey mullet was 0.4×10^6 cells ml⁻¹ of *Nannochloropsis oculata* or 0.023×10^6 cells ml⁻¹ of *Isochrysis galbana*, in terms of larval growth and survival. These microalgal concentrations, although differing between these species, both provided the same level of turbidity of 1.19 NTU. Turbidity is considered a factor that facilitates prey recognition and larval consumption by providing a contrasting background. On the other hand, further studies revealed that the dominant factor defining the benefit of algal tank supplementation was the biochemical composition of the microalgae, which contain unidentified compounds common to both *Isochrysis galbana* and *Nannochloropsis oculata* that promote larval growth and survival. Although algal supplementation to the larval rearing tanks did not affect the ontogeny of brush border and pancreatic digestive enzymes, there were dramatic changes in enzyme activity as a function of age and the transition from strictly carnivorous larvae to omnivorous juveniles. Alkaline phosphatase activity, a marker for brush border absorption, was ca. 8 times higher and α -amylase activity increased 5.3 times in 79 dph fish compared to 40 dph individuals. In addition, gut maturation occurred around 61 dph. The results suggest that aquaculture feeds at this developmental stage should include not only considerable protein but also higher levels of starch or other low cost amylolytic energetic compounds compared to starter feeds fed to younger grey mullet or the juvenile stages of carnivorous species.

From these studies, the clear benefits of microalgal addition at species-specific concentrations to the larval rearing tanks of grey mullet was shown. Further studies also highlighted that the use of lyophilized microalgae was just as effective as the use of live microalgae, in terms of tank turbidity as well as larval rotifer consumption, swim bladder inflation, growth and survival. Interestingly, the use of lyophilized microalgae enhanced the maturation of the intestine more rapidly in grey mullet fry, suggesting earlier weaning onto a dry prepared diet is possible, when using this dried alga. Taken together, the results of this study showed that using lyophilized algae would be a significant saving in time, labour and infrastructure and may have expressed a growth advantage in older fish and is recommended in the larva rearing of grey mullet. From these studies it was shown that juveniles are producing increasing amounts of amylase at the same time that protease activity is decreasing at an age when they are migrating to lower salinity estuarine waters. This begs the question whether weaning diets should be designed for a carnivorous, herbivorous or omnivorous mode of feeding. The results showed that fish performance was best, in terms of growth, survival, feed efficiency and gut maturation when fed an omnivorous diet. Furthermore, the high amylase and maltase activity in the omnivorous diet would provide glucose as an energy substrate, which could be protein sparing resulting in improved growth. These results continue to support the use of high carbohydrate-low protein diets to wean juvenile grey mullet, which would be more economical.

The results of this WP were implemented in the development of a grey mullet larval rearing protocol, which was tested in 6 m³ semi-commercial V-tanks in Israel. In the 2017 season, 78704 juveniles were produced as a result of the production protocols. This did not include the juveniles harvested for experimental tasks that year within the framework of DIVERSIFY. This meant that the entire juvenile production for 2017 was ca. 200,000 fish and survival was 20% from egg to 60 dph, which makes commercial juvenile production of grey mullet a reality.

1.4 Grow out husbandry

1.4.1 Meagre

The industry bottlenecks of variable growth rates and the possibly related need for defined feeding methodologies during grow out were addressed. The development of size variability in populations was described and was due to different growth rates amongst individuals and was observed at all stages including early juvenile stages before cage grow out sizes were attained and when cannibalism was a problem. There was no compensatory growth of slow growing fish and it was recommended that slow growing fish were not selected for grow out as an economic analysis indicated that these fish would need six months more to attain 500 g. Genetic differences were observed between fish that grow at different growth rates and genetic markers were identified that were associated to growth (see Reproduction meagre WP). A wide range of husbandry parameters did not alter the variable growth rates and consequently did not alter the wide size distribution obtained. These included light conditions (shaded or non shaded cages), depth (8 m or 6 m cages), feeding methods (self-feeding, hand feeding or automatic feeding), time of feeding (night or day) and depth of feeding (surface or bottom of the cage). In addition, the studies indicated many aspects that can improve feeding methodologies: Mortality and feed conversion ratio (FCR) were lower in deeper cages (8 m). High light intensity from natural sunlight had negative effects on feeding behavior. The structure of the visual system indicated that meagre are a nocturnal species that prefers low light intensity environments. A total of 50% of the stomach content had been transferred to the rest of the digestive channel 8 hours after feeding. Self-feeding fish feed during the entire 24-hour period throughout the year. Feeding behavior was stimulated by both visual (light) and mechanical (aeration) cues. In conclusion, variable growth rates appeared to be only related to genetic differences, which suggested that genetic breeding programs and domestication might be the solution to this problem. The information obtained, indicated that an optimal feeding methodology should adjust to the biological characteristics of meagre by feeding when light intensity is low (dusk, dawn and night), using stimuli to ensure a good feeding response from fish that often cannot be observed and fish should be left to digest during periods of high light intensity (daytime – particularly mid-day).

1.4.2 Greater amberjack

For the grow-out tasks of greater amberjack, development of methodologies emphasized cage technology. The feeding pattern of different age classes has been studied while trials to define optimal stocking densities were implemented. Furthermore there were trials aiming to study temperature effects on growth performance of greater amberjack. Cage rearing is important for the commercial production of amberjack, but appears to be challenging. Several trials have been performed at an industrial scale and during all trials fish accepted commercial feed of appropriate composition, i.e. high protein (of fish origin) without problem. There was also no problem during the standard husbandry practices of net cleaning/changing and although the stocking density was not high, a value of ~ 5 kg m⁻³ is considered acceptable for a pelagic fish. Regarding the growth performance, during the first 4 months the growth was high (5g d⁻¹) while it decreases later by 50%. Significant variations in growth were observed among individuals resulting in size variability of almost 100% a problem that requires further investigation. Another significant difficulty during grow out is the occurrence of parasitic infestations by monogenean worms. Even though treatment with peroxide was effective, the application is not easy and appropriate methodologies suitable for large cages should be developed. The species is also facing bacterial infections and in the case of Greece incidences with *Vibrio harvey* were reported, causing significant mortalities.

Environmental temperature was shown to affect significantly the performance of greater amberjack. Juveniles of 5 g held at 26°C showed significantly higher body weight compared with fish held at 22°C or 17°C. Morphological analysis showed that the increase of temperature led to an elongated fish body, especially of the head. Also, the specimens reared at 26°C showed significant swimming differences compared to the individuals reared at 17°C and 22°C, while there was no difference

between the later groups. For individuals of 350 g body weight, fish held at 21°C showed significantly higher growth compared to fish held at 26°C, while fish held at 16°C showed the lowest final body weight. The survival rate was higher at 16°C, but there was no significant difference in the FCR for the whole experimental period of 3 months. Plasma Cortisol levels were analogous to temperature and showed a high inter-individual variability. Nutrient digestibility coefficients were high indicating the good quality of the diets. Although temperature is one of many parameters affecting gut transit time it did not affect energy fat, protein and dry matter digestibility of greater amberjack. Finally, fish of 500 g showed no significant differences for the temperature studied (20°C and 23 °C) on feed intake and growth.

Regarding stocking densities, results showed that it affects growth rates and feed intake. Fish maintained at a high density (7 kg m⁻³) had better specific growth rate, while the condition index presented no difference between the groups. Further to this, feed intake was significantly lower at low density (2.5 kg m⁻³) during the second and third months, a tendency that changed in the fourth month during which the feed intake decreased with the increase of density. No negative effects on growth were observed in fish of 150 g initially stocked at 3.2 kg m⁻³ reaching a final stocking density of 6.8 kg m⁻³. Results from immunological parameters suggest that greater amberjack reared at the higher stocking density are not under a stressful condition. For the feeding pattern, studies showed that greater amberjack juveniles grew less when fed at 2.5% body weight d⁻¹ compared to fish fed 3.5% d⁻¹ or at apparent satiation. Furthermore animals fed one meal daily showed lower growth compared to those fed 3 or 4 meals per day. Similarly, FCR was higher for fish fed 2.5% body weight d⁻¹ or once daily compared to the other conditions tested. For larger individuals (200 g), between the feeding frequencies tested (1, 2, 3 and 7 meals d⁻¹) the best results in growth and FCR were obtained with 7 meals daily. The absence of changes among the hematological and biochemical parameters suggests that greater amberjack juveniles were able to adapt to the different feeding frequencies under the particular culture conditions. However, results from immunological parameters reveal differences in the immune status among fish subjected to different feeding frequencies that could influence the health status of fish.

1.4.3 Pikeperch

High mortality and unpredictable growth rate during the on growing of juveniles are among the major bottlenecks for the development of pikeperch aquaculture. These may be related to high stress responsiveness, since they are often observed after procedures of aquaculture management. The multifactorial study provided relevant outputs that covered well the objective to determine major directive husbandry and environmental factors for growth and welfare of pikeperch. The main results from this multifactorial study and from the confirming experiments indicated that pikeperch juveniles are highly sensitive to aquaculture manipulations such as grading and that long-term application of grading manipulations may alter growth rate and food utilization. In addition, other environmental variables were shown to affect the welfare of pikeperch, including the light intensity and, to a lesser extent, the light spectrum. Pikeperch is sensitive to the light environment due to its specialized retina and inadequate lighting conditions induce stress and immune suppression that may alter its resistance to pathogens. The second main objective was to study whether domestication level and geographical origin affect physiological stress response and immune status of pikeperch. The results indicated that domestication increases the stress response to the net chasing stress test. Moreover, the highest stress sensitivity of domesticated populations was associated to the best immune status. These results established basic knowledge for future selection studies of pikeperch strains according to the rearing conditions of commercial fish farms.

1.4.4 Grey mullet

Fish meal substitution between 50 and 75% by a mixture of different plant protein sources (corn glu

ten, wheat gluten and soy protein concentrate) in wild grey mullet fry weaned onto compound diets did not affect good growth performance and survival. The proximate composition, pancreatic and intestinal enzyme activity confirm the capacity of this species to digest plant protein sources at early life stages. These results indicated that weaning diets for wild grey mullet harvested for restocking aquaculture ponds and on-growing may be formulated with a high level of fish meal replacement by alternative plant protein sources. Moreover, it seems plausible that fry of this species may accept and use satisfactorily compound diets with a complete fishmeal substitution by plant protein sources. Diets with a 50 and 75% of fish meal replacement by plant protein sources were 15.5 and 23.6% less expensive than the fish meal diet, which is very relevant considering that feed costs account for >50% of the production costs in aquaculture production.

Three separate experiments tested the effect of stocking grey mullet at different densities (4, 6, 10, 12, 29, 55 and 286 fish per m²) in a range of cement and polypropylene tanks. The results showed that increasing the fish stocking density above 6 fish per m² can lead to decreased growth in an increasing segment of the population resulting in larger numbers of smaller fish. This may be a result of higher stress among cohorts from increasing competition for the same food sources. In future studies, the effect of increased ration size, use of extruded and not pelleted diets as well as the number of meals per day (simulate continuous feeding) will be employed. This should reduce the number of slower growing, smaller fish in the population and increase the efficiency of grow-out. The effect of different stocking densities during grow-out was tested in Greece (4 and 6 individuals per m²), Spain (0.5 and 1.0 fish per m²) and Israel (1 and 2 fish per m²). Generally, poor growth was reported in all countries with no significant effect of density or observed differences in proximate and fatty acid analyses. Spain did report a trend of improved growth and feed efficiency in the lower stocking density treatment, while this inclination was muted in the Greece and Israel trials. The generally poor performance of the grey mullet in the Greek, Spanish and Israeli trials can be due to a number of factors. Certainly attempting to grow mullet in full strength seawater (40‰), which was the case in the Israeli trial, is not going to deliver the best growth, as much energy will be channeled into osmoregulation instead of building tissue. However, a major impediment is likely the extruded diet, which remains not sufficiently attractive to the fish as they appear to prefer the detritus and primary productivity of the pond to the more nutrient dense feed. Moreover, in earthen ponds the mullet are likely using sediment to aid mashing of the plant material in the gizzard for better digestion and absorption. In order to improve the feasibility of intensive monoculture of this species, the dietary formula of the current grey mullet feed must be improved

1.5 Fish Health

1.5.1 Meagre

During the course of the DIVERSIFY project, all major diseases and health-related issues of meagre were recorded and studied. Through the various tasks, studies of key disease states, development of appropriate treatments, and a first characterization of the meagre immune system/immune responses were carried out. One of the most important bottlenecks of meagre production is Systemic Granulomatosis (SG), a pathological condition affecting the majority of farmed populations. Through various tasks we tried to identify the etiology of the disease; we have run various feeding trials to identify potential nutritional causes of SG and we monitored meagre populations farmed in various locations in order to isolate and identify *Nocardia* spp., or other granuloma-associated pathogens. The general conclusions from these tasks were that nocardiosis is not the cause of SG, the addition of Vitamin D₃, Se and Mn did not stop the development of the disease, while high dietary content of phosphorus, vitamin E and C in a fishmeal-based diet seemed to improve the condition. From the pathological assessment performed on various fish samples, a diagnostic protocol for SG was created based on the results of visual inspection, histopathology, electron microscopy and on the assessment of selected

blood biochemical parameters.

Meagre is one of the fish species that are sensitive to Chronic Ulcerative Dermatopathy (CUD). The results of the studies in DIVERSIFY indicated that CUD is induced by the use of borehole water, however neither pH nor CO₂ are the factors affecting the underlying causative agents. The causative agent is still unknown, however a full description of the disease in meagre was made using histology and SEM, as well as osteoclast activity using molecular markers.

Most of the currently important diseases in meagre are of parasitic aetiology, such as the monogenean *Sciaenacotyle panceri*. One of the tasks was focused on the use of essential oils with vermicide properties in order to test their efficiency as parasiticide. Overall, cinnamon showed immunostimulant properties and a clear potential to treat a parasitosis with *Sciaenacotyle pancerii* when administered orally to juvenile meagre. Furthermore, the first report of *Diplectanum scianae* infecting cultured meagre and the first report associating this parasite with fish mortality was recorded within the project framework.

Regarding the other pathogens of meagre, a wide range of molecular protocols for diagnosis by PCR have been developed that can be used for the detection of *Vibrio anguillarum*, *Vibrio alginolyticus*, *Vibrio parahaemolyticus* and *Vibrio vulnificus*, *Photobacterium damsela* subsp. *piscicida* and *Nocardia* spp. Moreover, based on the results obtained of the occurrence of different pathogens and experimental challenge test, recommended protocols have been developed with the recommendations on specific antibiotic dosages and treatment regimes. Furthermore, since meagre is a relatively new species to aquaculture it was necessary to document the immune response of specific genes under conditions of vaccination and against pathogens of significance for commercial aquaculture, such as *Vibrio anguillarum* as it is a pathogen with broad host-range and likely to be of concern for intensive rearing facilities of meagre. In total, 28 assays have been developed for measuring the expression of genes related to the immune function in this species. Moreover, two different vaccine preparations were evaluated in the trials performed that appeared to stimulate positively immune responses of a diverse repertoire. Further, immersion vaccination against *V. anguillarum* showed that it conferred protection in vaccinates when challenged with *V. anguillarum*. These data, and related published work from this project, show the potential to modulate immune responses in meagre in culture, such as by delivery of immuno-stimulants, to enhance particular immune pathways at a time of disease risk such as prior to transport.

1.5.2 Greater amberjack

New tools have been developed to study the immune system of greater amberjack, with the design of 20 primers relevant genes (IL-1b, IL-8, IL-10, IL-17AF, IL-17D, IL-22, Defensin, Hepcidin, Piscidin, RAG2, IgM, IgT, Mx prot, iNOS, IFN1, IFN γ , TNF α , EF-1a, b-actin, MUC-2). Similarly, the characterization of greater amberjack piscidin, as an important antimicrobial peptide (AMP) gives new insights about the function of this species' immune system.

Neobenedenia girellae is a monogenean parasite of the skin, and causes the main health problem for Atlantic populations of greater amberjack in aquaculture. This monogenean has been described in relation with water temperature increases in sea cages of the Canary Islands. New insights about the relation of this parasite with its host shows the mechanical damage that the fixation causes, resulting in thickening of the epidermis, vacuolization of epidermal cells, disruption of cellular layers, recruitment of goblet cells, and mononuclear cell lymphocytic type mobilization to the adhesion regions. Because of this, secondary infections appear and could result in 100% mortality. New prevention strategies have been developed, such as the inclusion in the diet of mannan oligosaccharides (MOS and cMOS), which enhanced mucus production and increases the immune response, reducing the parasite load and growth.

Zeuxapa seriola is another monogenean parasite of greater amberjack, considered the main health

problem for greater amberjack culture in the Mediterranean region. This parasite gets attached to the gills, being hematophagous, producing important gill anaemia and inefficient oxygen exchange. Due to its rapid lifecycle and its increase with water temperature, it could cause the demise of the whole production. Treatments with hydrogen peroxide at 75ppm during 30 minutes have been reported to be efficient for killing the adults, always combined with repeated treatments after 150 and 30 days, and net changes to avoid reinfection from the released eggs. Other parasites have also been described, such as the blood fluke *Paradeontoxylis* sp. is a blood parasite that has been observed in cultured greater amberjack in the Mediterranean. The proliferation inside the host circulatory system could produce obstruction of blood flow, resulting in ischemia and necrosis, and gill destruction when the eggs hatch. *Penella* sp. is one of the largest copepod parasites of fish, typically from swordfish (*Xiphias gladius*) and marine mammals. This parasite gets imbedded inside the skin of greater amberjack, nevertheless, it is not considered a problem for greater amberjack culture.

Epitheliocystis is a bacterial disease caused by *Chlamydia*, *Endozoicomonas* spp. and *Ichthyocystis* spp. The presence of multiple cysts in the gills cause respiration problems in the fish and high mortality. New tools have been developed for the early diagnosis of the disease, with molecular PCR probes.

1.5.3 Atlantic halibut

In order to develop a vaccine for Viral Neural Necrosis for Atlantic halibut larvae, the capsid protein of Nodavirus was successfully expressed recombinantly in three different systems; *E. coli*, *Leishmania tarentolae* and in tobacco plant, and as expected there was variation in the amount of expression between the systems. In addition, the recombinant capsid protein expressed in *Pichia* was provided from the EU project Targetfish. These four expression systems differ in the way the expressed proteins are post-translationally glycosylated. By constructing and using *E. coli* and *Leishmania tarentolea* expressing green fluorescent protein (GFP), it could be visualized by fluorescence microscope that *Artemia* filtered efficiently and ingested these microbes, and thereby the harboring recombinant protein. *Artemia* ingested recombinant Nodavirus capsid protein expressed by the various systems, which could be confirmed by immunoblotting. The recombinant capsid protein expressed by the different system was then fed to *Artemia*, which were fed to Atlantic halibut larvae at 100 dph. Ten weeks later the juveniles in all treatment groups were challenged by an i.p. injection with Nodavirus to check for efficacy. The challenged fish were terminated 8 weeks post challenge and tested for the presence of Nodavirus in the brain by real-time RT-PCR targeting the viral RNA2-segment. No significant difference could be seen between the different treatment groups, including the group with recombinant protein that has shown protection earlier. This indicates that the size of the fish and the need to sort fish to minimize huge variation between individuals in different phases at the time of vaccination have its inherent limitations, and should be carefully considered. In conclusion, although it has been shown that *Artemia* will take up and accumulate the various forms of recombinant Nodavirus capsid proteins and act as a vector for oral delivery to larvae of Atlantic halibut, the challenge experiments indicate that this strategy of antigen delivery does not induce protection against Nodavirus infection, at least under the conditions used in this study.

1.6 Socioeconomics

DIVERSIFY had a strong socioeconomic component, in order to address issues that are presently important bottlenecks in EU aquaculture development, consumption and diversification -- beyond biological/production issues. The socioeconomic part of the project had a science based applied market development approach with multiple components: the perception of aquaculture products in general and products specifically, market potential and demand factors and motives, consumer and professional

buyer preferences, new product development, creating added value in relation to raw products and market development. An important bottleneck is that a large proportion of EU consumers is product-loyal in buying food and, therefore also, in fish products. Therefore, introduction of new species requires in depth market research, as it has been done in DIVERSIFY. So, parallel to the technological improvement of production methods for the new species, expansion opportunities for the EU aquaculture sector have been identified.

Market research identified market potential for aquaculture fish products in cross-cultural consumer segments, with increased-to-strong interest in new products in the main EU fish markets (France, F, Germany, D, Italy, I, Spain, ES and United Kingdom, UK). In this project further processed new products were developed and sensory and conceptually tested by consumers in the five selected countries. This resulted in a sensory positioning in regard to other species in the market and framing suggestions for marketing. Next to that all consumer research was based on the Canvas business models. Buyers and consumers would welcome new species, if they are a) sustainably farmed, ideally in domestic or EU waters; b) fresh (especially southern-EU) or mildly processed (northern-EU); c) easy to prepare and/or ready to eat; and d) competitively priced.

In Europe, greater amberjack shows the most promising market opportunities, given its large size, processing potential and superior sensory characteristics. Grey mullet is a very interesting species due to the higher sustainability of its production methods. No specific preference region has been identified for this species. Wreckfish has very firm flesh that discriminates it readily from other fish. The remaining species (Atlantic halibut, pikeperch and meagre) have certain advantages due to their biological and physical characteristic and are of interest to specific regions in Europe.

Introduction of the new species seems to have most impact if it is done country by country instead of pan-European, because in each market other buying factors and motives are important. Next to that the growing perspectives per country are different. In some of the countries early adopters make that the majority of consumers try the new species, while in France the growth model shows that early adopters try the product easily, but that growth to the majority of consumers need extra marketing efforts. In all countries, introduction of the new products with a reference product that consumers already know improves acceptance and buying from retail buyers and consumers. Price actions to penetrate the market were only successful in Spain. In all other markets price actions had a negative impact on market penetration.

1.6.1 Final product development

The main objectives of this WP were to develop new product concepts from the selected species, by incorporating consumer and expert input; to select product ideas and develop physical new products from the selected species; to monitor the quality of new products in terms of organoleptic characteristics and nutrition-rearing history; and to make a technical assessment of the products. In order to generate input in the form of a set of ideas that will be screened out and further developed into product concepts for further testing in subsequent tasks in the new product development, different focus group discussions with consumers and interviews with experts in the selected countries of the project (UK, D, ES, F, I) were performed. This research provided a list of ideas for new product development that were further tested in the experimental and quantitative research that touch upon the two main areas of the work, namely related to development and selection of new product concepts from selected fish species, and evaluation and optimization of newly developed fish products. In total, fifteen feasible ideas were generated from consumer focus groups. Interviews with experts were conducted by using a structured questionnaire in each of the five countries to explore the possibility of creating new fish products from the ideas gathered from the focus groups. Experts from different countries agreed that the created products were attractive and feasible ideas that have potential in the

market. They considered that in overall these ideas could increase profits of the fish industry due to the higher diversity of choice. Generally, they stated that these ideas had a possible future if they are developed with good coordination between the fish farmers and consumers. Experts considered that some of the product concepts should be revised in collaboration with consumers and that they require product testing and sampling.

New product concepts, generated combining information of the market perceptions and the technical limitations and the economical prospect efficiencies, were submitted to a quantitative screening. From this screening, 12 concepts or ideas out of 43 that acquired the highest scores were suggested for product development. These ideas covered different options: mass market products, products targeted to specific market segments and added-value products. Before the development of the new products based on the suggested ideas, an extensive characterization of the raw material was performed. The five selected fish species (meagre, pikeperch, greater amberjack, grey mullet and wreckfish) were studied for their fillet composition, their technical yields, their fillet sensory properties and mechanical texture. Based on the results obtained, some processing recommendations (products best fitted for each species) were also suggested. Physical prototypes of new products per species of varying degree of processing in commercial format (size, packaging and presentation) were developed. The physical prototypes were designed based on the market potential of the new species, the product concepts technically and consumer driven, the consumer value perceptions and segmentation, the physico-chemical characteristics of each raw material, the technical properties of the products and the process, and the availability of similar product in the market. Provided that wreckfish was not available as farmed fish, the possibility to create prototypes out of this species and conduct further consumer test was not possible. Accordingly, the effort on new products development was only made on the available fish species from aquaculture. Twelve different prototypes were elaborated based on ten selected ideas and using 4 fish species.

Meagre was used for the development of the “frozen fish fillets with different recipes”, “fish burgers shaped as fish” and “ready to eat meal: salad with fish”. Pikeperch was used for the development of “fresh fish fillet with different ‘healthy’ seasoning and marinades”, “ready-made fish tartar with additional soy sauce” and “fish spreads/pate”. Grey mullet was used for the development of “thin smoked fillets”, “ready-made fish fillets in olive oil” and “fresh fish fillet with different ‘healthy’ seasoning and marinades”. Finally, greater amberjack was used for the development of “frozen fish fillet that is seasoned or marinated”, “ready-made fish tartar with additional soy sauce” and “fresh fish steak for grilling in the pan”. The necessary information to obtain these new products, as well as a number of guidelines, processing conditions, technical specifications and troubleshooting were also described. In addition, basic information regarding the packaging of the food products, conservation conditions, preliminary product shelf life and consumer handling/cooking specifications were provided as well. Regarding the different processing conditions, these new product ideas had different degree of complexity, but in all cases it was possible to elaborate different prototypes with the selected fish species. The technical feasibility suggested that it was possible to produce these products at an industrial scale, which was corroborated by the presence of other similar products in the market.

The technical quality of the developed products was also assessed. The total proximate composition of the products (protein, lipid, moisture, inorganic and carbohydrate content), the energy contents of the selected products, the quantitative nutritional value in aspects of fatty acids and the sensory profile of each of them was determined. As expected, processing had an effect on both the proximate composition and fatty quality of the products when compared to the raw fillet tissue. However, the effect depended on the processing method used as well as the inclusion of additional materials (such as olive oil) during the product formulation. Processing generally had a negative effect on nutritional quality reducing the proportion of essential fatty acids, i.e. EPA and DHA, of the majority of

products when compared to the corresponding fish fillets. Regarding sensory properties, all processed products exhibited unique sensory profiles. The processed products showed a more complex sensory profile, with more attributes than the unprocessed cooked fillet of the species. The developed characteristics of the processed products in their majority were connected to the added materials and/or the processing method.

Finally, the correlation between the fish dietary history (e.g. dietary fat and protein levels, fat sources, etc.) or other rearing parameters (e.g. rearing system, temperature, or density) and the end-product quality was evaluated. Results indicated that filleting yields and protein contents did not seem to be influenced significantly by rearing and dietary histories at grow out stage. Greater amber jack displayed the highest filleting yields and final contents of protein, fat and especially EPA+DHA. Due to its vulnerability to fat oxidation, it was suggested that commercial sizes should be 1-2 kg with a relatively lower fillet fat content than bigger fish. Meagre filleting yield and protein content were quite attractive. Its total fat contents did not seem to be highly influenced by the dietary or growing history, displaying low contents of fat even in the wild, an attractive feature for low fat dietary regimes. Grey mullet was confirmed as the best candidate for marine ingredient substitution of its diet either by terrestrial or marine origin vegetable sources. Regarding the sensory properties, diet had only an important effect on the sensory characteristics of the grey mullet, especially in aspects related to the fillet fat content and its oxidative stability.

1.6.2 Consumer value perceptions and behavioral change

The main aim of this WP was to comprehend overall value perceptions of consumers with regard to aquaculture fish in general and the DIVERSIFY fish species in particular, to undertake a value-based segmentation study, to evaluate consumer sensory perceptions of the newly developed products, and to optimize the newly developed products in terms of ideal intrinsic-extrinsic product attribute combinations.

Consumer value perceptions and segmentation: Based on a number of psychographic characteristics (i.e. category involvement, domain-specific innovativeness, subjective knowledge, suspicion of novelties and optimistic bias) three cross-cultural consumer segments have been provided that comprise the top fish markets in Europe (i.e. France, Germany, Italy, Spain, and the United Kingdom). These were named “involved traditional”, “involved innovators” and “ambiguous indifferent”. The consumer segments have been found to be uniform across investigated countries with homogeneous, converging fish-related culture, that bring opportunity to fashion new product concepts at the cross-border European level. The segmentation results further show that European aquaculture could profit from a market segmentation strategy that take full advantage of the market potential of the above segments besides nurturing consumer awareness regarding aquaculture products. The future of aquaculture seems less dependent on geography and more dependent on consumer lifestyles and their psychographic profiles.

Consumer sensory perceptions: Sensory profile of 10 newly developed products from the DIVERSIFY fish species (with low, medium and high processing level) have been tested with consumers in a cross-cultural context in all test countries, where products with a lower degree of processing and the genuine sensory properties of fish were those that generated higher overall acceptability of the consumer. On the other hand, products having a higher degree of processing were found to be more appropriate for consumers who do not like fish because of its taste, presence of bones and odour, among other attributes, where the existence of different processed product alternatives is found to be a good solution. In terms of the consumer segments previously identified, the overall acceptability and preferences across products were minimal, again showing that newly developed products from the new/emerging DIVERSIFY fish species could work well across the different consumer segments.

Optimization of intrinsic-extrinsic attribute combinations: Based on the experimentation with newly developed product mock-ups from DIVERSIFY fish species in the cross-cultural context, the optimal intrinsic-extrinsic product quality profiles have been identified. It was concluded that it is possible to create new aquaculture products targeting similar high-profile consumer segments across all big EU markets. Similar pattern in consumer choice-drivers have been observed where country of origin and price come first, followed by quality certification (i.e. ASC label), while nutrition/health claims appear to have varying effect. For the aquaculture industry, the use of ASC label in their marketing to signal consumers that their products come from a “controlled”, certified and responsible aquaculture source increases the probability of consumers considering the product as well as trusting it. For the general public, the use of nutrition and health claims would actually help EU consumer to make more informed choices, aligned with their preferences, stimulating health-related behaviour.

Communication effectiveness in behavioural change: The evaluation of communication effectiveness in changing consumers attitudes and behaviour towards the newly developed product mock-ups from DIVERSIFY fish species in the cross-cultural setting shows that there is a clear need for the aquaculture industry to promote new products and persuade/engage consumers that they can constitute an excellent source of sustainable and quality food. It further shows that aquaculture products should not be promoted using generic messages that cannot stand competition and defend against bad word of mouth, but should promote unique production process by increasing their visibility as traceable, healthy but also tasty alternatives for modern diets and responsible consumption.

1.6.3 Business model and marketing strategy

Each of the DIVERSIFY species has advantages in relation to the current aquaculture fish assortment in EU stores. The selection of species has been broad and diverse. However, production challenges make production process outcomes still uncertain for some of the species (e.g. wreckfish and grey mullet) and a constant and high-quality supply is therefore still difficult. Consequently, selling to large retail chains could be difficult or impossible at this stage. This channel demands a continuous stream of production. Based on this, suppliers of the experimental species are advised to begin by selling to smaller retailers/parties and local restaurants. This strategy will help generate cash flow that can be invested to further professionalize production. For these producers, collaborating with innovative channel partners (for co-creation and co-investment) is the best bet.

The more promising business opportunities and thus business models concern greater amberjack, pikeperch, meagre, and Atlantic halibut. For these species, most bottlenecks in production have been addressed satisfactorily. The challenge now is to grow customer demand and market acceptance. The newly developed products can help give an impulse to this effort. The results showed a coherent business story for these four species, which is the first litmus test for any viable business model. The value propositions can be summarized as follows:

- (i) Greater amberjack is a delicious and excellent alternative to fresh tuna. It grows fast and offers an excellent food conversion rate. Prices could be high but set slightly below tuna. Because it is a large, rapidly growing species it is interesting as a fresh product, frozen and for further processing. In promotion, the excellent flesh quality and high omega 3 can be stressed.
- (ii) Pikeperch is a freshwater fish and resembles rainbow trout. Its meat is white with soft texture and a mild taste. It lends itself to many different forms in many preparations (e.g. salad). It is a good alternative for trout. An exclusive high-end positioning with fairly high price is recommended combined with an initial focus on the fish's traditional geographical markets first.
- (iii) Meagre is a white-flesh fish with an attractive fish shape that offers lean fillets with excellent texture and mild flavor. Its firm texture makes it very versatile; it is suitable for a large variety of recipes. Its rapid growth rate allows producers to farm them to larger size than many other farmed com

petitors (e.g. European sea bass or gilthead sea bream). It is appropriate for filleting and further processing. Promotion of this marine fish could stress high omega 3, leanness, and excellent taste. The fact that the species is known under different names in different countries requires attention.

(iv) Atlantic halibut is a large semi-fat flatfish rich in omega 3, with a characteristic flaky white meat and few bones. It has a reasonably good fillet yield. It competes on the market with turbot and sole. Building on its excellent reputation in the North European markets, firms can expand presence in retail channels with a high value/price.

While very good possibilities exist for the above production-ready four species, results did show that firms should increase their attention for marketing and relationship building with channel partners. Although farmers will benefit from enhancing their production processes to further increase quality/growth and decrease cost, investments in marketing and sales/channel management generally lag behind. This could jeopardize the chance of penetrating the market and reaping profits from their efforts. However, only with a buy-in from distribution partners and adequate marketing efforts can consumers be reached and convinced to adopt and continue purchasing these new species and products. Marketing can benefit from using country/region of origin branding and health claims (e.g. high omega 3), among others. Certification issues also need to be remedied, particularly since e.g., super markets consider this a key-purchasing requirement. Without proper certification, market development may prove difficult at best.

The final, online market test performed in DIVERSIFY focused on greater amberjack (as the most representative new species and one with the highest potential) and fillets to study acceptance in a competitive store setting. Results confirmed that consumers had a positive attitude and willingness to buy the new farmed products when instructed to buy fish for a meal for their families. However, communicating the new species' closest neighbor (referent product, i.e. similar to tuna) was found to be important in order to help consumers categorize the new fish and its product. Results showed that Spain and Italy are the most attractive EU markets to enter first. Whether these results can be generalized to all four (or six) species remains to be seen. Since production levels even for these four species remain fickle/uncertain, soft launches with slow ramp up scenarios are advised. By focusing on one distribution channel and country at a time, supply levels can be best managed and controlled. It can help mitigate risk related to sudden shortfall in production due to disease or other setbacks, or inability to scale up production in a timely manner. Regarding an internationalization strategy, it involves selecting a country-by-country (i.e. waterfall approach) rather than all-countries-at-once approach (i.e. the sprinkler approach). Similar to the communication tests, the fish in the online market test was sold under the DIVERSIFY label. Using such a fancy label or brand may help farmers build a more sustainable market position. A brand can help differentiate the product in the market and prevent the new product from becoming generic quickly. It can help to maintain a profitable margin for farmers and will help protect them against new entrants and followers with similar products. It will help make the farmers' business model more resilient. Farmers may create their own brand or explore developing collaborative/cooperative structures for this purpose.

Potential impact and main dissemination activities and exploitation results

The DIVERSIFY consortium integrated a multidisciplinary group of research and academic institutions, small and medium-sized enterprises, large enterprises, five professional associations and one consumer NGO from 12 European countries. The acquired knowledge and developed methods will enhance the production of the selected emerging species (meagre, Atlantic halibut, pikeperch) by the European aquaculture and will enable the incorporation of some new species (greater amberjack and grey mullet). Wreckfish is still far from commercial production, although significant advances have been made in the area of broodstock management, control of reproduction and production of fertil

ized eggs, and larval rearing with the production of a small number of juveniles.

2.1 Reproduction

In the area of reproduction, DIVERSIFY has provided improved understanding of the regulation of reproduction and the dysfunctions that occur when different fishes are maintained in captivity. The project has defined optimal broodstock management conditions and has developed species-specific spawning induction protocols for the acquisition of optimal gamete quality.

2.1.1 Meagre

Given the developed methods for reproduction control, we expect meagre production to increase, the cost of meagre production would decrease and this would have positive impacts on the rural coastal communities that farm meagre. In addition, the technologies would improve the production of similar species to which similar or the same technologies can be applied. The description of the limited genetic diversity of the meagre broodstocks held across Europe has highlighted the need for the implementation of meagre genetic breeding programs. The provision of genetic tools and protocols to control reproduction to produce the families necessary for a breeding program will enable the industry to implement breeding programs, thus enhancing the industries efficiency and profitability. The implementation of breeding programs has the potential to avoid negative effects of inbreeding on the production of meagre. Genetic breeding programs have many positive effects on the production traits that are selected, for example growth rates have been improved in other species by 10-20% each generation. Improved growth rates for meagre would increase production in a given time and decrease production costs as the production cycle would be shorter. These benefits would be with each generation enabling the industry to improve continually. These advantages would stabilize the production of meagre and would have socio-economic benefits for the areas, often rural coastal communities where meagre is cultured.

2.1.2 Greater amberjack

The greater amberjack is a highly valuable commercial species and a popular game fish. The total worldwide catch of this species has increased tenfold since 1990, still only reaching 3,287 tonnes in 2009, of which about 17% was taken by United State of America and around 80 % was fished in the Mediterranean and Black Sea by European (Greece, Italy and Spain), African (Algeria and Tunisia) and Asiatic countries (Cyprus, Israel and Syria). The greater amberjack flesh is much appreciated by consumers and its market quotations are high, ranging between 10 and 20 USD per kg in Europe and reaching 20–30 (sometimes up to 50) USD per kg in Japan. In the late 1980s, a greater amberjack farming activity initiated in the Mediterranean basin, based on the grow-out of juveniles caught from the wild and cultured in tanks and cages. Greater amberjack aquaculture production has an enormous potential for expansion: the total value of the global aquaculture production was just 808,051 USD in 2007 (source: Cultured Aquatic Species Information Programme, *Seriola dumerili*, FAO, 2016), despite its high quality flesh and high consumers' appreciation. Its rapid growth rate, worldwide market demand and high quotations make the greater amberjack a very promising aquaculture species. However, a proper commercial aquaculture production of the species has not developed so far, mainly due to its inconsistent and unpredictable reproduction in captivity which prevented the development of hatchery production of juveniles and the conversion of this capture-based farming activity into a true aquaculture industry. We expect that the spawning induction methods developed within DIVERSIFY will represent valuable tools towards the incorporation of this species in the aquaculture industry in Europe and its large-scale aquaculture production. Moreover, the production of a large number of artificially propagated juveniles will help reduce the fishing pressure on wild greater amberjack populations, whose state of conservation is unknown. Already within the time frame of DIVERSIFY, a number of commercial operations in Greece –both partners of DIVERSIFY and non-partners—have begun pilot production of greater amberjack using eggs and juveniles produced by

the project.

2.1.3 Pikeperch

Genetic studies in pikeperch were until recently limited and information was lacking on the genetic structure of wild populations, and more importantly on that of domesticated aquaculture stocks. Understanding spatial genetic variability patterns in pikeperch is expected to have a dual major throughput and impact: the first one more theoretical, which is linked to conservation actions and translocation regulations, and the second more practical and applied having to do with farming efficiency.

Pikeperch populations in Europe seem to be part of at least two genetically differentiated groups. The first group is more widely distributed in central and northern Europe and the second one comprises few populations in Central Europe and probably southern countries. In the latter, the Hungarian populations are having a key-position being different from those found geographically near, and this might imply that we are talking for another stock associated with Hungarian lakes, as opposed to all other populations that probably dispersed through the Danube River west and southwards. This should be taken into account for conservation actions as well as translocations of samples outside the species range for aquaculture practices through trading. We already know that this may have many conservation implications, such as biological invasion, pathogen spill over, etc.

Furthermore, aiming at having a long term and sustainable breeding program, it is fundamental to i) ensure sufficient genetic variation within populations, and ii) take into account different zootechnical performances that are due to the geographic differentiations of stocks. In domesticated stocks, caution is required because the loss of genetic variability within the first generations of breeding procedures limits the potential for future genetic improvement through selection practices. Last, we should examine carefully if differences in production traits (such as growth, disease resistance and/or survival rates, aggressiveness, food conversion ratio, etc.) between populations of different origin are consistent to genetically differentiated groups in our analyses, in order to recognize populations with best performances for the aquaculture industry.

2.1.4 Atlantic halibut

Documentation of reproductive performance and endocrine cycles in wild-caught and farmed female Atlantic halibut led to the development of optimized spawning protocols with consistently high fertilization of eggs. The optimized protocols also meant that fish were subjected to less handling stress and improved fish welfare. Protocols for induction of maturation and spawning with GnRH α were tested and showed that ovulation and spawning advanced in females that were treated during late vitellogenesis, before final maturation had started. However, results were not consistent and gamete quality was highly variable in treated fish. We expect that these results will have a positive impact on output and availability of high-quality gametes from Atlantic halibut. In addition, we expect an impact on handling routines and improved welfare in breeders.

2.1.5 Wreckfish

The wreckfish is one of the most prominent species for the diversification of European aquaculture due to its fast growth, late reproductive maturation and limited fisheries landings. With a high market price, worldwide distribution, and the high potential for the production of value-added products, this is a great fish for aquaculture production. However, lack of reproduction control and larval rearing protocols were considered major bottlenecks preventing the establishment of the wreckfish aquaculture. The objectives of DIVERSIFY were to understand and control the species reproductive function and develop larval rearing protocols for the industry. The expected results have been achieved in the area of reproduction with the production of large number of eggs of good quality. However, we have not yet produced consistent results in the area of larval rearing, so the species is not yet ready to be

incorporated in the aquaculture industry. Nevertheless, DIVERSIFY has acquired significant knowledge on the ontogeny of the fish in culture, and the success in larval rearing we had during the last year of the project is encouraging for the European aquaculture. These results warrant and should encourage further research efforts –both at the National and European level— for the development of working protocols for the production of juveniles by the industry.

2.1.6 Grey mullet

Grey mullet, which are fished and farmed extensively around the world for centuries, have many favorable culture characteristics such as being omnivorous, euryhaline, fast growing, disease resistant and producing not only flesh of high quality, but also a secondary product of very high value, the egg roe called “bottarga”. Currently, the supply of fingerlings for grey mullet culture is almost exclusively from the wild, which increases pressure on the dwindling wild fry populations, particularly along the Mediterranean coasts. This project enabled the establishment of a potent hormonal therapy to synchronize gonadal development in captive grey mullet females and males, and sequentially induced their spawning. In addition, by using artificial thermo- and photoperiod regimes, we have managed to shift the natural spawning season, which increases the feasibility of a year-round supply of fingerlings. The achievements accrued in this WP are expected to influence the economics of grey mullet culture and help reduce the harvesting of wild fry from the sea for stocking fish culture systems.

The roe of grey mullet is consumed either as salted individual eggs or as salted and dried whole ovaries (bottarga). The catching of grey mullet and the processing of its high value roe has a long tradition in countries on both the northern and southern coasts of the Mediterranean Sea. In this regard, the current study points to favorable effects of captive conditions on the fish’s competence to undergo and complete vitellogenesis. These results emphasize the potential of hatchery-produced grey mullet to develop their ovaries up to a condition appropriate for bottarga production (advanced vitellogenesis). Furthermore, the development of a method to enhance coloration of grey mullet roe in farmed fish through the use of natural pigments in the feed ingredients incorporated in their food is a major advantage in guaranteeing final product quality. Thus, the increase in egg roe for bottarga production, that will occur if fish are grown out to sufficient size, may increase the farming economic sustainability by accelerating the production cycle of this high-value "mullet caviar", and reduce the need for importing ovaries from third countries for the production of bottarga in Europe (Italy).

2.2. Nutrition

The cost of feeding in aquaculture production is around 40-70% of total production cost; therefore, improving feed conversion efficiency and growth rates is directly related to the profitability of the industry. New species in aquaculture are fed with available diets designed for other well-established species, which may constraint their growth performance, welfare and health. For this reason, it is important to develop species-specific feeds that consider the nutritional requirements of each species at different stages of development and that can improve their performance, quality and health condition. To achieve this goal, DIVERSIFY has established the nutritional requirements of several macro- and micronutrients for most of the species considered in the project. In addition, specific live prey enrichment products have been developed. Specific formulated feeds, live prey enrichment products and feeding protocols will result in new products that can be commercialized worldwide.

2.2.1 Meagre

The nutrient requirements for meagre larvae were determined, improving larvae growth and survival and reducing both skeleton deformities and early incidence of systemic granulomatosis. Essential fatty acid requirements have been also determined for meagre juveniles, requirements linked also

with the incidence of systemic granulomatosis. The results obtained have a clear positive impact on the meagre manufactured diets, improving the formulae to produce high quality fingerlings. This is expected to improve the quality of the produced juveniles by the EU aquaculture industry, thus improving its cost efficiency.

2.2.2 Greater amberjack

Nutrient requirements for greater amberjack larvae were determined, improving larval growth and survival and reducing skeleton deformities. Recommendations for enrichment protocols for both *Artemia* and rotifers have been produced, improving the quality of the fingerlings produced. The lysine requirement has been determined for juveniles, improving the feed conversion and growth of juveniles in sea cages. For broodstock diets, important improvements have been done, determining the levels of essential fatty acid, histidine and Taurine to improve the spawning quality of this species. The different results obtained will be indispensable for the feed production companies that will be called to produce specialized feed for the emerging greater amberjack aquaculture industry.

2.2.3 Pikeperch

Development of intensive farming of pikeperch in Europe is a new industry and tailor-made commercial feeds have yet to be formulated for several rearing stages of this species. The project DIVERSIFY focused on nutritional challenges in larval, early juvenile rearing and the specific dietary requirements of phospholipids, fatty acids and minerals (Ca, P) and the effect on their interaction during early fish ontogeny. DIVERSIFY established the requirement of these nutrients in pikeperch and proved accordingly that available existing commercial extruded feeds could be optimized. If the obtained DIVERSIFY knowledge is commercialized to marketable feeds, this will benefit both the feeding industry, which can offer new better products, as well as boosting the economy of farmers due to higher growth rate, a better feed utilization, higher survival and lower frequency of deformities. Thus, in a broader sense, the DIVERSIFY results obtained will improve performance and stimulate an increased hatchery production of pikeperch juveniles for the benefits of the EU aquaculture industry.

2.2.4 Atlantic halibut

The work on Atlantic halibut nutrition established a method for early weaning of larvae, indicated at which developmental stage larvae can be weaned and established a quantitative difference between how different feeds are accepted by the larvae. This is one step towards early weaning of Atlantic halibut larvae. The ability to use formulated feeds in larval rearing will lower costs and increase efficiency for commercial hatcheries. Also, DIVERSIFY has established that *Artemia nauplii* produced with modern methods have sufficient levels of nutrients to cover the requirements of Atlantic halibut larvae. Phospholipid (PL) levels did not affect growth and lipid composition of juveniles. This means that further research should concentrate on other issues than nutrition in larvae fed *Artemia* and PL requirements of juveniles. This will release resources for research on other topics related to Atlantic halibut farming.

2.2.5 Wreckfish

Studies on wreckfish nutrition were very scarce until the onset of DIVERSIFY and the advances in this area are very important for the development of the culture of this species. In DIVERSIFY, studies about broodstock and larval nutrition of wreckfish were performed. Two new live food enrichment products for feeding larvae were developed and these products had a good acceptance by wreckfish larvae. Advances in the knowledge of nutritional requirements of this species were obtained with data obtained from different tissues and eggs from wild fish. Based on this and regarding broodstock nutrition a new dry food was specifically formulated for this species. The development of the products obtained for wreckfish nutrition in DIVERSIFY will contribute to the improvement of

feeding regimes for wreckfish broodstock and larvae leading to a higher production and a good commercialization of this species in the future. In addition, a new dry feed has been designed for the fattening phase and will be tested with the fingerlings obtained during the last year of the project.

2.2.6 Grey mullet

The findings of the nutrition WP on grey mullet have made a significant impact on our understanding of the nutritional requirements of this species, which leads to more efficient and profitable production. Specifically, the conclusion that the costly ingredient DHA, an essential fatty acid for growth and development, can be reduced under low salinity during juvenile grow-out is very important. On the other hand, DHA must be added to broodstock diets to improve the quality of bottarga, a high price added value product for the industry, and increase larval performance and robustness. Taurine is also a necessary dietary supplement at 0.5% of the diet, despite the fact that this species has some capacity for endogenous synthesis, as it improves both larval and juvenile growth. On the other hand, studies carried out in this WP have shown that the current grey mullet grow-out diet formula continues to require animal based meals to achieve satisfactory growth. However, the supplementation of taurine and selected amino acids might negate the necessity of animal based meals and provide a fish meal-free and more sustainable feed for fish farmers. Taken together, these advances in the grey mullet nutrition would translate as significant savings for farmers as the purchase of feed for the grow-out of fish to market weight can represent 60% of production costs.

2.3 Larval husbandry

A larval rearing system is a complex artificial environment, with numerous factors influencing fish development and performance, as well as behavior and survival. These factors can be environmental, nutritional, social and genetic. For species such as meagre, pikeperch, grey mullet and Atlantic halibut, improvements in fish growth and husbandry have been addressed to refine the existing protocols and facilities in order to solve existing bottlenecks. In contrast, emphasis has been given to developing new species-specific larval rearing protocols in the case of greater amberjack and wreckfish, since these were species with important knowledge gaps in these areas. The output of these tasks is the development and refining of rearing protocols for the selected species that will result in the improvement of current practices, and will provide an increase in production yields.

2.3.1 Meagre

For meagre larval rearing the most important factor to be improved was to reduce production costs derived from the use of live prey (cost of Artemia cysts and labor dedicated to live prey culture and enrichment). Thus, in the project we have provided the industry a protocol for early weaning the larvae onto artificial feeds using a co-feeding period of at least 5 days and introducing several methods to reduce cannibalism during this phase. The protocol is effective in advancing larval feeding on micro diets by 5 days compared to the standard rearing method, although it produces an increase in the incidence of larval cannibalism. Thus, more research is needed to reduce this cannibalism in the larvae and to formulate more attractive feeds for meagre larvae. Increasing the survival rate and the use of artificial feeds will contribute to increase the production of meagre juveniles for on growing.

2.3.2 Greater amberjack

As a result of DIVERSIFY, a commercial larval rearing protocol has been developed, with a considerable increase in larval survival over previous attempts. This protocol enabled the industry—both partners in DIVERSIFY, but also non-partner companies—to obtain juveniles from the research partners or to produce juveniles themselves, and then start pilot sea cage rearing. As a result, the first harvesting of food-size fish begun already before the end of the project (Dec 2017) and in the Canary Islands this species has already been included in the Regional Plan for the Management of Aquacul

ture (PROAC), approved on July 9, 2018. Therefore, as a result of DIVERSIFY we expect the EU production of greater amberjack to continue to increase gradually in the coming years.

2.3.3 Pikeperch

The optimal combination of factors that was developed to improve larval rearing in RAS is very important to secure the biological and economical basis for the design of further hatchery – nursery for pikeperch production. For the first time a reliable protocol is available for people who intend to invest in pikeperch culture. At that moment, only few farms produced pikeperch using RAS in Europe (including Switzerland), they have developed their own protocol, which remains confidential and not accessible for new investors or producers who want to diversify their fish production. Moreover the production cost of a juvenile was estimated, consequently that will help also the building of new farms. It must be also considered here that the protocol proposed could be still improved in the future.

2.3.4 Atlantic halibut

Infections with opportunistic bacteria are a severe problem in marine larviculture, thus limiting the production of juvenile fish for commercial fish farming or for re-stocking of natural populations. While at later life stages the frequency of bacterial infections can be reduced by preventive measures such as vaccination and good management practices, the very young larvae and small fish have an immature immune system and cannot be protected by vaccination. Very often infections in larviculture are treated by antibiotics. However, this is not a sustainable practice since bacterial antibiotic resistance will develop and antibiotic-contaminated effluents are deleterious to marine ecosystems. Therefore, alternative strategies for preventing bacterial infections in fish larvae, such as pathogen-reducing probiotic bacteria or bacteriophages are highly needed. The commercial production of Atlantic halibut fry is currently carried out in flow through systems (FT). The successful application of RAS in first feeding of Atlantic halibut in the DIVERSIFY project is an important breakthrough, as the more stable environmental and chemical water parameters led to improved larval performance. A metagenomic analysis of the bacteriological composition of water and larvae in RAS and FT systems for both yolk sac and first feeding stages has been completed, and will provide a basis for selection of candidates for probiotic bacteria for use in Atlantic halibut larviculture. We expect these results to have a major positive impact on juvenile production of Atlantic halibut, by providing a rearing system with higher stability and reduced use of antibiotics compared to the FT systems that are commonly used at present.

2.3.5 Wreckfish

This was the first time that a project succeeded in producing juveniles weaned to inert food, and it signifies a milestone in the efforts to produce wreckfish under aquaculture conditions. The work in DIVERSIFY acquired important data on growth and increased our knowledge about the feeding protocol and the specific behavior and metamorphosis of wreckfish larvae. These data could be the starting point for future experiments and a reality to propose the cultivation of wreckfish as a possibility for the diversification of EU aquaculture. The success in producing wreckfish juveniles in captivity has generated great interest among aquaculture companies interested in diversifying and innovating their production, from Spain to Greece. The general interest for scientific advances in the cultivation of wreckfish is clear, and in particular from the few companies that currently maintain broodstocks of this species, and see the possibilities of incorporating this species in their production increasing. The increase of our knowledge of this species in the larval and juvenile period are definitely very important for the encouragement of subsequent projects and studies.

2.3.6 Grey mullet

The results of the WP on larval husbandry in grey mullet improved significantly many practical aspects of the current larval rearing protocol. The most effective concentration, turbidity and type of microalgae added to the tanks, in terms of larval growth, survival and rotifer ingestion, was determined. Moreover, it was shown that lyophilized microalgae was just as effective as the use of live microalgae, in terms of tank turbidity, larval rotifer consumption, swim bladder inflation, growth and survival. The use of dry microalgae instead of live represents a considerable saving in infrastructure, labor and off-the-shelf convenience. Although the co-feeding of copepods and rotifers to larval grey mullet was not completed in this WP due to technical complications, a protocol for the ozone disinfection of copepods before feeding them to the larvae was developed. This is particularly important in controlling the red-pigmented pathogenic bacterium *Pseudoalteromonas* spp., which can decimate or eradicate larval populations of grey mullet and other species.

This WP determined the dramatic changes in digestive tract enzyme activity, as a function of age, during the transition from carnivorous larvae to omnivorous juveniles. Alkaline phosphatase activity, a marker for brush border absorption, was ca. 8 times higher and α -amylase activity increased 5.3 times in 79 dph fish compared to 40 dph individuals. In addition, gut maturation occurred relatively late at around 61 dph. These results suggested that fish performance would improve, in terms of growth, survival, feed efficiency and gut maturation, when fed an omnivorous diet. This was confirmed in weaning studies which demonstrated that fish fed an omnivorous weaning diet performed markedly better than cohorts fed a strictly carnivorous or herbivorous diet. These findings suggest that aquaculture feeds at this developmental stage should include not only considerable protein but also higher levels of starch or other low cost amylolytic energetic compounds compared to starter feeds fed to younger grey mullet or the juvenile stages of carnivorous species. The combined results of this WP were implemented in the development of a grey mullet larval rearing protocol, which was tested in 6 m³ semi-commercial V-tanks. This resulted in a juvenile production of ca. 200,000 fish where survival was > 20% from egg to 60 dph. This result is certainly a proof that hatchery production of grey mullet is possible, and we expect the industry to capitalize on this in the coming years.

2.4 Grow out husbandry

As with the larvae, juvenile rearing systems are artificial environments, with numerous factors influencing behavior, growth and performance. For species such as meagre and pikeperch, improvements in fish growth and husbandry have been addressed to refine the existing protocols and facilities in order to solve existing bottlenecks. In contrast, emphasis has been given to developing new species-specific rearing protocols in the case of grey mullet and greater amberjack, since these were species with important knowledge gaps in these areas. The output of these tasks is the development and refining of rearing protocols for the selected species that will result in the improvement of current practices, and will provide an increase in production yields.

2.4.1 Meagre

The information on variable growth rates and optimal feeding methodologies has clarified how to address these bottlenecks. The knowledge on the biology of meagre in the grow out systems has identified optimal feeding methodologies. Optimal feeding methodologies should improve feed utilization and reduce feed conversion ratios (FCR). Feed is the most expensive aspect in growout and even small reductions in FCR can translate to massive economic gains to reduce production costs. The work on optimal feeding methodologies also demonstrated that feeding and husbandry aspects were not related to variable growth rates. Variable growth rates were related or partially related to genetic aspects indicating that genetic breeding programs and domestication should reduce or solve this bottleneck. Therefore, the implementation of genetic breeding programs (see meagre reproduction) can in addition to improving growth rates, reduce growth variation to facilitate management of stocks and

provide a uniform product. Improved growth rates and improved feed utilization for meagre would increase production and decrease production costs. These advances would enable the industry to establish management practices that can in the long term improve production and, therefore, attract investment for existing and new companies for the culture of meagre. Improved production and investment in aquaculture companies that produce meagre would have socio-economic benefits for the areas, often rural coastal communities, where meagre is cultured.

2.4.2 Greater amberjack

The results obtained in DIVERSIFY are of great importance, as several barriers for the industrial production of the species have been removed. The information accumulated during the project enriched the specific knowledge base with a range of parameters appropriate for the biological requirements of the greater amberjack (temperature ranges, feeding rates, stocking densities, innate immune status). Of particular importance was the involvement of private companies in the implementation of tasks and the associated direct transfer of research results in the everyday husbandry practice in the farms. Worth noting is the initiation of the species commercialization in Greece by project partners and follow up by more companies. Despite the difficulties identified related to health management and husbandry, the growout of the species is feasible. Alongside with the results obtained for the larval rearing of the species it is apparent that greater amberjack may represent a new aquaculture product. Due to its characteristics (size, market, etc.) this may result in wider socioeconomic implications that can shape the Mediterranean aquaculture.

2.4.3 Pikeperch

Due to its fast growth, high quality flesh and high economical expectation, pikeperch is one of the most promising freshwater fish species for the diversification of European inland aquaculture. However, its culture is still limited by impairment in growth rate and high mortality rate during on growing. These failures may be related to inadequate rearing conditions inducing high stress level since the pikeperch aquaculture management has not been optimized yet. It has been shown that percid fishes are more sensitive to aquaculture stressors than other species with a longer history of domestication. And since decreased welfare may lead to increased stress level and to disease outbreaks, it was essential to improve its management strategy. Our results defined key elements to improve pikeperch welfare, leading to the improvement of pikeperch culture. The results include specific environmental conditions that reduce stress and, as a consequence, the negative effects on growth, immunity and disease resistance. In addition, our results on domestication level and geographical origin establish the basic knowledge for future selection studies of pikeperch strains, which are essential for the development of pikeperch aquaculture.

2.4.4 Grey mullet

This WP found that fish meal substitution between 50 and 75% by a mixture of different plant protein sources (corn gluten, wheat gluten and soy protein concentrate) in wild grey mullet fry weaned onto compound diets, did not affect growth performance and survival. This means that weaning diets for wild grey mullet harvested for restocking aquaculture ponds and on growing may be formulated with a high level of alternative plant protein sources. Diets with a 50 and 75% of fish meal replacement by plant protein sources were 15.5 and 23.6% cheaper, respectively, than a diet containing fish meal as its protein source. This is very relevant considering that the expense of feed account for >50% of the production costs in aquaculture facilities. Separate experiments tested the effect of stocking various sizes of grey mullet at different densities in a range of cement and polypropylene tanks. The results demonstrated that increasing the fish stocking density above 6 fish per m² can lead to decreased growth in an increasing segment of the population resulting in larger numbers of smaller fish. Further studies testing the effect of different mullet stocking densities in grow-out ponds in Greece (4 and 6 individuals per m²), Spain (0.5 and 1.0 fish per m²) and Israel (1 and 2 fish per m²)

resulted in generally poor growth with no significant effect of density or observed differences in proximate and fatty acid analyses. A major impediment to better fish performance is likely the extruded diet. This formulated feed remains not sufficiently attractive to the fish as they appear to prefer the detritus and primary productivity of the pond to the more nutrient dense diet. Moreover, in earthen ponds the mullet are likely using sediment to aid mashing of the plant material in the gizzard for better digestion and absorption. In order to improve the feasibility of intensive monoculture of this species, the dietary formula and feeding protocols of the current grey mullet feed must be improved. In future studies, the effect of increased ration size, use of extruded and not pelleted diets as well as the number of meals per day (simulate continuous feeding) will be tested. This should reduce the number of slower growing, smaller fish in the population, and increase the efficiency of grow-out.

2.5 Fish Health

Fish health is a key aspect to be optimized in cultured fish. The effect of the developmental stage, rearing conditions and nutrition on the capacity to modulate specific immune responses will help predict vaccine responsiveness and fish health. DIVERSIFY has characterized the immune system of meagre and greater amberjack to identify key immune molecules as potential markers of immune system development, and induction of antiviral and antibacterial responses in preparation for vaccine development for disease management. In addition, potential solutions for specific bacterial infections and parasitoses have been investigated, providing means to prevent and/or minimize these issues at an industrial scale. DIVERSIFY has produced practical health manuals for meagre and greater amberjack, which are freely available and can be used immediately by the industry in order to improve their stock management.

2.5.1 Meagre

One of the requirements for the successful introduction of a new species in the aquaculture industry is the knowledge of the pathological problems that may arise. For Systemic Granulomatosis and Chronic Ulcerative Dermatopathy, which are diseases that affect 100% of meagre cultured population, diagnostics protocols with causes and solutions were produced addressing fish health specialists and aquaculture scientists and producers. The etiological factors of these two diseases are still unknown; however several factors have been eliminated and the results obtained from DIVERSIFY may lead to future investigation. In addition, in the effort to find alternative treatment for parasitoses, parasiticides obtained from natural sources such as cinnamon, which can be administered with the feed, would be tremendously convenient and safe for use from the aquaculture industry. Through the various tasks of DIVERSIFY, immune markers are now established for the innate, adaptive and inflammatory responses of the immune system of meagre. The assays that developed for genes of interest for the study of immune function in this species, will be of interest for anyone who may be studying this species outside of the DIVERSIFY consortium.

2.5.2 Greater amberjack

New markers have been described to assess changes in immune status of greater amberjack. These tools are an important advance in our ability to evaluate the health status of this species, which is highly susceptible to parasite infections. A functional diet has been formulated to increase resistance of greater amberjack to the monogenean parasite *Neobenedenia girellae* and could be applicable for other monogenean parasites. This diet is based on a high protein diet (required for fast growing species) and the utilization of additives with immunostimulant properties, including mannan oligosaccharides. This important milestone will provide a tool to reduce the incidence of this parasite in sea cages, reducing mortality of greater amberjack juveniles in farms. Besides, the formulation of the functional diet will have a direct impact on feed producers that can produce an effective feed for im

proving the amberjack quality in farms.

A Health Manual for greater amberjack describing different pathologies has been produced, that describes the general incidence and potential treatments and some tools for identification. Epitheliocystis, Zeuxapa seriolae, the blood fluke Paradeontoxylix sp. and the copepod Penella sp. has been described. The description of new or emerging pathologies for greater amberjack is of special importance for a rapid diagnosis and selection of the most efficient treatment to reduce mortalities in farms.

2.5.3 Atlantic halibut

Artemia showed to uptake and accumulate the various forms of recombinant Nodavirus capsid proteins and act as a vector for oral delivery to late larval/juvenile stage of Atlantic halibut. The challenge experiments, however, was inconclusive whether this strategy of antigen delivery does induce protection against Nodavirus infection.

2.6 Socioeconomics

The impact of the Socioeconomic work package of DIVERSIFY goes much further than marketing of the new species. Primary insights for the new species are provided, on how the product can be marketed with added value, what segments of consumers could be interesting in the selected five countries, how the product should be priced to have a good margin and where costs could or should be reduced to improve the margins. So entrepreneurs active in the species can have direct practical use of the outcomes of the project. Furthermore, the project has provided a lot of new scientific insights on consumer behavior, choice motives and sensory perception. This part of the project has provided a large number of scientific papers in peer reviewed international scientific journals. In addition to the objectives of the project, all this research has provided also new insights in choice and buying behavior of fish in the five main markets of the EU, which can be of interest for all stakeholders in the fish sector. In relation to other sectors, scientific consumer research in the fish sector is very unique, so the participants in this project have actively shared the outcomes with stakeholders in Germany, Spain, Italy, Greece and the Netherlands.

2.6.1 Final product development

The production at an industrial scale of the developed products from the DIVERSIFY fish species can be a feasible task, subject to the application of certain principles and conditions. The technical yields that can be achieved are very satisfying for all products, thus providing high profit margins. The duration of high quality life ranges depends on the product nature, but also on the optimization of processing and preservation procedures. Frozen and sterilized products (e.g. oil-preserved fish fillet and fish pate) have long high quality shelf life, spanning in months, while fresh products have a high quality shelf life of a few days, varying with the ingredients included (most sensitive ingredient is the limiting factor), the manufacturing process and the packaging type. The principles for proper production include three aspects: 1. raw materials of good quality 2. good manufacturing (processing) practices. 3. Proper traceability. Freshness of the raw materials should always be ensured. The ISO and HACCP principles should apply throughout the whole processing chain and commercialization for ensuring safety and maximum quality. Food traceability systems should be implemented in all products but also in raw materials that are incorporated during processing. These rules are necessary and sufficient condition for high quality and economic sufficient products.

Altogether, the activities included and results produced by DIVERSIFY provide a broad picture of the main quality characteristics of the raw material and the developed products, thus giving a valuable input for those interested in the commercialization of any of the studied species and/or products..

2.6.2 Consumer value perceptions and behavioral change

Economically feasible production of new aquaculture products is dependent on stable consumer demand. To be able to guarantee stable consumer demand, it is of outmost importance for the aquaculture industry to increase consumer acceptance of European aquaculture and new aquaculture products optimized to consumer preferences and eating habits. Marketing and communication strategies produced by DIVERSIFY increase consumer trust and endorse stable consumer demand.

Newly developed products from DIVERSIFY fish species have desirable nutritional characteristics and can be part of a balanced diet that contribute to consumer health. This may only be accomplished, though, if consumers develop preferences for these products, that is find claims about their nutritional and health properties reliable, and accept the underlying production method. The effort undertaken in the DIVERSIFY project proliferate the product-market fit and lead to improved consumer acceptance of the newly developed aquaculture products.

2.6.3 Business model and marketing strategy

Fish farming is still a very product- and production-driven industry. As a result, diversification efforts have focused on eco system development and value creation at the supply side, and much less on developing the eco-system at the demand side. Although farmers will benefit from continuing to work with partners to enhance their production processes for increasing quality/growth and decrease cost, it is clear that serious investments in marketing and sales/channel management are/will be needed to develop the market and create socio-economic gains of employment and healthier living. Certification is a license-to-produce for large retail chains and lack of such quality standard may cripple farmers' business models for their new species. Only with a buy-in from distribution partners and adequate marketing efforts can retailers and consumers be reached and convinced to purchase the new species and their products. Such marketing efforts may benefit from country/region of origin branding and health claims (e.g. high Omega 3 content), among others. Such efforts will make business models for these species more resilient, resulting in a positive long lasting impact on the providers' business and industry. The best chances exist, in the short run, for meagre, greater amberjack and pikeperch, i.e. the species that are most production ready.

Aquaculture offers important opportunities for new species of the DIVERSIFY project. However, carefully positioning the species/new products and managing the reputation of farmed fish are important to prevent bad media coverage about farming conditions at fish farms outside the EU (e.g. in Asian and African countries) from spoiling the market. Through their market strategy and promotion of their new species providers can help not only increase fish consumption, but stimulate more balanced diets and healthier living in the countries they decide to target.

2.7 Sustainability

Sustainability of aquaculture production is a major concern worldwide. DIVERSIFY has considered this issue from different points of view. For example, the acquired knowledge will support the growth and expansion of the sector based on different production systems that can be regarded as more sustainable: cage culture – no competition with land resources; RAS- ecologically friendly, with efficient use of water; extensive pond-lagoon culture, with very low environmental effects and in some cases even contributing to the restoration of ecosystems. Also, the introduction of an omnivorous fish into the aquaculture sector, such as the grey mullet, with positive influence in the environment where it is cultured and requiring low or close to no input from fish meal/oils, will contribute to the reduction of the pressure in the capture fisheries. The determination of species-specific dietary requirements, as well as feeding behavior will result in less waste of diets and nutrients into the environment. Altogether, these factors will ensure a sustainable growth and expansion of aquaculture within the EU and EEA member states.

So, overall, the main expected impact of DIVERSIFY will be the improvement of production technologies for the new/emerging species of the project. Furthermore, DIVERSIFY is expected to have also a significant impact on removing bottlenecks in markets and consumer's perception and preferences, resulting in increases in the EU consumption of aquaculture products. Such an integrated combination of biological, technological and socioeconomic activities will lead to a reduction in the dependence of the EU on imports from third countries of at times questionable production, health, environmental and social standards.

2.8 Description of the main dissemination activities

(For the Figures and Tables cited in this Section, please see the attachment “DIVERSIFY Final Report Appendix I.pdf)

During the five years of DIVERSIFY, multiple dissemination activities have been carried out to broadcast the findings and outputs of the project. The website of the project (Fig. 2.8.1) was one of the first dissemination tools to communicate the main news on the research activities and to update the general public with the latest events and achievements in the project. The website has evolved with the project and its structure has been adapted to the project evolution. Along the project life, the website has proven to be a very powerful tool also to keep the large consortium of DIVERSIFY up to date with the internal meeting organization, the legal documentation of the project, the deliverables, reports and publications.

In the first year of the project (M6), a printed folder (initial project folder, Fig. 2.8.2) with the main information of DIVERSIFY was design and distributed to all the partners and in all the meetings, conferences and events in general attended by the PC and the Dissemination leader, as well as by any project partner. An estimated 2.600 initial folders have been distributed during the project's lifetime. A final folder has been designed in the year 5 of the project with the objective of presenting the most relevant results of the DIVERSIFY research for each of the fish species in a summarized way (Fig. 2.8.3). The folder also includes a concise resume of the socioeconomic findings and the updated list of participants. This final folder has also been distributed in different types of events, starting with the Final Coordination meeting held in Brussels, in November 2018, and will be distributed to future aquaculture event in 2019 and 2020.

During the five years of existence, DIVERSIFY has been presented in different forums and conferences involving all kind of audiences. In addition to presentations in the European Aquaculture Society and the World Aquaculture Society meetings, DIVERSIFY presentation were given to specific scientific events focused on fish biology and culture, such as LARVI; the International Symposium on Fish Reproductive Physiology, the International Symposium on Fish Nutrition and Feeding; the International Conference on Diseases of Fish and Shellfish, etc.; to meetings with Regional and National Government representatives (Regional Development Officer from Junta de Andalucía, Spain); or presentations to university students (National Aquaculture Day, University of Cádiz, Spain).

DIVERSIFY has been brought to the aquaculture stakeholders and to the society in general through more than one hundred press releases, websites, applications and articles published in the popular press along its life time. The project has been presented to a wider public and to scientific events more than 120 times (oral presentations). During the five years of the project, DIVERSIFY related scientific information has been displayed with 66 posters in conferences and aquaculture events all over Europe. A total of 15 videos have been produced to bring the results of the project to the society as audiovisual material. All the videos are available in the project web, including a 3-min profession

al dissemination video (Fig. 2.8.4). DIVERSIFY has been present in the social media too, in twitter and Facebook with a total number of 490 followers.

With regard to scientific publications, at the moment of writing this report, a total of 44 scientific articles have been published in peer-review scientific journals, and 6 are under review. More publications are expected to be published in the coming months since there is still a considerable amount of data and information being processed by the researchers and the project has successfully produced more than 200 Deliverables, the vast majority of them with scientific results, which will find their way in the scientific literature.

DIVERSIFY has also given special attention to the dissemination of the project's results to the aquaculture sector and to the whole seafood value chain. Two types of activities have been developed during the last two years of the project to achieve those objectives:

Promotional Workshops were specialized one-day workshop in strategic countries to present the project's activities and results. These events were addressed to fish farmers, feed producers, farmer's associations, fish processors, fish retailers, hypermarkets, consumer organizations and aquaculture authorities. Four Promotional Workshops were organized, one each in Germany (Bremen), Spain (Cádiz), Italy (Verona) and Greece (Athens). Each workshop consisted of several presentations dealing with fish products, consumer issues, regulatory issues, etc., and was followed by a debate to analyze with the audience the acceptance of aquaculture products, consumer perception, value added products and trends in farmed fish markets. The Promotional Workshops had an average attendance of 30 people, which promoted constructive and highly informative debates on the real constraints of the market acceptance of new fish species.

Species Workshops were full day seminars on know-how transfer to the fish producers and researchers. Six Species Workshops (one per species) were organized in different European countries, where the species was well known and where it could have a potential to become industrially produced aquaculture species. In Table 3.1 species, locations and timing of the Species Workshops are included. The Species Workshops were designed to have a set of oral presentations from the DIVERSIFY partners working on the specific species and also presentations from other researchers and specialists in the world invited for the meeting. The event was addressed to fish farmers, feed companies, pharmaceutical companies, equipment suppliers, academia, government institutions and aquaculture media. The agenda of the event included 10 presentations of 30 minutes each to explain and present the advances and achievements of DIVERSIFY with the species of interest and the corresponding work done on the socioeconomic aspect such as the development of new/traditional product presentation and the business model developed. A final debate on the possibilities of culturing the species and on the concerns of the industry representatives present in the conferences allowed to identify the main bottlenecks for incorporating the DIVERSIFY species into the production of aquaculture companies.

As part of the exploitation of the research done in the project, six Technical Species Manuals have been produced and are freely available at the website of the project, in English, Spanish and German. Some of them have been translated to other languages as well. These Manuals provide protocols and instructions to culture each of the species of DIVERSIFY. Market studies and, especially, the business models per species have been followed closely during the presentations in the Species Seminars. Moreover, the transfer of the developed know-how in DIVERSIFY has been materialized also in the production of two Health Technical Manuals, one for greater amberjack and another one for meagre. Both documents are freely available at the DIVERSIFY website. A new device for collection and quantification of parasites in tanks has been also developed by DIVERSIFY research and it is avail

able for the farmers.

The presence of DIVERSIFY during Y4 and Y5 in the Seafood Expo in Brussels and the establishment of close links and cooperation with the European Association of Fish Processors and the Association of International Seafood Professionals have been very helpful dissemination tools to bring the DIVERSIFY message on new species to the fish processing and new fish product development sector.

Also, within the Exploitation of project outcomes, the results of the project have led to the production of 35 Master Thesis and PhD Dissertations on greater amberjack (15), pikeperch (8), meagre (6), grey mullet (2) and on new product development (3).

Address of project public website and relevant contact details

The website of the project is www.diversifyfish.eu. It is managed by the Project Coordinator Dr Constantinos C Mylonas of the Hellenic Centre for Marine Research (Greece) and the WP31 Dissemination leader Dr Rocio Robles from CTAQUA (Spain). Their full contact details are shown below.

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The site will remain active for the next few years (at least 2) and be updated with relevant information such as published articles (Scientific Journals and Sector magazines), and organisation of meetings and workshops.

4.2 Use and dissemination of foreground

Section A (public)

Publications

LIST OF SCIENTIFIC PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
No.	Title / DOI	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Is open access provided to this publication ?	Type
1	Diplectanum sciaenae (Van Beneden & Hesse, 1863) (Monogenea) infecting meagre, <i>Argyrosomus regius</i> (Asso, 1801) broodstock in Catalonia, Spain. A case report	K.B. Andree , A. Roque , N. Duncan , E. Gisbert , A. Estevez , M.I. Tsertou , P. Katharios	Veterinary Parasitology	Vol. 1-2	Elsevier		26/02/2016	75-79	No	Peer reviewed
2	A Comparison of Two Methods for Generating Descriptive Attributes with Trained Assessors: Check-All-That-Apply (CATA) vs. Free Choice Profiling (FCP) 10.1111/joss.12202	Oxana Lazo , Anna Claret , Luis Guerrero	Journal of Sensory Studies	Vol. 31/Issue 2	Blackwell Publishing	United Kingdom	01/04/2016	163-176	No	Peer reviewed
3	Consumers as co-creators of new product ideas: An application of projective and creative research techniques 10.1016/j.foodres.2016.07.010	Marija Banovi# , Athanasios Krystallis , Luis Guerrero , Machiel J. Reinders	Food Research International	Vol. 87	Elsevier Limited	United Kingdom	01/09/2016	211-223	No	Peer reviewed
4	Weaning wild flathead grey mullet (<i>Mugil cephalus</i>) fry with diets with different levels of fish meal substitution dx.doi.org/10.1016/j.aquaculture.2016.04.035	Enric Gisbert , Mansour Torfi Mozanadeh , Yannis Kotzamanis , Alicia Estévez	Aquaculture	462	Elsevier	Netherlands	01/09/2016	92-100	No	Peer reviewed

5	Consumer perceptions of farmed fish	Machiel J. Reinders , Marija Banović , Lluís Guerrero , Athanasios Krystallis	British Food Journal	Vol. 118/Issue 10	Emerald Group Publishing Ltd.	United Kingdom	03/10/2016	2581-2597	No	Peer reviewed
6	Enhancement of oogenesis/spermatogenesis in meagre <i>Argyrosomus regius</i> using a combination of temperature control and GnRHα treatments 10.1016/j.aquaculture.2016.07.006	Constantinos C. Mylonas , Sara Salone , Tommaso Biglino , Paulo H. de Mello , Ioannis Fakriadis , Irina Sigelaki , Neil Duncan	Aquaculture	464	Elsevier	Netherlands	01/11/2016	323-330	No	Peer reviewed
7	Rearing in captivity affects spermatogenesis and sperm quality in greater amberjack, (Risso, 1810) 10.2527/jas.2017.1708	R. Zupa , C. Fauvel , C. C. Mylonas , C. Pousis , N. Santamaria , #. Papadaki , I. Fakriadis , V. Ciciirelli , S. Mangano , L. Passantino , G. M. Lacalandra , Aldo Corriero	Journal of Animal Science	Vol. 95/Issue 9	American Society of Animal Science	United States	01/01/2017	4085	Yes	Peer reviewed
8	Comparative Study of Reproductive Development in Wild and Captive-Reared Greater Amberjack <i>Seriola dumerili</i> (Risso, 1810) 10.1371/journal.pone.0169645	Rosa Zupa , Covadonga Rodríguez , Constantinos C. Mylonas , Hanna Rosenfeld , Ioannis Fakriadis , Maria Papadaki , José A. Pérez , Chrysovalentinos Pousis , Gualtiero Basalone , Aldo Corriero	PLoS One	Vol. 12/Issue 1	Public Library of Science	United States	05/01/2017	e0169645	Yes	Peer reviewed

9	The importance of dietary HUFA for meagre larvae (<i>Argyrosomus regius</i> ; Asso, 1801) and its relation with antioxidant vitamins E and C 10.1111/are.12890	Najlae El Kertaoui , Carmen María Hernández-Cruz , Daniel Montero , María José Caballero , Reda Saleh , Juan Manuel Afonso , Marisol Izquierdo	Aquaculture Research	Vol. 48/Issue 2	Blackwell Publishing	United Kingdom	01/02/2017	419-433	No	Peer reviewed
10	Hormonal manipulations for the enhancement of sperm production in cultured fish and evaluation of sperm quality	Constantinos C. Mylonas , Neil J. Duncan , Juan F. Asturiano	Aquaculture	Vol. 472	Elsevier	Netherlands	01/04/2017	21-44	No	Peer reviewed
11	Multifactorial analyses revealed optimal aquaculture modalities improving hushbandry fitness without clear effect on stress and immune status of pikeperch <i>Sander lucioperca</i> http://dx.doi.org/10.1016/j.ygcen.2017.08.010	Sébastien Baekelandt , Baptiste Redivo , Syaghalirwa N.M. Mandiki , Thibaut Bournonville , Alexis Houndji , Benoît Bernard , Najlae El Kertaoui , Mélodie Schmitz , Pascal Fontaine , Jean-Noël Gardeur , Yannick Ledoré , Patrick Kestemont	General and Comparative Endocrinology	Vol. 258	Academic Press Inc.	United States	01/03/2018	194-204	No	Peer reviewed
12	Ontogeny and modulation after PAMPs stimulation of α -defensin, hepcidin, and piscidin antimicrobial peptides in meagre (<i>Argyrosomus regius</i>) https://doi.org/10.1016/j.fsi.2017.08.026	Cindy Campherde a, 1, Douglas J. Milne b, 1, Alicia Estévez a, Neil Duncan a,	Fish and Shellfish Immunology	69	Academic Press Inc.		24/08/2017	200-210	Yes	Peer reviewed

		Christopher J. Secombes b, Karl B. Andree a								
13	Is personality of young fish consistent through different behavioural tests? ht tp://dx.doi.org/10.1016/j.applanim.2017.05.012	Tatiana Colchen , Elodie Faux , Fabrice Teletchea , Alain Pasquet	Applied Animal Behaviour Science	Vol. 194	Elsevier	Netherlands	01/09/2017	127-134	No	Peer reviewed
14	The effect of live food enrichment with docosahexaenoic acid (22:6n-3) rich emulsions on growth, survival and fatty acid composition of meagre (<i>Argyrosomus regius</i>) larvae ht tps://doi.org/10.1016/j.aquaculture.2017.05.012	Cindy Cam poverde , Alicia Estevez	Aquaculture	Vol. 478	Elsevier	Netherlands	01/09/2017	16-24	No	Peer reviewed
15	Investigation of sensory profiles and hedonic drivers of emerging aquaculture fish species 10.1002/jsfa.8571	Niki Alexi , Derek V Byrne , Evangelia Nanou , Kriton Grigorakis	Journal of the Science of Food and Agriculture	2017	John Wiley and Sons Ltd	United Kingdom	10/09/2017	1-9 (in press)	No	Peer reviewed
16	Fillet proximate composition, lipid quality, yields, and organoleptic quality of Mediterranean farmed marine fish: A review with emphasis on new species 10.1080/10408398.2015.1081145	Kriton Grigorakis	Critical Reviews in Food Science and Nutrition	Vol. 57/Issue 14	Taylor and Francis Inc.	United Kingdom	22/09/2017	2956-2969	No	Peer reviewed
17	Sensory characterization, physico-chemical properties and somatic yields of five emerging fish species 10.1016/j.foodres.2017.07.023	Oxana Lazo , Luis Guerrero , Niki Alexi , Kriton Grigorakis , Anna Claret , José A. Pérez , Ricard Bou	Food Research International	100	Elsevier Limited	United Kingdom	01/10/2017	396-406	No	Peer reviewed
18	Early weaning in meagre <i>Argyrosomus regius</i> : Effects on growth, survival, digestion and skeletal deformities 10.1111/are.13342	Cindy Cam poverde, Covadonga Rodríguez, José Pérez, Enric Gisbert,	Aquaculture Research	48	Blackwell Publishing		02/10/2017	5289-5299	No	Peer reviewed

		Alicia Estévez								
19	Effect of temperature on growth performance of greater amberjack (<i>SERIOLA DUMERILI</i> Risso 1810) Juveniles	Alvaro Fernández-Montero , Maria Jose Caballero , Silvia Torrecillas , Victor Manuel Tuset , Antoni Lombarte , Rafael Ruiz Ginés , Marisol Izquierdo , Lidia Robaina , Daniel Montero	Aquaculture Research	Vol. 49/Issue 2	Blackwell Publishing	United Kingdom	01/02/2018	908-918	No	Peer reviewed
20	Two types of TNF# in meagre (<i>Argyrosomus regius</i>): Discovery, distribution and expression modulation dx.doi.org/10.1016/j.molimm.2017.10.007	D.J. Milne , C. Campoverde , K.B. Andree , J. Zou , C.J. Secombes	Molecular Immunology	Vol. 92	Elsevier Limited	United Kingdom	01/12/2017	136-145	Yes	Peer reviewed
21	The observed oogenesis impairment in greater amberjack <i>Seriola dumerili</i> (Risso, 1810) reared in captivity is not related to an insufficient liver transcription or oocyte uptake of vitellogenin 10.1111/are.13453	Chrysovalentinos Pousis , Constantinos C Mylonas , Caterina De Virgilio , Gemma Gadaleta , Nicoletta Santamaria , Letizia Passantino , Rosa Zupa , Maria Papadaki , Ioannis Fakradis , Rosalia Ferreri , Aldo Corriero	Aquaculture Research	49	Blackwell Publishing	United Kingdom	01/01/2018	243-252	No	Peer reviewed
22	Review of the principal diseases affecting cultured meagre (<i>Argyrosomus regius</i>)	Florbela Soares , Ana Roque , Paulo	Aquaculture Research	Vol. 49/Issue 4	Blackwell Publishing	United Kingdom	01/04/2018	1373-1382	No	Peer reviewed

	10.1111/are.13613	J Gavaia								
23	The discovery and comparative expression analysis of three distinct type I interferons in the perciform fish, meagre (<i>Argyrosomus regius</i>) doi.org/10.1016/j.dci.2018.02.001	D.J. Milne , C. Campoverde , K.B. Andree , X. Chen , J. Zou , C.J. Secombes	Developmental and Comparative Immunology	Vol. 84	Elsevier Limited	United Kingdom	07/02/2018	123-132	No	Peer reviewed
24	Genes related to cell-mediated cytotoxicity and interferon response are induced in the retina of European sea bass upon intravitreal infection with nodavirus 10.1016/j.fsi.2018.01.034	Yulema Valero , Bassima Boughlala , Marta Arizcun , Sonal Patel , Ingrid U. Fiksdal , M. Ángeles Esteban , Joaquín De Juan , José Meseguer , Elena Chaves-Pozo , Alberto Cuesta	Fish and Shellfish Immunology	Vol. 74	Academic Press Inc.	United States	01/03/2018	627-636	No	Peer reviewed
25	Dietary requirement for n-3 long-chain polyunsaturated fatty acids for fast growth of meagre (<i>Argyrosomus regius</i> , Asso 1801) fingerlings 10.1016/j.aquaculture.2018.01.028	M. Carvalho , H. Peres , R. Saleh , R. Fontanillas , G. Rosenlund , A. Olivanteles , M. Izquierdo	Aquaculture	Vol. 488	Elsevier	Netherlands	01/03/2018	105-113	No	Peer reviewed
26	Check-All-That-Apply (CATA) with semi-trained assessors: Sensory profiles closer to descriptive analysis or consumer elicited data? 10.1002/jsfa.8571	N. Alexi , E. Nanou , O. Lazo , L. Guerrero , K. Grigorakis , D.V. Byrne	Food Quality and Preference	Vol. 64	Elsevier Limited	United Kingdom	01/03/2018	11-20	No	Peer reviewed
27	Muscle and liver transcriptome characterization and genetic marker discovery in the farmed meagre, <i>Argyrosomus regius</i> doi.org/10.1016/j.margen.2018.01.002	T. Manousaki , A. Tsakogiannis , J. Laganel , D. Kyriakidis , N. Duncan , A. Estevez , C.S.	Marine Genomics	Vol. 39	Elsevier	Netherlands	01/06/2018	39-44	No	Peer reviewed

		Tsigeno poulos								
28	Effects of high-level fishmeal replacement by plant proteins supplemented with different levels of lysine on growth performance and incidence of systemic noninfectious granulomatosis in meagre (<i>Argyrosomus regius</i>) 10.1111/anu.12814	Yannis Kotzamanis , Emmanouil Kouroupakis , Vassiliki Iliia , John Haralabous , Nikos Papaioannou , Kantham Papanna , Randolph Richards , Enric Gisbert	Aquaculture Nutrition	Vol. 24/Issue 6	Blackwell Publishing	United Kingdom	01/12/2018	1738-1751	No	Peer reviewed
29	Paired spawning with male rotation of meagre <i>Argyrosomus regius</i> using GnRH α injections, as a method for producing multiple families for breeding selection programs doi.org/10.1016/j.aquaculture.2018.06.017	Neil J. Duncan , Constantinos C. Mylonas , Edwards Milton Sullon , Dimitris Karanlidis , Maria Claudia França Nogueira , Zohar Ibarra-Zatarain , Marco Chimento , Ricardo Olinser Aviles Carrillo	Aquaculture	Vol. 495	Elsevier	Netherlands	08/06/2018	506-512	No	Peer reviewed
30	Dietary combination of vitamin E, C and K affects growth, antioxidant activity, and the incidence of systemic granulomatosis in meagre (<i>Argyrosomus regius</i>) ht tps://doi.org/10.1016/j.aquaculture.2018.08.078	M.A. Ruiz , M.B. Betancor , L. Robaina , D. Montero , C.M. Hernández-Cruz , M.S. Izquierdo , G. Rosenlund , R. Fontanillas , M.J.	Aquaculture	Vol. 498	Elsevier	Netherlands	01/01/2019	606-620	No	Peer reviewed

		Caballero								
31	Spawning Induction of First-Generation (F1) Greater Amberjack <i>Seriola dumerili</i> in the Canary Islands, Spain Using GnRHα Delivery Systems	Salvador Jerez , Ioannis Fakriadis , Maria Papadaki , M. Martín , Juana Cejas , Constantinos Mylonas	Fishes	Vol. 3/Issue 3	MDPI	Swaziland	01/09/2018	1-22	Yes	Peer reviewed
32	The importance of phospholipids combined with long-chain PUFA in formulated diets for pikeperch (<i>Sander lucioperca</i>) larvae ht tps://doi.org/10.1017/S0007114518001794	Ivar Lund , Najlae El Ker taoui , Marisol S. Izquierdo , David Dominguez , Benni W. Hansen , Patrick Kestemont	British Journal of Nutrition	Vol. 120/Issue 06	Cambridge University Press	United Kingdom	28/09/2018	628-644	No	Peer reviewed
33	Ontogeny of lymphoid organs and mucosal associated lymphoid tissues in meagre (<i>Argyrosomus regius</i>) https://doi.org/10.1016/j.fsi.2018.09.033	Cindy Cam poverde , Karl B. Andree , Douglas J. Milne , Alicia Estévez , En ric Gisbert , Francesca Carella	Fish and Shellfish Immunology	84	Academic Press Inc.	United States	01/09/2018	509-520	No	Peer reviewed
34	Effects of increased protein, histidine and taurine dietary levels on egg quality of greater amberjack (<i>Seriola dumerili</i> , Risso, 1810) ht tps://doi.org/10.1016/j.aquaculture.2018.09.011	S. Sarih , A. Djellata , J. Roo , C.M. Hernández-Cruz , R. Fontanillas , G. Rosenlund , M. Izquierdo , H. Fernández-Palacios	Aquaculture	Vol. 499	Elsevier	Netherlands	01/01/2019	72-79	No	Peer reviewed
35	Influence of the light spectrum on the daily rhythms of stress and humoral innate immune markers in pikeperch <i>Sander lucioperca</i> ht	Sébastien Baekelandt , Syaghalirwa N.M. Mandiki , Mélodie	Aquaculture	Vol. 499	Elsevier	Netherlands	01/01/2019	358-363	No	Peer reviewed

	https://doi.org/10.1016/j.aquaculture.2018.09.046	Schmitz , Patrick Kestemont								
36	Description of the Annual Reproductive Cycle of Wreckfish <i>Polyprion americanus</i> in Captivity 10.3390/fishes3040043	Maria Papadaki , José Benito Peleteiro , Blanca Alvarez-Blázquez , José Luis Rodríguez Villanueva , Fatima Linares , Antonio Vilar , Evaristo Pérez Rial , Nuria Lluch , Ioannis Fakriadis , Irina Sigelaki , Constantinos C. Mylonas	Fishes	Vol. 3/Issue 4	MDPI	Swaziland	19/10/2018	43 (1-20)	Yes	Peer reviewed
37	Increased parasite resistance of greater amberjack (<i>Seriola dumerili</i> Risso 1810) juveniles fed a CMOS supplemented diet is associated with upregulation of a discrete set of immune genes in mucosal tissues 10.1016/j.fsi.2018.10.034	Álvaro Fernández-Montero , Silvia Torrecillas , Marisol Izquierdo , María José Caballero , Douglas John Milne , Christopher John Secombes , John Sweetman , Polyana Da Silva , Félix Acosta , Daniel Montero	Fish and Shellfish Immunology	Vol. 86	Academic Press Inc.	United States	01/03/2019	35-45	No	Peer reviewed
38	High-quality spontaneous spawning in greater amberjack (<i>Seriola dumerili</i> , Risso 1810) and its comparison with GnRHα implants or injections	Samira Sarih , Adnane Djelata , Antonino La Barbera ,	Aquaculture Research	Vol. 49/Issue 10	Blackwell Publishing	United Kingdom	01/10/2018	3442-3450	No	Peer reviewed

	https://doi.org/10.1111/are.13808	Hipólito Fernández-Palacios Vallejo , Javier Roo , Marisol Izquierdo , Hipólito Fernández-Palacios								
39	Influence of salinity and linoleic or #-linolenic acid based diets on ontogenetic development and metabolism of unsaturated fatty acids in pike perch larvae (Sander lucioperca) doi.org/10.1016/j.aquaculture.2018.10.061	Ivar Lund , Covadonga Rodríguez , María S. Izquierdo , Najlae El Ker taoui , Patrick Kestemont , Diana B. Reis , David Dominguez , José A. Pérez	Aquaculture	Vol. 500	Elsevier	Netherlands	01/02/2019	550-561	No	Peer reviewed
40	The effect of algal turbidity on larval performance and the ontogeny of digestive enzymes in the grey mullet (Mugil cephalus) https://doi.org/10.1016/j.cbpa.2018.11.005	William Koven , Enric Gisbert , Oriya Nixon , Mikhail M. Solovyev , Aviad Gaon , Guy Allon , Iris Meiri-Ashkenazi , Amos Tandler , Hanna Rosenfeld	Comparative biochemistry and physiology. Part A, Molecular & integrative physiology	Vol. 228	Elsevier Inc.	United States	01/02/2019	71-80	No	Peer reviewed
41	Incidence of systemic granulomatosis is modulated by the feeding sequence and type of enrichment in meagre (Argyrosomus regius) larvae 10.1111/are.13896	Miguel Ángel Ruiz García , Carmen M. Hernández#Cruz , Maria Jose Caballero , Hipólito Fernández#Palacios , Reda Saleh , Marisol Izquierdo , Mónica Be	Aquaculture Research	Vol. 50/Issue 1	Blackwell Publishing	United Kingdom	01/01/2019	284-295	No	Peer reviewed

		atriz Betancor Quintana								
42	Effect of increasing n-3 HUFA content in enriched Artemia on growth, survival and skeleton anomalies occurrence of greater amberjack <i>Seriola dumerili</i> larvae 10.1016/j.aquaculture.2018.09.065	J. Roo , C.M. Hernández-Cruz , A. Mesa-Rodriguez , H. Fernández-Palacios , M.S. Izquierdo	Aquaculture	Vol. 500	Elsevier	Netherlands	01/02/2019	651-659	No	Peer reviewed
43	Spawning kinetics and egg/larval quality of greater amberjack (<i>Seriola dumerili</i>) in response to multiple GnRHα injections or implants https://doi.org/10.1016/j.ygcen.2018.12.007	Ioannis Fakriadis , Francesca Lisi , Irini Sigelaki , Maria Papadaki , Constantinos C. Mylonas	General and Comparative Endocrinology	000	Academic Press Inc.	United States	01/12/2018	1-20	No	Peer reviewed
44	Intra-cohort cannibalism in early life stages of pikeperch https://doi.org/10.1111/are.13966	Tatiana Colchen , Pascal Fontaine , Yannick Ledoré , Fabrice Teletchea , Alain Pasquet	Aquaculture Research	000, 000-000	Blackwell Publishing	United Kingdom	13/01/2019	1-10	No	Peer reviewed
45	Wreckfish (<i>Polyprion americanus</i>). New knowledge about reproduction, larval husbandry and nutrition. Promise as a new species for aquaculture	Evaristo Pérez, Fátima Linares, José Luis Rodríguez Villanueva, Antonio Vilar, Constantinos C. Mylonas, Ioannis Fakriadis, Maria Papadaki, Nikos Papandroulakis, Ioannis Papadakis, Rocío Robles, Christian	Fishes	under review	MDPI		25/01/2019	1-15	Yes	Peer reviewed

		Fauvel, Javier Roo, José Benito Pe leteiro 1, Nuria Lluch, Gema Pazos, Belén Méndez, Irini Sigelaki, Castora Gómez, Montse Pérez and Blanca Álvarez- Blázquez								
46	Gamete quality and management for in vitro fertilisation in meagre (<i>Argyrosomus regius</i>)	Sandra Ramos, Wendy González, Gilbert Dutto, Constantinos C. Mylonas, Christian Fauvel, and Neil Duncan	Aquaculture	under review	Elsevier		15/01/2019	1-49	No	Peer reviewed
47	Ontogeny of greater amberjack digestive system under different rearing conditions. A histological and enzymatic approach.	J.A. Pérez, I.E. Papadakis, N. Papandroulakis, L. Cruces, E. Cotou, E. Gisbert, A. Lorenzo2, C.C. Mylonas, C. Rodríguez	Aquaculture	under review	Elsevier		18/12/2018	1-47	No	Peer reviewed
48	Developing an internationalization strategy using diffusion modeling: the case of Greater Amberjack	Edwin J. Nijssen, Machiel J. Reinders, Athanasios Krys tallis and Gemma Tack en	Fishes	under review	MDPI		15/01/2019	1-10	Yes	Peer reviewed
49	Key nutritional factor and interactions during larval development of pikeperch	Najlae EL KERTAOU,	Scientific Reports	under review	Nature Publishing Group		18/01/2019	1-43	Yes	Peer reviewed

	(Sander lucioperca)	Ivar Lund , Hospice Asso gba , David Domínguez , Maria Soledad Izquierdo , Se bastien Baekelandt , Valerie Cor net , Syagha lirwa. N.M. Mandiki , Daniel Montero , Patrick Keste mont								
50	Are cortisol and melatonin involved in the immune modulation by the light environment in pikeperch Sander lucioperca	Sébastien Baekelandt *, Syaghalirwa N.M. Mandiki, Patrick Keste mont	Fishes	under re view	MDPI		15/01/2019	1-23	No	Peer re viewed
	Assessing genetic diversity in domesticated pikeperch (Sander lucioperca) broodstocks	Tsapis, D., Kyriakis, D., Darivianakis, S., Fontaine, P. and Tsigen opoulos, C.S.	11th Panhellenic Symposium on Oceanography and Fisheries, Mytilene, Lesbos island, Greece		Hellenic Center for Marine Research	Anavyssos, Athens, Greece	15/05/2015		Yes	Conference
	Perceived Consumer Value towards new farmed fish species: A psychographic segmentation in top-five EU markets	Krystallis, Athanasios; Banovic, Mar ija; Guerrero, Luis; Reinders, Machiel	EAAE-AAEA Joint Seminar ‘Consumer Behavior in a Changing World: Food, Culture, Society’ March 25 to 27, 2015, Naples, Italy		EAAE-AAEA		25/03/2015		Yes	Conference
	Influence of ethical beliefs and trust on purchase decisions: The moderating effect of involvement	Marija Ban ovic, Athanas ios Krystallis	Association for Consumer Research (ACR) Conference , October 11-14, 2018, Dallas, TX , USA.		Association for Con sumer Research (ACR)		11/10/2018		Yes	Conference
	Métodos de control del parasito Benedenia sp. en tanques de cultivo de Seriola dumerili	Alexander Doble Rivera			Instituto Español de Oceanografía	Santa Cruz de Ten erife, Spain	23/09/2014		Yes	Thesis

Lipid characterization of greater amber jack's gonadal tissue	Josua Gregorio Herre Bethencourt			UNIVERSIDAD DE LA LAGUNA, MÁSTER BIOLOGÍA MARINA: BIODIVERSIDAD Y CONSERVACIÓN	TENERIFE, SPAIN	30/09/2016		Yes	Thesis
Caracterización de la ontogenia del sistema digestivo de las larvas del medregal (<i>Seriola dumerili</i>), mediante el análisis de la actividad de las principales enzimas digestivas: amilasas, lipasas y proteasas. Characterization of ontogeny of the digestive system of cultured greater amber jack (<i>Seriola dumerili</i>) larvae through the activity of the major digestive enzymes: amylases, lipases and proteases.	Lorenzo Cruces Caparrós			UNIVERSIDAD DE LA LAGUNA, MÁSTER BIOLOGÍA MARINA: BIODIVERSIDAD Y CONSERVACIÓN	TENERIFE, SPAIN	05/07/2016		Yes	Thesis
Evaluación de la calidad nutricional del medregal (<i>Seriola dumerili</i>): estudio comparativo de hembras salvajes y cultivadas en distintas etapas reproductivas. Nutritional quality assessment of greater amber jack (<i>Seriola dumerili</i>): comparative study of wild and cultured females at different productive stages. https://sede.ull.es/validacion Identificador del documento: 702848 Código de verificación: DWk0TkGG	Eduardo De Benito Díez			UNIVERSIDAD DE LA LAGUNA, MÁSTER BIOLOGÍA MARINA: BIODIVERSIDAD Y CONSERVACIÓN	TENERIFE, SPAIN	11/07/2016		Yes	Thesis
Greater amberjack (<i>Seriola dumerili</i>) spawning induction trial: effects of different GnRH treatments on spawning dynamics and egg/larval performance parameters	Francesca Lisi			University Autònoma de Barcelona	Barcelona, Spain	28/08/2016		Yes	Thesis
Population genetic structure of greater amberjack <i>Seriola dumerili</i> Risso, 1810 (Perciformes, Carangidae) in the Mediterranean Sea and the Atlantic Ocean	Evangelos Kolios			University of Crete, Department of Biology	Crete, Greece	25/10/2017		Yes	Thesis
Comparison of GnRH injections and implants on the induction of spawning in greater amberjack (<i>Seriola dumerili</i>)	Andrea Bertini			University of Bologna	Cesenatico, Italy	15/03/2018		Yes	Thesis
Quality characterization of emerging aquaculture fish products: multisensory	Niki Alexi			Aarhus University, Department of Food	Kirstinebjergvej 10, DK-5792 Årsløv	19/04/2018		No	Thesis

	and instrumental approach				Science					
	Intensive rearing conditions and stress evaluation on meagre (<i>Argyrosomus regius</i>)	Marilena Kostari			University of Crete	Crete, Greece	20/09/2015		Yes	Thesis
	Advances in the Larval Rearing of Meagre (<i>Argyrosomus regius</i>): Diet, weaning protocols, and ontogeny of the digestive and innate immune systems	Cindy Cam poverde Vera			Autonomous University of Barcelona	Barcelona, Spain	30/06/2017		Yes	Thesis
	IMPACT OF WATER TEMPERATURE ON PERFORMANCE OF GREATER AMBERJACK (<i>Seriola dumerili</i>) UNDER INTENSIVE CULTURE CONDITIONS	PATRÍCIA KELLY ALVES PEREIRA			ERASMUS MUNDUS JOINT MASTERS DEGREE IN AQUACULTURE, ENVIRONMENT AND SOCIETY (EM JMD ACES)	Scotland, UK	20/07/2017		Yes	Thesis
	Nutritional characterization of products deriving from farmed fish species	Thanasis Kyriakopoulos			Harokopeion University (Department of Nutrition & Dietetics)	Athens, Greece	30/06/2018		Yes	Thesis
	Study of epitheliocystis in Greece	Angeliki Antonakaki			University of Crete, Department of Biology	Heraklion, Crete, Greece	10/02/2017		Yes	Thesis
	Diseases of farmed meagre, <i>Argyrosomus regius</i> with emphasis on the diseases of non-infectious aetiology	Maria Ioanna (Marianna) Tsertou			Aristotle University of Thessaloniki	Thessaloniki, Greece	30/11/2018		Yes	Thesis
	Vitellogenesi in esemplari di ricciola (<i>Seriola dumerili</i>) selvatici e allevati in cattività	Antonella Di Pasqua			University of Bari Aldo Moro, Department of Biosciences, Biotechnology and Biopharmaceutics	Bari, Italy	22/03/2016		Yes	Thesis
	Caratterizzazione molecolare dei recettori VGR e LRP13 in esemplari di ricciola (<i>Seriola dumerili</i>) e loro espressione mediante Real-Time PCR.	Pasquale De Ruvo			University of Bari Aldo Moro, Department of Biosciences, Biotechnology and Biopharmaceutics	Bari, Italy	26/07/2017		Yes	Thesis
	Spermatogenesi e valutazione del seme di specie innovative per l'acquacoltura: ricciola (<i>Seriola dumerili</i>) e riccio di mare (<i>Paracentrotus lividus</i>)	Vincenzo Cicirelli			University of Bari Aldo Moro, Department of Biosciences, Biotechnology and	Bari, Italy	04/04/2016		Yes	Thesis

					Biopharmaceutics					
	Behavioural study of intra-cohort cannibalism in sander (<i>Sander lucioperca</i>) during the early life stages.	COLCHEN Tatiana			University of Loraine	Nancy, France	29/11/2017		Yes	Thesis
	cDNA sequencing of the CYP27A1 gene in <i>Argyrosomus regius</i> and study of its expression in liver after the dietary administration of different vitamin D3 levels in growing fish	Theodora Loukanari			Agricultural University of Athens	Athens, Greece	20/09/2016		Yes	Thesis
	Reproduction in captivity of isolated pairs of meagre (<i>Argyrosomus regius</i>) of wild and hatchery origin	Edwards Milton			University Autonoma de Barcelona	Barcelona, Spain	30/09/2014		Yes	Thesis
	Artificial fertilisation in meagre (<i>Argyrosomus regius</i>): determination of the optimal sperm to egg ratio, the timing of ovulation and stripping and evaluation of different conservation methods of sperm	Sandra Ramos			University Autonoma de Barcelona	Barcelona, Spain	30/09/2016		Yes	Thesis
	Effect of different stimuli on feeding behavior of the meagre (<i>Argyrosomus regius</i>)	Alkyoni Sfindouraki - Basacarou			University of Crete, Department of Biology	Crete, Greece	20/02/2017		Yes	Thesis
	Physiological and molecular responses to selected dietary nutrients during the early developmental stages of pikeperch <i>Sander lucioperca</i>	Najlae EL KERTAOU			University of Namur	Belgium	31/05/2019		Yes	Thesis
	Immunoregulation by the light environment in pikeperch (<i>Sander lucioperca</i>) and involvement of the melatonin hormone	Sébastien BAEKELANDT			University of Namur	Belgium	30/09/2020		Yes	Thesis
	Influence of potential prey on cannibalism during the early life stages of a freshwater species: <i>Sander lucioperca</i>	Cortay Aurore			University Paris 13	Villetaneuse, France	25/06/2018		Yes	Thesis
	Onset study of the cannibalism in sander larvae	Hmila Soumaya			Institut National Agronomique de Tunisie	Tunisie	16/12/2017		Yes	Thesis
	Onset of the ichthyophagy in sander larvae (<i>Sander lucioperca</i>)	Diaz Andreas			University Paris 13	Villetaneuse, France	30/06/2016			Thesis
	Cannibalism and personality in the early	Faux Elodie			University Paris 13	Villetaneuse, France	26/06/2015		Yes	Thesis

stages of the freshwater fish Sander lucio perca										
Heavy metals in adult specimens of wild and reared greater amberjack (<i>Seriola dumerili</i> Risso, 1810) from the Mediterranean Sea	Ninoska Adern Febles				Universidad de La Laguna	La Laguna, Tenerife, Spain	31/07/2016		Yes	Thesis
Impact and control of monogenean parasites in greater amberjack (<i>Seriola dumerili</i>)	Andrea Vilena Rodríguez				Universidad de La Laguna	La Laguna, Tenerife, Spain	31/07/2018		Yes	Thesis
Study of the feeding behavior and growth of wild-caught mullet <i>Mugil cephalus</i> reared at two densities	Elissavet Paschali				University of Aegean, School of the Environment	Lesvos, Greece	13/10/2016		Yes	Thesis
Optimization of pikeperch (<i>Sander lucio perca</i>) larval rearing : validation of optimal combinations of factors	ROHRER Yannick				University of Wageningen	Wageningen, The Netherlands	29/09/2018		Yes	Thesis
Effect of dietary DHA and salinity on growth, survival, fatty acid elongation and desaturation gene expression in grey mullet (<i>Mugil cephalus</i>) juveniles.	Dor Israeli				Ben Gurion University of the Negev	Israel	30/10/2018		Yes	Thesis
Incidence and control of monogenean parasites in <i>Seriola dumerili</i>	Andrea Vilena Rodríguez				Instituto Español de Oceanografía-Centro Oceanográfico de Canarias	Tenerife, Islas Canarias, España	17/07/2018		Yes	Thesis
External parasites in the rearing of the greater amberjack (<i>Seriola dumerili</i>) in Tenerife	Yefermin Jesús Darías Dágfeel				Instituto Español de Oceanografía-Centro Oceanográfico de Canarias	Tenerife, Islas Canarias, España	18/07/2018		Yes	Thesis
Incidence and control of monogenean parasites in <i>Seriola dumerili</i>	Andrea Vilena Rodríguez TUTORS: J.A. PÉREZ, S.JEREZ				UNIVERSIDAD DE LA LAGUNA	UNIVERSIDAD DE LA LAGUNA, TENIRIFE (SPAIN)	17/07/2018		Yes	Thesis
External parasites in the rearing of the greater amberjack (<i>Seriola dumerili</i>) in Tenerife	Yefermin Jesús Darías Dágfeel TUTORS: G. LOZANO, S.				UNIVERSIDAD DE LA LAGUNA	UNIVERSIDAD DE LA LAGUNA, TENIRIFE (SPAIN)	18/07/2018		Yes	Thesis

		JEREZ								
	DEVELOPMENT OF NEW PRODUCTS FROM AQUACULTURE FISH SPECIES	Oxana Lazo			Institut de Recerca i Tecnologia Agroalimentaries	Girona, Spain	13/02/2018		Yes	Thesis

LIST OF DISSEMINATION ACTIVITIES								
No.	Type of activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Press release: "Andalucía participa en un proyecto europeo para mejorar producción acuicultura"	29/10/2013	http://www.finanzas.com/noticias/empresas/20131029/andalucia-participa-proyecto-europeo-2533715.html	Civil society - Policy makers		Spain
2	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Press release: "Un proyecto en 12 países investigará cómo ampliar la oferta acuícola europea"	29/10/2013	http://www.besana.es/web/201310/proyecto-12-paises-investigara-como-ampliar-oferta-acuicola-europ	Industry - Civil society		Spain
3	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Press release: "Un proyecto en 12 países investigará cómo ampliar la oferta acuícola europea"	29/10/2013	http://www.farodevigo.es/mar/2013/10/29/proyecto-12-paises-investigara-ampliar/904476.html	Industry - Civil society - Medias		Spain
4	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Press release: "Ctaqua trabajará en la diversificación de la acuicultura europea en DIVERSIFY"	31/10/2013	http://www.lamarsalao.com/2013_10_01_archive.html	Civil society - Medias		Spain
5	Press releases	FUNDACION CENTRO TECNOLÓGICO	Press release: "Ctaqua incluida en el proyecto europeo"	02/11/2013	http://www.lavozdigital.es/cadiz/v/20131	Civil society - Medias		Spain

		ACUICULTURA DE ANDALUCIA	de acuicultura Diversify"		102/ciudadanos/ctaquac-incluida-proyecto-europeo-20131102.htm			
6	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Ctaquac will help diversify EU aquaculture	06/11/2013	http://fis.com/fis/worldnews/worldnews.asp?monthyear=11-2013&day=6&id=64575&l=e&country=&special=&end	Industry		Spain, EU
7	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	La diversificación piscícola española a través de la corvina, el lenguado y la seriola	28/11/2013	http://www.mispecies.com/nav/actualidad/noticias/noticia-detalle/La-diversificación-piscícola-española-a	Industry		Spain
8	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	Enhancing the European aquaculture production by removing production bottlenecks of emerging species, producing new products and accessing new markets	16/12/2013	http://www.theparliament.com/	Policy makers		EU
9	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	The fish that will feed Europe in the future	05/02/2014	Patris (newspaper) Crete, Greece	Civil society	200000	Greece
10	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	IMBBC of HCMR in a research programme for aquaculture	05/02/2014	http://www.flashnews.gr/page.ashx?pid=3&aid=162746&cid=312	Civil society		Greece
11	Web sites/	HELLENIC	Kickoff meeting of	05/02/2014	ht	Civil society		Greece

	Applications	CENTRE FOR MARINE RESEARCH	the research programme DIVERSIFY at IMBBC/HCMR		tp://www.2810.gr/index.php/news-technologie-epistimi/39952-enarktiria-synantisi-tou-erevnikoy-pro			
12	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	Inauguration of the programme DIVERSIFY for the production of aquaculture fish	05/02/2014	ht tp://www.agrocapital.gr/Category/Thalassis/Article/8761/xekina-to-programma-diversify-gia-tin-par	Civil society		Greece
13	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	HCMR/IMBBC in a large research project for aquaculture	05/02/2014	ht tp://www.cretalive.gr/culture/view/to-elkethe-ithab-bukse-megaloreunhtiko-programma-ichthuok	Civil society		Greece
14	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	Kickoff meeting of the research programme DIVERSIFY	06/02/2014	ht tp://www.kathimerini.com.cy/index.php?pageaction=kate&modid=1&artid=161776	Civil society		Cyprus, Greece
15	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Press release: "El proyecto DIVERSIFY coordina en Creta las tareas de su primer año de trabajo"	06/02/2014	ht tp://www.ctaqua.es/140206-reunion-lanzamiento-diversify-ctaqua.aspx#.VEjB9_1te9	Industry		Spain
16	Press releases	FUNDACION CENTRO TECNOLÓGICO	Project Diversify started	07/02/2014	ht tp://www.mispecies	Industry - Civil society - Medias		Spain

		LOGICO ACUICULTURA DE ANDALUCIA			com/nav/actualidad/noticias/noticia-detalle/Expertos-europeos-dan-inicio-al-proy			
17	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Da comienzo Diversify: el objetivo convertirse en un pilar de apoyo para la diversificación acuícola en Europa	07/02/2014	http://www.ipacuicultura.com/noticias/en_portada/33016/da-comienzo_diversify_el_objetivo_convertirse	Industry - Civil society - Medias		Spain and Portugal
18	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	EC works to diversify aquaculture	11/02/2014	http://www.worldfishing.net/news101/industry-news/ec-works-to-diversify-aquaculture	Industry - Civil society	100000	Europe
19	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Arranca DIVERSIFY	11/02/2014	http://aquicat.blogspot.com.es/2014/02/arranca-diversify.html	Scientific community (higher education, Research) - Industry	10000	Spain
20	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	E.U. - Kick off meeting of new FP7 project DIVERSIFY	13/02/2014	http://www.aquafeed.com/read-article.php?id=5203§ionid	Scientific community (higher education, Research) - Industry		World
21	Interviews	HELLENIC CENTRE FOR MARINE RESEARCH	DIVERSIFY, an new European Project for the aquaculture industry	14/02/2014	ANTENA TV/RADIO, Cyprus	Medias	700000	Cyprus
22	Articles published in the popular press	INSTITUTO ESPAÑOL DE OCEANOGRAFIA	Article about wreck fish and DIVERSIFY project: "La	16/02/2014	http://www.lavozdegalicia.es/noticia/eco	Civil society - Medias		Spain

			Cherna, nueva estrella acuícola"		nomia/2014/02/16/cherna-nueva-es-trella-acuicola/0003_201402G			
23	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	Dr Mylonas speaks to AgroTypos for the largest research project in aquaculture that he is coordinating	21/02/2014	Agrotypos.gr	Industry - Civil society	11000000	Greece
24	Press releases	AARHUS UNIVERSITET	Kick Off meeting of new FP7 project DIVERSIFY	22/02/2014	http://badm.au.dk/research/research-centre/mapp/currently/news/news/artikel/kick-off-meeting-of-new-f	Scientific community (higher education, Research)		Denmark
25	Web sites/ Applications	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	El proyecto Diversify tratará de dar respuesta a las preocupaciones del sector de la corvina	07/03/2014	http://www.mispecies.com/nav/actualidad/noticias/noticia-detalle/El-proyecto-Diversify-tratar-de-dar-	Scientific community (higher education, Research) - Industry	35000000	Spain
26	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	Article: "Diversification of fish species and products in European aquaculture"	13/03/2014	http://www.eufic.org/article/es/show/eu-initiatives/rid/diversify/	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		EU
27	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RE	Improvement of the European aquaculture production with	28/03/2004	Fishing News, Issue 385, Feb 2014	Scientific community (higher education, Research) -	10000	Greece, Cyprus

		SEARCH	the removal of production bottlenecks for the production of new/emerging species, production of new products and access to new markets (in greek)			Industry		
28	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	Removing production bottlenecks of emerging species for European aquaculture	03/04/2014	www.easonline.org, Aquaculture Europe, March 2014, Vol 39	Scientific community (higher education, Research) - Industry - Policy makers	70000	Europe
29	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	11.8 million to diversify EU aquaculture sector	07/04/2014	http://www.intrafish.com/ffi/epaper	Industry	100000	Europe, World
30	Web sites/ Applications	HELLENIC CENTRE FOR MARINE RESEARCH	Fish Diversify: The Hellenic Center for Marine Research, Greece, leads a project to enhance the European aquaculture production with new and emerging fish species	08/04/2014	http://www.paneuropeneet.com/H2/#90	Scientific community (higher education, Research) - Policy makers - Medias	245000	Europe
31	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	New EU project aims to expand the production, marketing and consumption of European finfish species	29/04/2014	http://www.eufic.org/article/en/page/FTARCHIVE/article/New_EU_project_aims_to_expand_the_production_ma	Civil society - Medias	250000	Europe
32	Press releases	ASOCIACION NACIONAL DE FABRICANTES DE CONSERVAS DE PESCADOS Y MARISCOS-CENTRO TEC	Press release: "Apoyo a la innovación empresarial. Proyecto DIVERSIFY"	03/05/2014	http://www.anfaco.es/es/categorias.php?var1=Apoyo%20a%20la%20Innovaci%F3n%20Emp	Industry - Civil society - Medias		Spain and Portugal

		NICO NACIONAL DE CONSERVACION DE PRODUCTOS DE LA PESCA			resarial&var2=Apoyo%2			
33	Web sites/ Applications	EUROPEAN FOOD INFORMATION COUNCIL AISBL	Acquacoltura europea: è arrivato Diversify	15/05/2014	file://localhost/1.%20PROGRAMS/13.%20DIVERSIFY/Dissemination/Articles/2014/201405016%20food%20&%20te	Civil society	100000	Italy
34	Videos	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY	29/05/2014	https://docs.google.com/file/d/0BwJmB6K6-pZX Y2t3ODRFNExUNTQ/edit	Civil society - Medias		all
35	Oral presentation to a wider public	ASOCIACION EMPRESARIAL DE PRODUCTORES DE CULTIVOS MARIÑOS - APROMAR	Presentation of DIVERSIFY at CommNet 2014 by J.Ojeda (APROMAR): "New fish to feed the world. DIVERSIFY identifies the potential of new species for fish farming"	12/06/2014	COMMNET Bruselas June 2014	Scientific community (higher education, Research) - Civil society - Medias	500	EU
36	Posters	INSTITUTO ESPAÑOL DE OCEANOGRAFIA	A simple method to monitoring the parasite population of <i>Benedenia seriola</i> in rearing tanks of <i>Seriola dumerili</i>	12/06/2014	IV International Symposium on Marine Sciences, Las Palmas de Gran Canaria, Spain	Scientific community (higher education, Research)	500	Europe, World
37	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	FIRST DIVERSIFY NEWSLETTER	15/06/2014	http://www.diversifyfish.eu/newsletter.html	Scientific community (higher education, Research) - Civil society - Medias		EU
38	Articles published in the popular press	FUNDACION CENTRO TECNOLÓGICO	Article "New fish to feed the world. DI	01/07/2014	http://commnet.eu/01	Scientific community (higher edu		EU

		LOGICO ACUICULTURA DE ANDALUCIA	VERSIFY identifies the potential of new species for fish farming" published in CommNet Catalogue 2014		About_CommNet/Commnet_Community/Business/Innovation-Catalogue-2014.kl	cation, Research) - Civil society - Medias		
39	Web sites/ Applications	STICHTING DI ENST LAND BOUWKUNDIG ONDERZOEK	Press release: "EU aquaculture boosted through research in to emerging species"	01/08/2014	FIS Fish Information & Services	Scientific community (higher education, Research) - Industry - Medias		Europe, World
40	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	DIVERSIFY brochures and book marks	18/09/2014	Postal delivery to individual Aquaculture producers, policy makers and regulators	Industry - Policy makers	170	Greece, Cyprus
41	Oral presentation to a scientific event	INSTITUTO ESPANOL DE OCEANOGRAFIA	Especies emergentes en la acuicultura europea: La Cherna	20/09/2014	Vigo, Spain	Scientific community (higher education, Research)		EU
42	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	DIVERSIFY brochures and book marks	24/09/2014	Distribution (at HCMR, Crete, Greece) to a group of owners, directors or managers of aquacult	Industry	10	Turkey
43	Oral presentation to a scientific event	UNIVERSIDAD DE LA LAGUNA	Nuevos Avances en el Cultivo Larvario de la Corvina (Argyrosomus regius).	30/09/2014	Meeting of Ecuatorian PhD students in Europe. Ecu. National Secretary of Education, Berlin, Germany	Scientific community (higher education, Research)	30	EU
44	Media briefings	HELLENIC CENTRE FOR MARINE RESEARCH	Enhancing the European aquaculture production by removing production bottlenecks of emerging species, producing new products and accessing new markets (DIVERSIFY)	30/09/2014	HCMR headquarters, Athens, Greece	Medias	15	World
45	Articles published in the popular press	FUNDACION CENTRO TECNOLÓGICO	Focus on early rearing in European Diversify project	13/10/2014	http://hatcheryinternation	Scientific community (higher education, Research) -		World

		ACUICULTURA DE ANDALUCIA			al.com/research/greek-research-centre-to-focus-on-early-rearing-in-europea	Industry - Medias		
46	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Stress response of Greater Amberjack <i>Seriola dumerilii</i> : plasma and skin mucus cortisol response to handling and stocking density.	14/10/2014	Aquaculture Europe 2014, San Sebastian, Spain	Scientific community (higher education, Research)	550	EU
47	Oral presentation to a wider public	BUNDESVERBAND DER DEUTSCHEN FISHINDUSTRIE UND DES FISCHGROSSHANDELS E.V.	"DIVERSIFY - New species meet markets" - Host of discussion at fair "Eurotier"	17/11/2016	Hannover, Germany	Industry - Civil society - Policy makers - Medias	5000	EU
48	Flyers	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	Distribution of 180 Diversify flyers and 300 bookmarks at the AE 2014 Conference in San Sebastian,	14/10/2014	Aquaculture Europe 2014 San Sebastian	Scientific community (higher education, Research) - Industry - Policy makers - Medias	1200	EU
49	Web sites/ Applications	BUNDESVERBAND DER DEUTSCHEN FISHINDUSTRIE UND DES FISCHGROSSHANDELS E.V.	Requesting the editor of www.aquakulturinfo.de to set links to the project DIVERSIFY where appropriate.	14/10/2014	http://www.aquakulturinfo.de/index.php/domestikation.html	Scientific community (higher education, Research) - Civil society - Medias		Germany
50	Flyers	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	100 Folders and 120 bookmark distribution during the Species Diversification Session at AE 2014 San Sebastian	15/10/2014	Species Diversification Session, AE 2014 San Sebastian	Scientific community (higher education, Research) - Medias	120	EU
51	Posters	CONSELLERIA	Growth of wreck	15/10/2014	AQUACULTURE	Scientific com	1300	Europe, World

		DO MAR - XUNTA DE GALICIA	fish Polyprion americanus in Galicia (Spain)		EUROPE 2014, San Sebastian, Spain	munity (higher education, Research) - Industry		
52	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Enhancing the European aquaculture production by removing production bottlenecks of emerging species, producing new products and accessing new markets (DIVERSIFY)	15/10/2014	AQUACULTURE EUROPE 2014, San Sebastian, Spain	Scientific community (higher education, Research) - Industry	1300	Europe, World
53	Oral presentation to a wider public	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Diversify project presentation to Delegation of Ministry of Agriculture and Fisheries of Turkey	21/10/2014	CTAQUA facilities	Scientific community (higher education, Research) - Policy makers	12	Turkey
54	Flyers	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Distribution of 10 Diversify flyers and 10 bookmarks to the Delegation of the Ministry of Agriculture and Fisheries from Turkey	21/10/2014	CTAQUA facilities	Scientific community (higher education, Research) - Policy makers	12	Turkey
55	Articles published in the popular press	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Relevant R&D projects. DIVERSIFY	30/10/2014	http://www.fundacionoesa.es/proyectos-iod-destacados/diversify	Scientific community (higher education, Research)		Spain
56	Interviews	UNIVERSITA DEGLI STUDI DI BARI "ALDO MORO"	Interview with Prof. Aldo Corriero from University of Bari, on the objectives of DIVERSIFY and the Annual Coordination Meeting taking place in Bari 4-6 November 2014	05/11/2014	University of Bari Aldo Moro, Bari, Italy	Civil society - Media		Italy
57	Oral presentation to a scientific event	AARHUS UNIVERSITET	EU CONSUMERS PERCEPTIONS OF VALUE OF NEW AQUACULTURE FISH PRODUCTS:	15/11/2014	VOLOS, GREECE	Scientific community (higher education, Research) - Civil society	100	EU

			A CROSS-CULTURAL PROOF OF EVIDENCE					
58	Oral presentation to a wider public	CONSELLERIA DO MAR - XUNTA DE GALICIA	ACUACULTURE day 2014-DIVERSIFY PROJECT	05/12/2014	Domus, A Coruña, Spain	Civil society - Policy makers - Medias		EU
59	Oral presentation to a wider public	UNIVERSITA DEGLI STUDI DI BARI "ALDO MORO"	Presentation of Diversify project during the conference 'Blue Growth in the Mediterranean and the Black Sea: developing sustainable aquaculture for food security - Regional Aquaculture Conference 2014	10/12/2014	Mediterranean Agronomic Institute of Bari - Italy	Scientific community (higher education, Research) - Industry - Policy makers		Italy
60	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	SECOND DIVERSIFY NEWSLETTER	09/01/2015	http://www.diversifyfish.eu/newsletter.html	Scientific community (higher education, Research) - Civil society - Medias		EU
61	Videos	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY SECOND VIDEO	10/01/2015	https://www.youtube.com/watch?v=TRkhBlu1aLg	Scientific community (higher education, Research) - Civil society - Medias		EU
62	Exhibitions	BUNDESVERBAND DER DEUTSCHEN FISHINDUSTRIE UND DES FISCHGROSSHANDELS E.V.	International Green Week 2015 in Berlin. Dr. Keller informed interested consumers about the project and distributed the flyer and the bookmarks.	16/01/2015	Berlin, Germany	Civil society - Policy makers - Medias	60000	Germany
63	Videos	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Meagre work IRTA 2014	26/01/2015	www.diversifyfish.eu, https://www.youtube.com/watch?v=l0EwXhkIqgI&feature=youtu.be&a	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	EU

64	Web sites/ Applications	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Linking with the As sociation website	29/01/2015	ht tp://www.fgm.com. gr	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias		Greek and English speaking
65	Articles published in the popular press	INSTITUTO ES PANOL DE OCEANOGRAFIA	"Los primeros mer os de acuicultura podrían llegar a los mercados en 10 años"	10/02/2015	ht tp://www.ieo.es/doc uments/ 10640/38594/NP_1 00215_diversify.pd f/ d26a3e12-5980-49a a- aa99-503d7d47d23 d	Scientific com munity (higher edu cation, Research) - Industry - Policy makers		Spain
66	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	Los primeros meros de acuicultura podrían llegar a los mercados en 10 años	10/02/2015	ht tp://www.fundacion oesa.es/noticias/los- primeros-mer os- de-acuicul tura-podri an-lleg ar-a-los-mercados	Scientific com munity (higher edu cation, Research) - Industry - Policy makers		Spain
67	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	"Los primeros mer os de acuicultura podrían llegar a los mercados en 10 años"	10/02/2015	ht tp://www.noticiases pano las.es/index.php/18 4047/los-primeros- meros- de-acuicul tura-podri an-llegar-a-	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias		Spain
68	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	Los primeros meros de acuicultura podrían llegar a los mercados en 10 años	10/02/2015	ht tp://www.agenciasi nc.es/Noticias/Los- primeros-mer os- de-acuicul tura-lleg aran- a- los-merca dos-en-10-a	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias		Spain

69	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	"Científicos vigueses creen que el mero de acuicultura puede llegar al mercado en una década"	10/02/2015	http://www.lavozdegalicia.es/noticia/vigo/2015/02/10/cientificos-vigueses-creen-mero-acuicultura-pue	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Spain
70	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	"Científicos de Vigo apuran la salida comercial del mero de acuicultura"	10/02/2015	http://www.noticiasgalicia.com/index.php/medio-ambiente-vigo/15365/cientificos-de-vigo-apuran-la-sal	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Spain
71	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	"Científicos de Vigo apuran la salida comercial del mero de acuicultura"	10/02/2015	http://www.farodevigo.es/mar/2015/02/10/cientificos-vigo-apuran-salida-comercial/1181724.html	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Spain
72	Press releases	Ayuntamiento de A Coruna	"El Aquarium Finis terrae participa en el proyecto 'Diversify' para impulsar la industria de la acuicultura en Europa"	10/02/2015	http://www.laopinioncoruna.es/coruna/2015/02/10/acuario-participa-plan-europeo-acuicultura/926447.ht	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Spain
73	Press releases	Ayuntamiento de A Coruna	"Las chernas del Acuario coruñés promueven su inclusión en un proyecto europeo"	10/02/2015	http://www.abc.es/agencias/noticia.asp?noticia=1788250	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Spain
74	Press releases	Ayuntamiento de A Coruna	"Visita del equipo de investigadores"	10/02/2015	http://prensa.mc2coru	Scientific community (higher edu		Spain

			del proyecto europeo Diversify, en el que participa el Aquarium Finisterrae"		na.org/2015/02/visita-del-equipode-vestigadores-del.html	cation, Research) - Industry - Civil society - Policy makers - Medias		
75	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	"Farmed Atlantic wreckfish could reach the market in 10 years"	11/02/2015	http://fis.com/fis/worldnews/worldnews.asp?monthyear=&day=11&id=74532&l=e&special=&nb=1%20target=	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Europe
76	Articles published in the popular press	Ayuntamiento de A Coruna	"El Aquarium Finis terrae participa en el proyecto 'Diversify' para impulsar la industria de la acuicultura en Europa"	11/02/2015	http://corunaonline.com/blog/el-aquarium-finisterrae-participa-en-el-proyecto-diversify-que-explora-	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Spain
77	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	"Los primeros meros de acuicultura llegarán a los mercados en 10 años"	11/02/2015	http://noticiasdelaciencia.com/not/12657/los-primeros-meros-de-acuicultura-llegaran-a-los-mercados-e	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Spain
78	Videos	UNIVERSIDAD DE LA LAGUNA	Wild wreckfish sampling	20/02/2015	http://www.diversifyfish.eu/	Scientific community (higher education, Research) - Industry - Civil society		European countries
79	Articles published in the popular press	INSTITUT DE RE CERCA I TECNOLOGIA AGROALI	Advances in Meagre (Argyrosomus regius) Research during	01/03/2015	"Aquaculture Europe" magazine of the European	Scientific community (higher education, Research)		Europe

		MENTARIES.	the first year of the project DIVERSIFY		Aquaculture Society, Vol 40, March 2015			
80	Oral presentation to a scientific event	AARHUS UNIVERSITET	Perceived Consumer Value towards New Farmed Fish Species: A Psychographic Segmentation in Top-five EU Markets	26/03/2015	143rd European Agricultural Economics Association (EAAE) Seminar, Napoli, Italy	Scientific community (higher education, Research) - Industry - Policy makers	250	All EU countries
81	Articles published in the popular press	HAVFORSKNINGSSINSTITUTTET	Havforskningsrapporten 2015: Nye arter i europeisk akvakultur: i Norge er kveite mest aktuell	01/04/2015	Bergen, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	5000	Norway
82	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Presentation of DIVERSIFY and its 1st year progress	28/04/2015	EATiP Annual General Meeting, Brussels, Belgium	Scientific community (higher education, Research) - Industry - Policy makers - Medias	50	EU
83	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	Assessing genetic diversity in domesticated pikeperch (Sander lucioperca) broodstocks	13/05/2015	11th Panhellenic Symposium of Oceanography & Fisheries, Mytilene, Greece - http://www.symposia.gr/en/	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	150	Greece, Turkey, Europe
84	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Lateral line ontogeny and chronic ulcerative dermatopathy of meagre (Argyrosomus regius (Asso, 1801)) by Marianna Tsertou	14/05/2015	11th Oceanography & Fisheries Conference, Mitilene, Greece	Scientific community (higher education, Research)	200	Greece
85	Organisation of Conference	UNIVERSIDAD DE LA LAGUNA	Fish reproduction dysfunctions. Manipulation of maturation in aquaculture fish. Dr. C. Mylonas	14/05/2015	Faculty of Sciences (La Laguna University)	Scientific community (higher education, Research)	40	Spain
86	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RE	DIVERSIFY: The first year completed with success	30/05/2015	Fishing News, May 2015	Scientific community (higher education, Research)	1000	Greece

		SEARCH						
87	Oral presentation to a wider public	BUNDESVERB AND DER DEUTSCHEN FISHINDUSTRIE UND DES FISCHGROSSHANDELS E.V.	Presentation of Diversify activities during the annual general assembly of the German federation for fish processors and wholesalers	12/06/2015	Frankfurt am Main, Germany	Industry	60	Germany
88	Posters	INSTITUT DE RESEARCH I TECNOLOGIA AGROALIMENTARIES.	Fish meal substitution in diets for flat head grey mullet (<i>Mugil cephalus</i>) fry	12/06/2015	Avenços en Recerca en Aqüicultura, Institut de Estudis Catalans, Barcelona, Spain	Scientific community (higher education, Research)	100	Spain
89	Web sites/ Applications	EUROPEAN FOOD INFORMATION COUNCIL AISBL	Farmed fish a healthy and sustainable choice?	25/06/2015	http://www.eufic.org/article/en/artid/Farmed_fish-a_healthy_and_sustainable_choice/	Civil society	20000000	Europe
90	Oral presentation to a wider public	BUNDESVERB AND DER DEUTSCHEN FISHINDUSTRIE UND DES FISCHGROSSHANDELS E.V.	Presentation of DIVERSIFY at "Runder Tisch Aquakultur" (german round table aquaculture)	15/07/2015	Bonn, Germany	Industry	50	Germany
91	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	Transcriptome Characterization And Marker Discovery In Meagre <i>Argyrosomus regius</i> .	22/07/2015	ISGA XII - The International Symposium On Genetics In Aquaculture, Santiago De Compostela, Spain	Scientific community (higher education, Research) - Industry	180	World
92	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	A First Step For Sustainable Breeding Programmes In Pikeperch (<i>Sander lucioperca</i>) Through The Evaluation Of The Genetic Variation In Domestic	26/07/2015	ISGA XII - The International Symposium On Genetics In Aquaculture, Santiago De Compostela, Spain	Scientific community (higher education, Research) - Industry	180	World

			ated Broodstocks And Natural Popula tions					
93	Posters	INSTITUT DE RE CERCA I TECNO LOGIA AGROALI MENTARIES.	Comparison of CATA vs FCP in generating descript ive attributes with trained assessors	23/08/2015	11th Pangborn Sensory Science Symposium, Gothenburg, Sweden	Scientific com munity (higher edu cation, Research) - Medias		EU
94	Posters	UNIVERSIDAD DE LA LAGUNA	Consumer beliefs re garding farmed versus wild fish: a cross-cultural per spective	23/08/2015	11th Pangborn Sensory Science Symposium, Gothenburg, Sweden	Scientific com munity (higher edu cation, Research) - Medias	100	EU
95	Interviews	FUNDACION CENTRO TECNO LOGICO ACUICULTURA DE ANDALUCIA	Interview with the Project Coordinator	31/08/2015	ht tps://youtu.be/oFM LFTZIVYg	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Medias		EU
96	Posters	FUNDACION CA NARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVER SIDAD DE LAS PALMAS DE GRAN CANARIA	Comparative mor phological study of greater amberjack (<i>Seriola dumerili</i>) skin between fish in fected and non- infected with mono genea <i>Neobenedenia</i> <i>girelliae</i>	07/09/2015	17th International Conference on Dis eases of Fish and Shellfish, Las Pal mas de Gran Ca naria, Spain	Scientific com munity (higher edu cation, Research)	450	world
97	Oral presentation to a wider public	BUNDESVERB AND DER DEUTSCHEN FISHINDUSTRIE UND DES FISC HGROSSHAN DELS E.V.	Presentation of Di versify activities during the discus sion meeting "Fisch- Forum" to guests and members of the German federation for fish processors and wholesalers	07/09/2015	Hamburg	Industry	62	Germany
98	Flyers	FUNDACION CENTRO TECNO LOGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY AT THE EAFP CON FERENCE 2015	07/09/2015	LAS PALMAS DE GRAN CANARIA- SPAIN	Scientific com munity (higher edu cation, Research) - Industry	600	EU
99	Articles published in the popular press	Université de Lor raine	Advances in pike perch (<i>Sander lucio</i>	08/09/2015	"Aquaculture Europe" magazine	Scientific com munity (higher edu	1000	EU, world

			perca) research during the last 18 months of the project		of the European Aquaculture Society, Vol 40 (2), September 2015	cation, Research) - Industry - Medias		
100	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Optimized spawning induction protocol for meagre (<i>Argyrosomus regius</i>) using weekly GnRHa injections	09/09/2015	5th International Workshop on the Biology of Aquatic Gametes, Ancona, Italy	Scientific community (higher education, Research)	120	EU, World
101	Organisation of Workshops	ASOCIACION NACIONAL DE FABRICANTES DE CONSERVAS DE PESCADOS Y MARISCOS-CENTRO TECNICO NACIONAL DE CONSERVACION DE PRODUCTOS DE LA PESCA	JORNADA "LAS TENDENCIAS DEL SECTOR INDUSTRIAL DE PRODUCTOS DEL MAR HACIA EL USO DE NUEVAS MATERIAS PRIMAS"	24/09/2015	ANFACO-VIGO-SPAIN	Industry - Policy makers - Medias	200	EU
102	Oral presentation to a wider public	CONSELLERIA DO MAR - XUNTA DE GALICIA	"Presentación do proxecto da UE: Diversificación e potencial de cultivo de especies emerxentes na acuicultura europea: caso da cherna. Diversify"	08/10/2015	O Grove (Pontevedra) Spain	Scientific community (higher education, Research) - Industry	40	Spain
103	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	Population genetic analysis of wild and domesticated pike perch (<i>Sander lucio perca</i> , Linnaeus, 1758) populations in Europe	09/10/2015	13th International Congress on the Zoogeography and Ecology of Greece and Adjacent Regions, Irakleio	Scientific community (higher education, Research) - Policy makers	120	Greece, Turkey, S. Balkans
104	Interviews	HELLENIC CENTRE FOR MARINE RESEARCH	The DIVERSIFY project, interview with Mrs Anneke Meyer, freelance journalist for German National Radio	12/10/2015	Hellenic Center for Marine Research	Civil society - Medias		Germany
105	Posters	FUNDACION CA	Comparación entre	13/10/2015	XV Congreso	Scientific com	300	Spain, Portugal

		NARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	la calidad de puestas naturales e inducidas, mediante inyección e implante de GnRH _a , del pez de limón (<i>Seriola dumerili</i>)		Nacional de Acuicultura, Huelva, Spain.	munity (higher education, Research)		
106	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Obtención en cautividad de puestas naturales del pez de limón (<i>Seriola dumerili</i>), en la isla de Gran Canaria (España)	13/10/2015	XV Congreso Nacional de Acuicultura, Huelva, Spain.	Scientific community (higher education, Research)	300	Spain, Portugal
107	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Comparación entre puestas naturales e inducidas, mediante inyección e implante de GnRH _a , en la producción de huevos del pez de limón (<i>Seriola dumerili</i>)	13/10/2015	XV Congreso Nacional de Acuicultura, Huelva, Spain.	Scientific community (higher education, Research)	350	Spain, Portugal
108	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Obtención de puestas del pez de limón (<i>Seriola dumerili</i>) mediante GnRH _a , comparación de la eficacia de la inducción con implante e inyección	13/10/2015	XV Congreso Nacional de Acuicultura, Huelva, Spain.	Scientific community (higher education, Research)	300	Spain, Portugal
109	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	Monogéneos en el cultivo de <i>Seriola dumerili</i> en la región atlántica canaria	13/10/2015	XV CONGRESO NACIONAL Y I CONGRESO IBÉRICO DE ACUICULTURA. HUELVA (SPAIN)	Scientific community (higher education, Research) - Industry	400	Spain, Portugal
110	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	Maduración sexual de tres stocks de cherna (<i>Polyprion americanus</i>) en Galicia	13/10/2015	XV CONGRESO NACIONAL Y I CONGRESO IBÉRICO DE ACUICULTURA. HUELVA (SPAIN)	Scientific community (higher education, Research) - Industry	800	Spain, Portugal, EU, International
111	Oral presentation to	FUNDACION CA	Effect of temperat	20/10/2015	Aquaculture	Scientific com	550	EU

	a scientific event	NARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	ure on growth performance of greater amberjack <i>Seriola dumerili</i> juveniles		Europe 2015, Rotterdam, The Netherlands	munity (higher education, Research)		
112	Posters	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	Progress in understanding the ontogeny of the immune system in meagre (<i>Argyrosomus regius</i>). Results of the EU diversify Project in 2014 and 2015	21/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	900	EU, International
113	Posters	CONSELLERIA DO MAR - XUNTA DE GALICIA	BIOCHEMICAL COMPOSITION OF WILD WRECK FISH (POLYPRION AMERICANUS)	21/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	900	EU, International
114	Posters	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	Fish meal substitution in diets for flat head grey mullet <i>Mugil cephalus</i> Fry	21/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	900	EU, International
115	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	EVALUATION OF DIFFERENT FEEDING FREQUENCIES INSERIOLA DUMERILI JUVENILES: EFFECTS ON HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS	21/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	500	EU, International
116	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	GROWTH PERFORMANCE OF SERIOLA DUMERILI JUVENILES FED ON DIFFERENT FEEDING FREQUENCIES	21/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	500	EU, International
117	Oral presentation to a scientific event	HAVFOR SKNINGSINSTI	Solving bottlenecks in commercial pro	21/10/2015	Aquaculture Europe 2015 (EAS	Scientific community (higher edu	50	EU, International

		TUTTET	duction of Atlantic halibut (Hippoglossus hippoglossus L.): The Diversify Project		conference), Rotterdam (Netherlands)	cation, Research) - Industry - Policy makers		
118	Posters	INSTITUTO ES PANOL DE OCEANOGRAFIA	Biometric parameters of wild wreck fish (Polyprion americanus)	21/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	900	EU, International
119	Flyers	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY brochures and book marks	21/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	200	EU, International
120	Organisation of Conference	HELLENIC CENTRE FOR MARINE RESEARCH	Special Session: New/emerging fin fish species (the EU DIVERSIFY project)	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	250	EU, International
121	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	UPDATE ON THE FIRST REPORTING PERIOD OF THE PROJECT DIVERSIFY: EXPLORING THE BIOLOGICAL AND SOCIO-ECONOMIC POTENTIAL OF NEW/EMERGING CANDIDATE SPECIES FOR THE EXPANSION OF THE EUROPEAN AQUACULTURE INDUSTRY	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	120	EU, International
122	Oral presentation to a scientific event	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	New advances in meagre (Argyrosomus regius) culture. Results of the EU Diversify Project in 2014 and 2015	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	150	EU, International

123	Oral presentation to a scientific event	AARHUS UNIVERSITET	The time is right for fish product innovation: an exploration of European consumers' attitudes towards sustainable new fish product ideas	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	150	EU, International
124	Oral presentation to a scientific event	STICHTING DIENST LANDBOUWKUNDIG ONDERZOEK	Customer value perceptions towards new farmed fish: A European consumer segmentation	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	50	EU, International
125	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	GREATER AMBERJACK (<i>Seriola dumerili</i>) AQUACULTURE ADVANCES IN THE FRAME OF THE DIVERSIFY PROJECT	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	100	EU, International
126	Posters	UNIVERSIDAD DE LA LAGUNA	Preliminary studies on rotifer enrichment for the improvement of greater amberjack larviculture	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	900	EU, International
127	Posters	UNIVERSIDAD DE LA LAGUNA	Fatty acid profile of wild greater amberjack female gonads from Mediterranean and Atlantic areas	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	900	EU, International
128	Oral presentation to a scientific event	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	INDUCED SPAWNING OF PAIRED MEAGRE (<i>ARGYROSUMUS REGIUS</i>) WITH MALE ROTATION: AN APPROACH TO PRODUCE MULTIPLE FULL AND HALF-SIB FAMILIES FOR GENETIC	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	50	EU, International

			BREEDING PROGRAMS					
129	Oral presentation to a scientific event	INSTITUTO ES PANOL DE OCEANOGRAFIA	DIVERSIFY: Results for the first year of wreckfish (<i>Polyprion americanus</i>) culture.	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	50	EU, International
130	Oral presentation to a scientific event	ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH LIMITED	FSH agonist: a missing therapeutic agent facilitating breeding for captive grey mullet (<i>mugil cephalus</i>) broodstock	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	100	EU, International
131	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	EVALUATION OF THE GENETIC VARIATION IN DOMESTICATED BROODSTOCKS AND WILD POPULATIONS OF PIKEPERCH (<i>Sander lucioperca</i>) IN EUROPE AS A TOOL FOR FUTURE BREEDING PROGRAMMES	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	50	EU, International
132	Posters	UNIVERSITE DE NAMUR ASBL	IMPACT OF DIETARY L-TRYPTOPHAN ON NEUROPHYSIOLOGICAL AND IMMUNE RESPONSES OF PIKEPERCH TO EMERSION STRESS	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	1000	EU, International
133	Oral presentation to a scientific event	Université de Lorraine	REDUCTION OF MAJOR BOTTLE NECK IMPACTS TO SUSTAIN THE INTENSIVE CULTURE OF PIKEPERCH (<i>SANDER LUCIOPERCA</i>).	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	1000	EU, International
134	Oral presentation to	Université de Lor	EFFECTS OF	22/10/2015	Aquaculture	Scientific com	100	EU, International

	a scientific event	raine	FOUR ENVIRONMENTAL FACTORS ON THE SURVIVAL AND DEVELOPMENT OF THE LARVAE OF PIKEPERCH (SANDER LUCIO PERCA).		Europe 2015 (EAS conference), Rotterdam (Netherlands)	munity (higher education, Research) - Industry - Policy makers		
135	Oral presentation to a scientific event	ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH LIMITED	FIRST SUMMARY OF STUDIES CARRIED OUT ON THE GREY MULLET (Mugil cephalus) IN THE EU PROJECT: DIVERSIFY	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	100	EU, International
136	Oral presentation to a scientific event	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	PAIRED INDUCED SPAWNING OF MEAGRE (ARGYROSONUS REGIUS) WITH MALE ROTATION: AN APPROACH TO PRODUCE FAMILIES FOR GENETIC BREEDING PROGRAMS	22/10/2015	Aquaculture Europe 2015 (EAS conference), Rotterdam (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	100	EU, International
137	Videos	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY AFTER 18 MONTHS	30/12/2015	www.youtube.com/watch?v=I_JTnaPskK8	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		EU, world
138	Web sites/ Applications	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY 4TH NEWSLETTER	15/01/2016	http://www.diversifyfish.eu/newsletter.html	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		EU, world
139	Flyers	FUNDACION CENTRO TECNOLOGICO	50 FLYERS SENT TO TRAFON FISH WP LEADER	25/01/2016	POSTAL DELIVERY Vodňany, Czech republic In	Industry - Civil society	100	EU

		ACUICULTURA DE ANDALUCIA	TO DISTRIBUTE DURING FISH WORKSHOP FEBRUARY		International Environmental Educational, Advisory and Inform			
140	Flyers	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	20 FLYERS SENT TO TRAFON COORDINATOR GERMANY	25/01/2016	Universität Hohenheim GERMANY	Scientific community (higher education, Research) - Industry - Civil society		EU
141	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	Advances in greater amberjack (Seriola dumerili) research: the DIVERSIFY project	23/03/2016	"Aquaculture Europe" magazine of the European Aquaculture Society, Vol 41(1), March 2016	Scientific community (higher education, Research) - Industry - Policy makers	2000	Europe
142	Articles published in the popular press	HAVFORSKNINGSINSTITUTTET	Hvordan går det med kveita?	01/04/2016	Havforskningsrapporten 2016, Bergen, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Norway
143	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	"DIVERSIFY": AN EU PROJECT EXPLORING THE BIOLOGICAL AND SOCIO-ECONOMIC POTENTIAL OF NEW/EMERGING CANDIDATE FISH SPECIES FOR THE EXPANSION OF THE EUROPEAN AQUACULTURE INDUSTRY	06/04/2016	Offshore Mariculture Conference 2016, 76-7 April, Barcelona, Spain	Scientific community (higher education, Research) - Industry - Policy makers	500	Europe, International
144	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	Offshore Mariculture Conference 2016	06/04/2016	Barcelona, Spain	Scientific community (higher education, Research) - Industry - Policy makers - Medias	130	EU, World
145	Flyers	FUNDACION CENTRO TECNOLOGICO	Seafood Expo Brussels 2016 Distribution of flyers and	25/04/2016	Brussels	Scientific community (higher education, Research) -	5000	EU, world

		ACUICULTURA DE ANDALUCIA	bookmarks			Industry - Civil society - Policy makers - Medias		
146	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	FISHBOOST-An EU 7FP project on breeding programs for EU aquaculture species. An invited presentation on DIVERSIFY and its status was given during the coordination meeting of FISH BOOST	27/04/2016	Heraklion, Crete, Greece	Scientific community (higher education, Research) - Industry	50	EU
147	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	FISHBOOST-An EU 7FP project on breeding programs for EU aquaculture species	27/04/2016	HCMR, Heraklion, Crete, Greece	Scientific community (higher education, Research) - Industry	50	EU
148	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	EMBO Practical Course on "Computational Molecular Evolution" http://events.embo.org/16-computational-evolution/	09/05/2016	HCMR, Heraklion, Crete, Greece	Scientific community (higher education, Research)	60	EU, International
149	Articles published in the popular press	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY New species for European Aquaculture	25/05/2016	SUSTAINABLE AQUACULTURE MAGAZINE	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	28000	EU, world
150	Exhibitions	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY New species for European Aquaculture	25/05/2016	AQUACULTURE UK	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1500	EU
151	Videos	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA	VIDEO SUMMARY OF THE ANNUAL COORDINATION	02/06/2016	www.diversifyfish.eu ; https://www.youtube.com/	Scientific community (higher education, Research) - Industry - Civil so	1000	EU, world

		DE ANDALUCIA	MEETING OF DIVERSIFY HELD AT THE UNIVERSITY OF LORRAINE (NANCY, FRANCE).		watch?v=juk8_bOIm0I	ciety - Policy makers - Medias		
152	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	THE EFFECTS OF DIETARY INCLUSIONS OF VITAMIN D3 ASSOCIATED TO CYP27A1, ANTI-OXIDANT ENZYMES AND NON-INFECTIOUS SYSTEMIC GRANULOMATOSIS IN MEAGRE (<i>Argyrosomus regius</i>).	06/06/2016	International Symposium on Fish Nutrition and Feeding (ISFNF), Sun Valley, Idaho, USA	Scientific community (higher education, Research) - Industry	500	International
153	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	The importance of dietary content of vitamins k and d for meagre (<i>Argyrosomus regius</i>) larvae.	06/06/2016	International Symposium Fish Nutrition and Feeding (ISFNF) 2016, Sun Valley, Idaho, USA	Scientific community (higher education, Research)	450	world
154	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Dietary combinations of vitamin k, e and c affect the incidence of systemic granulomatosis in on-growing meagre (<i>Argyrosomus regius</i>).	06/06/2016	International Symposium Fish Nutrition and Feeding (ISFNF) 2016, Sun Valley, Idaho, USA	Scientific community (higher education, Research)	450	world
155	Posters	THE UNIVERSITY COURT OF THE UNIVERSITY OF ABERDEEN	Characterising the mucosal immune response in the greater amberjack, <i>Seriola dumerili</i>	20/06/2016	Portland, Maine, USA	Scientific community (higher education, Research)	200	UK, International
156	Posters	FUNDACION CANARIA PARQUE	Effect of temperature on growth per	27/06/2016	2nd International Conference of Fish	Scientific community (higher edu	350	world

		CIENTIFICO TECNOLÓGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	performance and immunological parameters of greater amberjack <i>Seriola dumerili</i> juveniles		and Shellfish Immunology, Portland, Maine, USA	cation, Research)		
157	Articles published in the popular press	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY project seeking to solve bottlenecks and expand EU aquaculture	29/06/2016	AQUAFEED.COM	Scientific community (higher education, Research) - Industry - Civil society - Medias	1000	EU, world
158	Posters	HAVFOR SKNINGSINSTITUTTET	Effect of GnRH therapy on spawning performance of Atlantic halibut (<i>Hippoglossus hippoglossus</i>)	29/06/2016	Göteborg, Sweden	Scientific community (higher education, Research)	250	International, world-wide
159	Articles published in the popular press	HAVFOR SKNINGSINSTITUTTET	Advances in Atlantic halibut (<i>Hippoglossus hippoglossus</i>) research: the Diversify project	01/09/2016	"Aquaculture Europe" Magazine of the European Aquaculture Society vol 41(2) September 2016	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	2000	Europe
160	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	DIVERSIFY	21/09/2016	Aquaculture Europe 2016, Edinburgh (Scotland, UK)	Scientific community (higher education, Research) - Industry - Policy makers - Medias	1500	EU, International
161	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Diversification of fish species and products in European aquaculture - "DIVERSIFY"	21/09/2016	Aquaculture Europe 2016, Edinburgh (Scotland, UK), Session: EU Forum	Scientific community (higher education, Research) - Industry - Policy makers	100	EU, International
162	Posters	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	Early weaning in meagre <i>Argyrosomus regius</i> : Effects on growth, survival, digestion and skeletal deformation	21/09/2016	Aquaculture Europe 2016, Edinburgh (Scotland, UK), Session: Larvae	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1700	EU, International
163	Posters	INSTITUTO ESPAÑOL DE OCEANOGRAFIA	DESCRIPTION OF THE WRECKFISH (<i>Polyprion americanus</i>)	21/09/2016	Aquaculture Europe 2016, Edinburgh (Scotland, UK)	Scientific community (higher education, Research)	1700	European Union

			anus) REPRODUCTIVE CYCLE IN CAPTIVITY		UK), Session: Diversification in fin fish production.			
164	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	INFLUENCE OF BROODSTOCK NUTRITION OF WRECKFISH (Polyprion americanus) ON THE OOCYTES FATTY ACID COMPOSITION	21/09/2016	Aquaculture Europe 2016, Edinburgh (Scotland, UK), Session: Diversification in fin fish production.	Scientific community (higher education, Research)	1700	European Union
165	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	FIRST EXPERIENCES OF WRECKFISH (Polyprion americanus) LARVAL HUSBANDRY IN NW ATLANTIC AND EAST MEDITERRANEAN.	21/09/2016	Aquaculture Europe 2016, Edinburgh (Scotland, UK), Session: Nutrition.	Scientific community (higher education, Research)	1700	European Union
166	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Exploring the biological and socioeconomic potential of new/emerging candidate fish species for the expansion of the European aquaculture industry	22/09/2016	Aquaculture Europe 2016, Edinburgh (Scotland, UK), Session: EATip Day	Scientific community (higher education, Research) - Industry - Policy makers	50	EU, International
167	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	EFFECT OF BACKGROUND COLOR AND EXPRESSION OF GENES RELATED TO THE GH/IGF AXIS AT EARLY DEVELOPMENT OF GREATER AMBERJACK (Seriola Dumerili)	22/09/2016	Edinburgh, EAS 2016 Conference	Scientific community (higher education, Research) - Industry	100	EU
168	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	EVALUATION OF COMMON HUSBANDRY PRACTICES IN GREAT	22/09/2016	Edinburgh, EAS 2016 Conference	Scientific community (higher education, Research) - Industry	100	EU

			ER AMBERJACK (Seriola dumerili)					
169	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	THE STRESS RESPONSE OF GREATER AMBERJACK (Seriola dumerili)	22/09/2016	Edinburgh, EAS 2016 Conference	Scientific community (higher education, Research)	1700	EU
170	Posters	CONSELLERIA DO MAR - XUNTA DE GALICIA	INFLUENCE OF BROODSTOCK NUTRITION OF WRECKFISH (Polyprion americanus) ON THE OOCYTES FATTY ACID COMPOSITION	22/09/2016	Aquaculture Europe 2016, Edinburgh, Scotland (UK)	Scientific community (higher education, Research)	1700	EU, International
171	Posters	UNIVERSIDAD DE LA LAGUNA	Ontogeny of greater amberjack digestive system	22/09/2016	Aquaculture Europe 2016, Edinburgh, Scotland (UK), Session: Hatcheries	Scientific community (higher education, Research)	1700	EU, International
172	Posters	UNIVERSIDAD DE LA LAGUNA	COMBINED EFFECT OF LC-PUFA-RICH LIPIDS AND CAROTENOIDS IN ROTIFERS ENRICHMENT PRODUCTS FOR GREATER AMBERJACK LARVAE	22/09/2016	Aquaculture Europe 2016, Edinburgh, Scotland (UK), Session: Diversification in Fin fish Production	Scientific community (higher education, Research)	1700	EU, International
173	Oral presentation to a scientific event	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Exploring the biological and socioeconomic potential of new/emerging candidate fish species for the expansion of the European aquaculture industry: major results after two years of research	22/09/2016	Aquaculture Europe Conference 2016 Edinburgh.	Scientific community (higher education, Research) - Industry - Medias	1700	EU, world
174	Flyers	FUNDACION	DIVERSIFY New	22/09/2016	Aquaculture	Scientific com	1700	EU, world

		CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	species for European Aquaculture		Europe Conference 2016 Edinburgh.	munity (higher education, Research) - Industry - Medias		
175	Oral presentation to a scientific event	HAVFORSKNINGENS INSTITUTT	Solving bottlenecks in commercial production of Atlantic halibut - the Diversity project	22/09/2016	Aquaculture Europe Conference 2016 Edinburgh.	Scientific community (higher education, Research) - Industry - Policy makers	60	Europe
176	Posters	AARHUS UNIVERSITET	IMPACT OF ENVIRONMENTAL ATTRIBUTES ON CONSUMER PERCEPTIONS OF AQUACULTURE PRODUCTS IN THE UK	22/09/2016	Aquaculture Europe Conference 2016 Edinburgh.	Scientific community (higher education, Research) - Medias	1700	EU, world
177	Oral presentation to a scientific event	AARHUS UNIVERSITET	THE ROLE OF INVOLVEMENT & INNOVATION IN CONSUMER PERCEIVED VALUE OF NEW AQUACULTURE PRODUCTS	22/09/2016	Aquaculture Europe Conference 2016 Edinburgh.	Scientific community (higher education, Research) - Medias	1700	EU, world
178	Posters	FUNDACION CANARIA PARQUE CIENTIFICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Comparison between the quality of natural and induced spawns, using GnRHα injections and implants, of the greater amberjack (<i>Seriola dumerili</i>) broodstock kept in captivity	22/09/2016	Aquaculture Europe 2016. Edinburgh, Scotland, UK	Scientific community (higher education, Research)	400	EU
179	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	effect of dietary vitamin C and E in larval performance and incidence of bone anomalies in meagre (<i>Argyrosomus regius</i>)	22/09/2016	Aquaculture Europe 2016. Edinburgh, Scotland, UK	Scientific community (higher education, Research)	400	EU

180	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Influence of dietary combinations of vitamin e, c and k in the development of systemic granulomatosis in meagre (<i>Argyrosomus regius</i>)	22/09/2016	Aquaculture Europe 2016. Edinburgh, Scotland, UK	Scientific community (higher education, Research)	400	EU
181	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Determination of vitamin k dietary requirements in meagre larvae (<i>Argyrosomus regius</i>)	22/09/2016	Aquaculture Europe 2016. Edinburgh, Scotland, UK	Scientific community (higher education, Research)	400	EU
182	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Effect of stocking density on greater amberjack (<i>Seriola dumerili</i>) larval performance	22/09/2016	Aquaculture Europe 2016. Edinburgh, Scotland, UK	Scientific community (higher education, Research)	400	EU
183	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Feeding rates for greater amberjack <i>Seriola dumerili</i> ; effects on growth, feed utilization and welfare indicators	22/09/2016	Aquaculture Europe 2016. Edinburgh, Scotland, UK	Scientific community (higher education, Research)	400	EU
184	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Effects of brood stock nutrition on larviculture of greater amberjack (<i>Seriola dumerili</i> , Risso, 1810)	22/09/2016	Aquaculture Europe 2016. Edinburgh, Scotland, UK	Scientific community (higher education, Research)	400	EU
185	Interviews	HAVFOR SKNINGSINSTITUTTET	Kveite mest interessant som oppdrettsart i fremtiden	28/09/2016	Norway	Scientific community (higher education, Research) - Industry - Civil so		Norway

						ciety - Policy makers - Medias		
186	Articles published in the popular press	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	DIVERSIFYING AQUACULTURE TO DEVELOP NEW MARKETS- Building a solid foundation for Europe	15/11/2016	Impact Magazine, Brussels	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		EU, International
187	Oral presentation to a wider public	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY New species for European Aquaculture at Eurotier 2016	17/11/2016	Hannover, Germany	Industry - Civil society - Policy makers - Medias	500	EU
188	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	We take a look at the EU project exploring the biological and socio-economic potential of new/ emerging candidate finfish species for the expansion of the European aquaculture industry	30/11/2016	Aqua Feed International Magazine, United Kingdom	Scientific community (higher education, Research) - Industry		International
189	Articles published in the popular press	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	DIVERSIFY-New Aquaculture Species-Consumer's perception of new fish products	30/11/2016	Aqua Feed International Magazine, United Kingdom	Scientific community (higher education, Research) - Industry		International
190	Videos	FUNDACION CENTRO TECNOLOGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY RESULTS AFTER 2,5 YEARS OF WORK	02/12/2016	https://youtu.be/uB1xqmih8aM	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1500	EU, world
191	Oral presentation to a scientific event	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	Control de la Reproducción de la Corvina (Argyrosomus regius)	02/12/2016	Tacna, Peru	Scientific community (higher education, Research) - Industry - Policy makers - Medias	100	Latin America and Spain
192	Web sites/ Applications	ASOCIACION EMPRESARIAL	DIVERSIFY Article in Aqua feed Inter	08/01/2017	social networks	Industry - Civil society - Policy	500	EU

		DE PRO DUCTORES DE CULTIVOS MARI NOS - APROMAR	national translated and presented to APROMAR mem bers			makers		
193	Web sites/ Applications	BUNDESVERB AND DER DEUTSCHEN FISHINDUSTRIE UND DES FISC HGROSSHAN DELS E.V.	DIVERSIFY Article in Aqua feed Inter national translated and transmitted to BVF members	08/01/2017	social networks	Industry - Civil so ciety - Policy makers	500	EU
194	Web sites/ Applications	Hungarian Aquacul ture Association	DIVERSIFY Article in Aqua feed Inter national translated and presented to MASZ members	08/01/2017	social networks	Industry - Civil so ciety	200	EU
195	Articles published in the popular press	FUNDACION CENTRO TECNO LOGICO ACUICULTURA DE ANDALUCIA	Building a solid foundation for Europe's aquacul ture industry	12/01/2017	Science IMPACT Magazine	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias	35000	EU, world
196	Flyers	FUNDACION CENTRO TECNO LOGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY New species for European Aquaculture	24/01/2017	FEDEPESCA, MADRID, SPAIN	Industry	200	Spain
197	Press releases	INSTITUTO ES PANOL DE OCEANOGRAFIA	Commercial farming of Atlantic wreck fish closer to reality	22/02/2017	Fish Information & Services website	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers		EU, International
198	Articles published in the popular press	INSTITUTO ES PANOL DE OCEANOGRAFIA	Investigadores avan zan en la domesticación de la cherna (Polyprion americanus)	01/03/2017	MisPECES website	Industry - Policy makers		EU, International
199	Flyers	HELLENIC CENTRE FOR MARINE RE SEARCH	Annual meeting of COST Action Ceph alopod Science from Biology to Welfare	28/03/2017	Crete, Greece	Scientific com munity (higher edu cation, Research)	80	EU, International

200	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	Advances in wreck fish (Polyprion americanus) research: the DIVERSIFY project	30/03/2017	"Aquaculture Europe" magazine of the European Aquaculture Society, Vol 42(1) March 2017	Scientific community (higher education, Research) - Industry - Policy makers	10000	EU, International
201	Press releases	UNIVERSIDAD DE LA LAGUNA	EL INVESTIGADOR DANÉS IVAR LUND PRESENTA EN LA ULL LOS AVANCES DE SUS INVESTIGACIONES SOBRE TÉCNICAS DE ACUICULTURA MÁS LIMPIAS	05/04/2017	UNIVERSIDAD DE LA LAGUNA, TENIRIFE (SPAIN)	Scientific community (higher education, Research) - Civil society - Medias	1000	SPAIN, AND PARTICIPANTS OF DIVERSIFY WE PAGE
202	Press releases	UNIVERSIDAD DE LA LAGUNA	EL INVESTIGADOR DANÉS IVAR LUND PRESENTA EN LA ULL LOS AVANCES DE SUS INVESTIGACIONES SOBRE TÉCNICAS DE ACUICULTURA MÁS LIMPIAS	05/04/2017	https://www.ull.es/portal/noticias/experto-acuicultura-ivar-lund-en-ull/	Scientific community (higher education, Research) - Civil society - Medias	1000	SPAIN, AND PARTICIPANTS OF DIVERSIFY WEB PAGE
203	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	DIVERSIFY: A program of the EU for the evaluation of the biological and socioeconomic potential of new/emerging fish species for the enhancement of the European Aquaculture	20/04/2017	Fishing News, Vol 419, March 2017	Scientific community (higher education, Research) - Industry - Policy makers	500	Greece
204	Flyers	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Seafood Expo Brussels 2017 Distribution of flyers and bookmarks	25/04/2017	Brussels	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	5000	EU, world

205	Organisation of Workshops	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	1st PROMOTIONAL WORKSHOP OF DIVERSIFY	24/05/2017	BREMEN, GERMANY	Industry - Civil society - Policy makers	30	EU
206	Organisation of Workshops	BUNDESVERBAND DER DEUTSCHEN FISHINDUSTRIE UND DES FISCHGROSSHANDELS E.V.	First promotional workshop of DIVERSIFY	24/05/2017	Bremen, Germany	Industry - Civil society - Policy makers	30	EU
207	Oral presentation to a scientific event	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	Gene expression analysis of antimicrobial peptides during larval rearing and grow-out of meagre (<i>Argyrosomus regius</i>)	27/06/2017	WAS meeting 2017-Cape Town, South Africa	Scientific community (higher education, Research) - Industry - Medias	2000	EU, world
208	Videos	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY PROJECT IN 3 MINUTES	16/08/2017	www.diversifyfish.eu/https://youtu.be/49EZKkBkiaQ	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	5000	EU, world
209	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLÓGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Effects of broodstock on nutrition larviculture of Greater amberjack (<i>Seriola dumerili</i> , Risso 1810), during the first 15 days of life.	04/09/2017	LARVI '17. 7TH FISH AND SHELLFISH LARVICULTURE SYMPOSIUM, Ghent, Belgium	Scientific community (higher education, Research)	300	International
210	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLÓGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Recent advances in greater amberjack culture in aquaculture research group (GIA).	04/09/2017	LARVI '17. 7TH FISH AND SHELLFISH LARVICULTURE SYMPOSIUM, Ghent, Belgium	Scientific community (higher education, Research)	300	International
211	Posters	FUNDACION CANARIA PARQUE	Effect of broodstock nutrition on greater	04/09/2017	LARVI '17. 7TH FISH AND	Scientific community (higher edu	300	International

		CIENTIFICO TECNOLÓGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	amberjack (<i>Seriola dumerili</i> , Risso, 1810) egg quality		SHELLFISH LARVICULTURE SYMPOSIUM, Ghent, Belgium	cation, Research)		
212	Oral presentation to a scientific event	DANMARKS TEKNISKE UNIVERSITET	IMPORTANCE OF DIETARY PHOSPHOLIPIDS AND HUFA LEVELS FOR PIKEPERCH (<i>SANDER LUCERIOPERCA</i>) LARVAL DEVELOPMENT AND THEIR IN VIVO CAPABILITY TO METABOLIZE UNSATURATED FATTY ACIDS	05/09/2017	LARVI '17. 7TH FISH AND SHELLFISH LARVICULTURE SYMPOSIUM, Ghent, Belgium	Scientific community (higher education, Research) - Industry - Medias	500	EU, world
213	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	New Species for Eu Aquaculture: What new Methods have been Developed?	20/09/2017	Aquaculture Europe, Vol 42(2) September 2017, p7-28	Scientific community (higher education, Research) - Industry - Policy makers	2000	EU
214	Organisation of Workshops	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	2nd Promotional Workshop of DIVERSIFY	28/09/2017	El Puerto de Santa Maria-Cádiz -Spain	Industry - Civil society - Policy makers	30	Spain
215	Exhibitions	ASOCIACION NACIONAL DE FABRICANTES DE CONSERVAS DE PESCADOS Y MARISCOS-CENTRO TECNICO NACIONAL DE CONSERVACION DE PRODUCTOS DE LA PESCA	CONXEMAR 2017	03/10/2017	Vigo, Spain	Industry - Civil society - Policy makers	1000	EU
216	Oral presentation to	INSTITUT DE RE	Calidad de los game	04/10/2017	National Aquacul	Scientific com	60	Spain, Portugal and

	a scientific event	CERCA I TECNOLOGIA AGROALIMENTARIES.	tos y su gestión en la fertilización artificial de la corvina (<i>Argyrosomus regius</i>) para facilitar la realización de programas de mejora genética		ture Conference, Zaragoza, Sapin	munity (higher education, Research) - Industry		France
217	Posters	CONSELLERIA DO MAR - XUNTA DE GALICIA	EVALUATION OF WRECKFISH (POLYPRION AMERICANUS) GROWTH IN GALICIA (SPAIN)	17/10/2017	Aquaculture Europe 2017 (EAS) Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
218	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Effect of dietary fatty acids on spawn quality in greater amberjack <i>Seriola dumerili</i> broodstock	17/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research)	1700	International
219	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Preliminary studies on the relationship of temperature and time of digestion on enzymatic activity and growth of <i>Seriola dumerili</i>	17/10/2017	Aquaculture Europe 2017 (EAS) Dubrovnik, Croatia	Scientific community (higher education, Research)	1700	International
220	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Requirements for n-3 HUFA of meagre <i>argyrosomus regius</i> (asso, 1801) finger lings	17/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research)		International
221	Oral presentation to a wider public	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS	Dietary use of prebiotics in greater amberjack juveniles: effects on growth performance, immune gene expression and	17/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research)		International

		PALMAS DE GRAN CANARIA	disease resistance against <i>Neobenedenia girellae</i>					
222	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Broodstock management and spawning induction of greater amberjack <i>Seriola dumerili</i> reared in tanks and sea cages in Greece	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
223	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	"Diversify": exploring the biological and socio-economic potential of new/emerging candidate species for the expansion of the European aquaculture industry	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
224	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Spawning kinetics of greater amberjack <i>Seriola dumerili</i> in response to multiple GnRH α injections or implants	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
225	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Description of the endocrine reproductive cycle of the wreckfish <i>Polyprion americanus</i> in captivity	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
226	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	The effect of different stimuli on meagre <i>Argyrosomus regius</i> feeding behavior	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
227	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Construction of the first genetic linkage map in meagre (<i>Argyrosomus regius</i>) and identification of growth-related loci to be used in marker assisted	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International

			selection programs					
228	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Recent advances in the study of systemic granulomatosis in meagre (<i>Argyrosomus regius</i>)	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
229	Oral presentation to a scientific event	INSTITUTO ESPANOL DE OCEANOGRAFIA	Progress in the wreckfish intensive culture. New candidate species for aquaculture	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
230	Oral presentation to a scientific event	UNIVERSITA DEGLI STUDI DI BARI "ALDO MORO"	Reproductive development in wild and captive-reared greater amberjack <i>Seriola dumerili</i> (Risso, 1810)	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
231	Oral presentation to a scientific event	INSTITUT DE RE CERCA I TECNOLOGIA AGROALIMENTARIES.	Gamete quality and management for in vitro fertilisation in meagre (<i>Argyrosomus regius</i>) to facilitate the implementation of genetic breeding programs	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
232	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Light environment affecting endocrine and immune circadian rhythms in pike perch (<i>Sander lucio perca</i>)	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
233	Oral presentation to a scientific event	AARHUS UNIVERSITET	Fish for the future: what could influence European consumer choice of new aquaculture products? Evidence from an experimental study with low and medium pro	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International

			cessed products					
234	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Requirements for n-3 hufa of meagre (Argyrosomus regius, Asso, 1801) fingerlings	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
235	Oral presentation to a scientific event	Université de Lorraine	Improvement of rearing conditions for juvenile pike perch (Sander lucio perca) production in RAS	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
236	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Lysine optimization of a diet with low fish meal inclusion for greater amber jack (Seriola dumerili, Risso 1810)	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
237	Oral presentation to a scientific event	ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH LIMITED	Designing weaning diets based on the ontogeny of digestive tract enzyme activity during the carnivorous-omnivorous transition in grey mullet Mugil cephalus juveniles.	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
238	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	Improvement of reproductive performance of F1 generation greater amber jack (Seriola dumerili) with successive implants of gonadotropin-releasing hormone agonist (GnRH _a)	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
239	Posters	INSTITUTO ESPANOL DE OCEANOGRAFIA	Effects of stocking density on growth performance and health of greater am	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy	1700	EU, International

			berjack (<i>Seriola dumerili</i>) juveniles.			makers		
240	Posters	INSTITUTO ES PANOL DE OCEANOGRAFIA	Hematological and plasma biochemical parameters in F1 generation greater amberjack (<i>Seriola dumerili</i>) during spawning induction with GnRH α delivery systems	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
241	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	Effect of male rotation on induced pair spawning of meagre <i>Argyrosomus regius</i>	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
242	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	Population genetic structure of greater amberjack (<i>Seriola dumerili</i>) in the Mediterranean Sea and eastern Atlantic Ocean	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
243	Posters	UNIVERSITE DE NAMUR ASBL	Effect of different ratios of DHA, EPA and ARA on ontogeny of digestive activities and larval development of pikeperch larvae (<i>Sander lucioperca</i>).	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
244	Posters	HELLENIC CENTRE FOR MARINE RESEARCH	Proximate, fatty acids and volatile compounds composition of reared vs. wild greater amberjack (<i>Seriola dumerili</i>) as affected by fish size.	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
245	Posters	INSTITUTO ES PANOL DE OCEANOGRAFIA	Combined effect of immune-stimulant enrichment products and feeding frequency on greater	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International

			amberjack larval performance.					
246	Oral presentation to a scientific event	HAVFOR SKNINGSINSTITUTTET	Recirculation (RAS) vs. flow-through (FT) systems during yolk sac and first feeding stages: effects of rearing system bacteriology, and survival, quality and growth of Atlantic halibut, <i>Hippoglossus hippoglossus</i> larvae	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
247	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Effect of background color and expression of genes related to the GH/IGF growth axis at early development of greater amberjack (<i>Seriola dumerili</i>)	18/10/2017	Aquaculture Europe 2017 (EAS), Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Policy makers	1700	EU, International
248	Oral presentation to a scientific event	UNIVERSITE DE NAMUR ASBL	Aquaculture Europe 2017 - Conference on cooperation and sustainability of fish farming	18/10/2017	Dubrovnik	Scientific community (higher education, Research)	100	Croatia, EU
249	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	Presentation of the activities of HCMR to a delegation from the 1st Institute of Oceanography of China	28/10/2017	Hellenic Center for Marine Research	Scientific community (higher education, Research)	3	China
250	Flyers	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	EUROTIER-AQUACULTURE FORUM	17/11/2016	Hannover, Germany	Industry - Civil society - Policy makers - Medias	5000	EU, world
251	Flyers	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	1st PROMOTIONAL WORKSHOP OF DIVERSIFY	28/05/2017	BREMEN, GERMANY	Industry - Civil society - Policy makers - Medias	5000	EU, world

252	Flyers	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	2nd Promotional Workshop of DIVERSIFY	28/09/2017	El Puerto de Santa Maria-Cádiz -Spain	Industry	30	Spain
253	Web sites/ Applications	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Diversification is key to boosting EU's aquaculture sector	12/12/2017	Aquaculture Magazine Vol 43(6)	Industry - Policy makers	10000	USA, International
254	Oral presentation to a scientific event	UNIVERSITE DE NAMUR ASBL	Larvi 2017 7th fish & shellfish larviculture symposium	04/09/2017	Ghent university, Belgium	Scientific community (higher education, Research)	300	Belgium, EU
255	Oral presentation to a scientific event	UNIVERSITE DE NAMUR ASBL	CECE16 - 28th conference of european comparative endocrinologists	21/08/2016	The University of Leuven, Belgium	Scientific community (higher education, Research)		Belgium, EU
256	Oral presentation to a scientific event	UNIVERSITE DE NAMUR ASBL	2nd International Conference of Fish & Shellfish Immunology	26/06/2016	Holiday Inn By the Bay Portland, Maine, USA	Scientific community (higher education, Research) - Industry - Medias		USA
257	Posters	UNIVERSITE DE NAMUR ASBL	2nd International Conference of Fish & Shellfish Immunology	26/06/2016	Holiday Inn By the Bay Portland, Maine, USA	Scientific community (higher education, Research) - Industry - Medias		USA
258	Oral presentation to a wider public	Ayuntamiento de A Coruna	INVESTIGACIÓN EN ACUARIOS-PROYECTO DIVERSIFY	23/03/2017	BENIDORM, SPAIN	Scientific community (higher education, Research) - Civil society - Medias	300	Spain
259	Oral presentation to a wider public	TECHNISCHE UNIVERSITEIT EINDHOVEN	Virtual store test and Revenue streams-2nd Promotional Workshop DIVERSIFY-Cádiz Spain	28/09/2017	El Puerto de Santa Maria-Cádiz -Spain	Industry - Civil society - Policy makers	30	Spain
260	Web sites/ Applications	SYNDESMOS ELLHNIKON THALASSOKALLI ERGEION SOMATEO	Presentation of Diversify Newsletters and Articles	28/01/2016	https://fgm.com.gr/article.php?id=59	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Greek and English speaking

261	Web sites/ Applications	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Presentation of Di versify Newsletters and Articles	30/01/2017	ht tps://fgm.com.gr/art icle.php?id=59	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias		Greek and English speaking
262	Organisation of Conference	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Presentation of FGM Annual Report - FGM Annual Meeting	09/03/2017	Athens, Greece	Scientific com munity (higher edu cation, Research) - Industry		Greek and English speaking
263	Organisation of Conference	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Presentation in FGMs Annual Re port - FGM Annual Meeting	11/03/2016	Athens, Greece	Scientific com munity (higher edu cation, Research) - Industry	30	Greek and English speaking
264	Flyers	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Monthly reports 2016 - Reporting to industry and sci entific community in monthly basis	22/12/2016	Athens, Greece	Scientific com munity (higher edu cation, Research) - Industry		Greek and English speaking
265	Flyers	TECHNISCHE UNIVERSITEIT EINDHOVEN	Monthly reports 2016 - Reporting to industry and sci entific community in monthly basis	22/12/2017	Athens, Greece	Scientific com munity (higher edu cation, Research) - Industry		Greek and English speaking
266	Press releases	UNIVERSIDAD DE LA LAGUNA	La ULL acoge el en cuentro de coordinación anual del proyecto europeo sobre acuicultura Diversi fy	16/01/2018	ht tps://www.ull.es/po rtal/noti cias/ la- ull- acoge-encuen tro-co ordinacion-anu al- del- proyecto- europeo-ac	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias	30000	EU, WORLD
267	Press releases	UNIVERSIDAD DE LA LAGUNA	Investigadores de doce países ponen al día en la ULL sus trabajos para el proyecto de acuicul	23/01/2018	ht tps://www.ull.es/po rtal/noti cias/comi enza-re	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy	30000	EU, WORLD

			tura Diversify		union-diversi fy-ull-2018/	makers - Medias		
268	Press releases	UNIVERSIDAD DE LA LAGUNA	Nuevas especies para la acuicultura	30/01/2018	ht tps://www.ull.es/po rtal/noti cias/re sponsables-diversi fy/	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias	30000	EU, WORLD
269	Press releases	UNIVERSIDAD DE LA LAGUNA	The european project DIVERSIFY has just finished the annual coordination meeting 2018 in Tenerife Spain. The meeting was atten ded by 75 persons. Dr. C. Rodriguez from #ITB was part of the team ht tp://www.diversifyfi sh.eu/	30/01/2018	ht tps://twitter.com/CI BICANarias/ status/ 9582838853930844 16	Scientific com munity (higher edu cation, Research) - Civil society - Me dias	30000	EU, WORLD
270	Press releases	UNIVERSIDAD DE LA LAGUNA	La Universidad de La Laguna (ULL) y el Centro Oceanográfico de Canarias del IEO or ganizaron entre los días 23 y 25 de enero el encuentro de coordinación anu al del proyecto europeo #Diversify, donde la Dra. Co vadonga Rodríguez, miembro del Insti tuto Universitario de Tecnologías Biomédicas (ITB) participa como In vestigadora Princip al de la ULL (socio del Consorcio). Pronto se publicara todo el material presentado en el siguiente enlace. ht	30/01/2018	ht tps://www.faceboo k.com/cibicanarias/	Scientific com munity (higher edu cation, Research) - Industry - Civil so ciety - Policy makers - Medias	30000	EU, WORLD

			tp://www.diversifyfish.eu/					
271	Press releases	UNIVERSIDAD DE LA LAGUNA	Enhancing the European aquaculture production by removing production bottlenecks of emerging species producing new products and accessing new markets.	30/01/2018	https://mobile.twitter.com/diversifyfish?s=08	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	30000	EU, WORLD
272	Oral presentation to a scientific event	Université de Lorraine	Diversification in European freshwater aquaculture : Perspectives from percid culture	01/02/2018	University of Gödöllő, VIII Fishing and Angling Professional Conference	Industry	180	Hungary
273	Oral presentation to a wider public	HELLENIC CENTRE FOR MARINE RESEARCH	Species diversification in aquaculture: broodstock management and reproduction control in greater amberjack (<i>Seriola dumerili</i>)	06/02/2018	Galaxidi Marine Farms Technological Workshop, Galaxidi, Greece	Industry	40	Greece, Spain
274	Oral presentation to a scientific event	KENTRO MELETON AGORAS KAI KOINIS GNOMIS ANONIMI EMPORIKI ETAIRIA	Understanding consumers: how to make use of this knowledge in decision-making about new product development for international markets	05/02/2018	Galaxidi Marine Farms Technological Workshop, Galaxidi, Greece	Industry	40	Greece, Spain
275	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	Visit of the General Secretary for Research and Development, Ministry of Development, Greece to the facilities of the AQUALABS	09/02/2018	Aqualabs, Institute of Marine Biology, Biotechnology and Aquaculture, Heraklion, Greece	Policy makers	2	Greece
276	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Reproduction in fish and induction of ovulation, spermiation and spawning	19/02/2018	CIHEAM, Advanced in Fish Reproduction and their Application to Broodstock Man	Scientific community (higher education, Research) - Industry	30	EU, Mediterranean

					agement, Torre de la S			
277	Oral presentation to a scientific event	Université de Lorraine	Cannibalisme intra-cohorte chez les premiers stades de vie des téléostéens : analyse de la mise en place des comportements.	28/03/2018	VIIème Rencontres de l'Ichtyologie en France, 26-30 Mars, Paris, France.	Scientific community (higher education, Research)	150	France
278	Organisation of Workshops	UNIVERSITA DEGLI STUDI DI BARI "ALDO MORO"	Knowledge Transfer workshop for grey mullet (<i>Mugil cephalus</i>)	14/05/2018	Bari, Italy	Scientific community (higher education, Research) - Industry - Policy makers	45	EU
279	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Epitheliocystis disease in Greece is caused by a wide variety of unrelated bacteria	08/09/2017	European Association of Fish Pathologists, Belfast, 4-8 September 2017	Scientific community (higher education, Research) - Industry		EU, International
280	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Chronic Ulcerative Dermatopathy in cultured meagre, <i>Argyrosomus regius</i>	08/09/2017	European Association of Fish Pathologists, Belfast, 4-8 September 2017	Scientific community (higher education, Research) - Industry		EU, International
281	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Effect of different levels of P and Ca on chronic ulcerative dermatopathy in meagre <i>Argyrosomus regius</i>	09/10/2016	16th Panhellenic Symposium of Ichthyologists, 6-9 October 2016	Scientific community (higher education, Research) - Industry		Greece
282	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Physiological and biochemical aspects of partial replacement of fish meal with plant protein sources in combination with dietary vitamin C in meagre	07/08/2014	International Congress on the Biology of Fish, Heriot-Watt University, Edinburgh, 3-7 August	Scientific community (higher education, Research) - Industry		EU, International
283	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	Systemic granulomatosis in farmed meagre (<i>Argyrosomus regius</i>): histological and molecular approach.	10/05/2014	Proceedings of the 36th Scientific Conference of Hellenic Association for Biological Sciences, Ioann	Scientific community (higher education, Research) - Industry		Greece

284	Press releases	HELLENIC CENTRE FOR MARINE RESEARCH	Workshop on greater amberjack (<i>Seriola dumerili</i>) aquaculture: results from the DIVERSIFY project	23/04/2018	Fishing News Magazine, Vol 431, April 2018	Scientific community (higher education, Research) - Industry - Policy makers	500	Greece
285	Articles published in the popular press	ASOCIACION NACIONAL DE FABRICANTES DE CONSERVAS DE PESCADOS Y MARISCOS-CENTRO TECNICO NACIONAL DE CONSERVACION DE PRODUCTOS DE LA PESCA	"Nuevas especies para la acuicultura de la UE", special article translated in to Spanish from Aquaculture Europe 42(2), september 2017	15/05/2018	https://www.diversifyfish.eu/publicaciones-es-en-es-pantildeol.html	Industry		España
286	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Effects of different dietary levels EPA + DHA on egg quality of greater amberjack (<i>Seriola dumerili</i>).	05/06/2018	International Symposium Fish Nutrition and Feeding 2018. Las Palmas de Gran Canaria	Scientific community (higher education, Research)	500	International
287	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Effect of different dietary n-3 long-chain polyunsaturated fatty acids levels on stress response of meagre (<i>Argyrosomus regius</i> , 1801) juveniles	05/06/2018	International Symposium Fish Nutrition and Feeding 2018. Las Palmas de Gran Canaria	Scientific community (higher education, Research)	500	International
288	Posters	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	The effect of fish density and dietary supplementation of vitamin C, manganese, zinc and selenium on the development of systemic granulomatosis in juvenile meagre (<i>Argyrosomus regius</i>)	05/06/2018	International Symposium Fish Nutrition and Feeding 2018. Las Palmas de Gran Canaria	Scientific community (higher education, Research)	500	International

			us)					
289	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Effect of increasing dietary levels of n-3 long-chain polyunsaturated fatty acids on liver composition and histopathology of meagre (<i>Argyrosomus regius</i> , Asso 1801) fingerlings	05/06/2018	International Symposium Fish Nutrition and Feeding 2018. Las Palmas de Gran Canaria	Scientific community (higher education, Research)	500	International
290	Oral presentation to a scientific event	FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Dietary use of mannan oligosaccharides in greater amberjack juveniles: effects on growth performance, immune gene expression and disease resistance against <i>Neobenedenia girellae</i>	05/06/2018	International Symposium Fish Nutrition and Feeding 2018. Las Palmas de Gran Canaria	Scientific community (higher education, Research)	500	International
291	Oral presentation to a scientific event	HELLENIC CENTRE FOR MARINE RESEARCH	BROODSTOCK MANAGEMENT AND SPAWNING INDUCTION OF GREATER AMBERJACK <i>Seriola dumerili</i> REARED IN SEA CAGES IN GREECE	04/06/2018	11th International Symposium on Fish Reproductive Physiology, 4-8 June 2018, Manaus, Brazil	Scientific community (higher education, Research)	230	International
292	Posters	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	REPRODUCTIVE CONTROL OF MEAGRE (<i>Argyrosomus regius</i>) TO OBTAIN FAMILIES FOR GENETIC BREEDING PROGRAMS	06/06/2018	11th International Symposium on Fish Reproductive Physiology, 4-8 June 2018, Manaus, Brazil	Scientific community (higher education, Research)	230	International
293	Posters	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	RECOMBINANT FOLLICLE-STIMULATING HORMONE IN DUCES VITELLO GENESIS AND	07/06/2018	11th International Symposium on Fish Reproductive Physiology, 4-8 June 2018, Manaus, Brazil	Scientific community (higher education, Research)	230	International

			SPERMATOGENESIS IN FLAT HEAD GREY MULLET (<i>Mugil cephalus</i>)					
294	Posters	ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH LIMITED	OVERCOMING REPRODUCTIVE DYSFUNCTIONS IN CAPTIVE GREY MULLET (<i>MUGIL CEPHALUS</i>): AN EXPANDED TOOL BOX FOR SUCCESSFUL BREEDING	07/06/2018	11th International Symposium on Fish Reproductive Physiology, 4-8 June 2018, Manaus, Brazil	Scientific community (higher education, Research)	230	International
295	Posters	CONSELLERIA DO MAR - XUNTA DE GALICIA	Fatty acid composition of oocytes and eggs from wreckfish (<i>Polyprion americanus</i>) females fed with different diets	04/07/2018	18th International Symposium on Fish Nutrition and Feeding ? Las Palmas de Gran Canaria, Spain	Scientific community (higher education, Research)		Spain
296	Organisation of Conference	CONSELLERIA DO MAR - XUNTA DE GALICIA	Local Organizing Committee	04/06/2018	International Symposium on fish nutrition and Feeding. Las Palmas de Gran Canaria. June 3rd-7th, 2018	Scientific community (higher education, Research)		Spain
297	Media briefings	Université de Lorraine	Un workshop pour domestiquer le sandre	05/07/2018	Le Petit Journal du Jeudi	Scientific community (higher education, Research) - Civil society		France
298	Press releases	CONSELLERIA DO MAR - XUNTA DE GALICIA	Galicia cierra el ciclo de cultivo del mero	09/07/2018	www.lavozdegalicias.es/noticia/maritim/a/2018/07/09/galicia-cierra-ciclo-cultivo-mero/0003_201807G9P22	Civil society		Spain
299	Organisation of Workshops	INSTITUTO ESPANOL DE	Knowledge Transfer Workshop for	19/07/2018	Vigo, Spain	Scientific community (higher education, Research)	50	Europe

		OCEANOGRAFIA	wreckfish			cation, Research) - Industry		
300	Organisation of Workshops	HAVFOR SKNINGSINSTITUTTET	Knowledge Transfer Workshop for Atlantic Halibut	11/09/2018	Hjemeland, Norway	Scientific community (higher education, Research) - Industry - Policy makers	35	Europe
301	Organisation of Workshops	HELLENIC CENTRE FOR MARINE RESEARCH	Knowledge Transfer Workshop for greater amberjack (Seriola dumerili)	18/09/2018	Athens, Greece	Scientific community (higher education, Research) - Industry - Policy makers - Medias	85	Europe
302	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	MISTRAL project meeting-INTERREG MED	03/10/2018	Heraklion, Crete, Greece	Scientific community (higher education, Research) - Industry - Policy makers	35	Europe
303	Organisation of Workshops	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	Knowledge transfer workshop for meagre (Argyrosomus regius)	09/10/2018	Palau Macaya, Barcelona, Spain	Scientific community (higher education, Research) - Industry - Medias	35	EU
304	Organisation of Workshops	Université de Lorraine	Knowledge Transfer Workshop for pike perch (Sander lucio perca)	27/06/2018	Nancy, France	Scientific community (higher education, Research) - Industry	40	Europe
305	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	Elleipseis-kai-prooptikes-giatin-ydatokalliergeiastin-kypro?, kathimerini.com.cy	21/10/2018	Nicosia, Cyprus http://www.kathimerini.com.cy/gr/oikonomiki/epixeiriseis/elleipseis-kai-prooptikes-g	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	100000	Cyprus
306	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	Fish Reproduction and Aquaculture	24/10/2018	University of Cyprus, Biological Sciences Postgraduate Seminar Series	Scientific community (higher education, Research) - Industry	40	Cyprus
307	Media briefings	CONSELLERIA DO MAR - XUNTA DE GALICIA	Vivir o mar-meros de granxa	21/10/2018	Galician TV	Civil society		Spain
308	Oral presentation to	HELLENIC	BROODSTOCK	09/11/2018	International Con	Scientific com	500	Greece, Europe

	a scientific event	CENTRE FOR MARINE RESEARCH	MANAGEMENT AND SPAWNING INDUCTION OF GREATER AMBERJACK <i>Seriola dumerili</i> REARED IN SEA CAGES IN GREECE		gress on Applied Ichthyology and Aquatic Environment, 8-11 November 2018, Volos, Gr	munity (higher education, Research) - Industry - Policy makers		
309	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY refuerza el potencial de la seriola y el fletán para la diversificación acuícola	09/10/2018	http://www.ctaqua.es/181009-diversify-resultados-seriola-fletan-diversificacion-acuicultura.aspx#.W-	Industry - Civil society - Policy makers - Medias	5000	EU, world
310	Organisation of Workshops	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	3rd Diversify Promotional Workshop	22/02/2018	Varona, Italy	Industry - Civil society - Policy makers - Medias	30	EU
311	Organisation of Workshops	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	4th Diversify Promotional Workshop	11/07/2018	Athens, Greece	Industry - Civil society - Policy makers - Medias	30	EU
312	Web sites/ Applications	SYNDESMOS ELLHNIKON THALASSOKALLI ERGEION SOMATEO	Translation and upload of DIVERSIFY article in the organizations website	16/03/2017	https://fgm.com.gr/uploads/file/Diversify%20Article%20Jan%202017%20-%20Newsletter%20(2).pdf	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	All
313	Organisation of Workshops	SYNDESMOS ELLHNIKON THALASSOKALLI ERGEION SOMATEO	Informed sector and members about Aquaculture Europe 2017 in Dubrovnik Croatia (DIVERSIFY session)	17/03/2017	Informative announcement	Scientific community (higher education, Research) - Industry	80	Greece
314	Videos	SYNDESMOS ELLHNIKON THALASSOKALLI	Informed sector and members about Diversify website up	25/08/2017	Informative announcement	Scientific community (higher education, Research) -	80	Greece

		ERGEION SO MATEO	dates and videos			Industry		
315	Organisation of Conference	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Participation in the ACM meeting in Tenerife and update of the members about the results	23/01/2018	Tenerife, Spain	Scientific community (higher education, Research) - Industry	80	Greece
316	Organisation of Workshops	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Announcement of the Grey Mullet workshop in Bari (14/5/2018)	21/03/2018	Informative announcement	Scientific community (higher education, Research) - Industry	80	Greece
317	Organisation of Workshops	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Announcement of the Greater Amberjack workshop in Athens (18/9/2018)	19/04/2018	Informative announcement	Scientific community (higher education, Research) - Industry	80	Greece
318	Organisation of Workshops	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Announcement of the Meagre workshop in Palau Macaya (9/10/2018)	04/06/2018	Informative announcement	Scientific community (higher education, Research) - Industry	80	Greece
319	Organisation of Workshops	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	4th Promotional Workshop in Athens Greece (11/7/2018)	02/07/2018	Invitation to Sector companies, executives, marketing experts, Ministry of Agriculture, Whole salers	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	150	Greece
320	Organisation of Workshops	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	4th Promotional Workshop in Athens Greece (11/7/2018)	17/07/2018	Informative announcement of the Workshop presentations upload and the results of the workshop	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	150	Greece
321	Organisation of Workshops	SYNDESMOS ELL HNIKON THALAS SOKALLI ERGEION SO MATEO	Announcement of the Halibut workshop of 11-12/9/2018	27/07/2018	Informative announcement	Scientific community (higher education, Research) - Industry	80	Greece
322	Organisation of Workshops	SYNDESMOS ELL HNIKON THALAS SOKALLI	Announcement of the Amberjack workshop of 18/9/2018	27/07/2018	Informative announcement	Scientific community (higher education, Research) -	80	Greece

		ERGEION SO MATEO				Industry		
323	Oral presentation to a scientific event	UNIVERSITA DEGLI STUDI DI BARI "ALDO MORO"	Reproductive development in wild and captive-reared greater amberjack <i>Seriola dumerili</i> (Risso, 1810).	18/10/2017	Aquaculture Europe 2017 (EAS Conference), Dubrovnik, Croatia	Scientific community (higher education, Research)		EU
324	Posters	UNIVERSITA DEGLI STUDI DI BARI "ALDO MORO"	Comparative analysis of male germ cells proliferation and apoptosis in wild and captive-reared greater amberjack (<i>Seriola dumerili</i>).	28/06/2016	ICAR 2016, Tours, France	Scientific community (higher education, Research)		EU
325	Posters	AARHUS UNIVERSITET	Influence of ethical beliefs and trust on purchase decisions: The moderating effect of involvement	13/10/2018	Association for Consumer Research (ACR) Conference, October 11-14, 2018, Dallas, TX, USA.	Scientific community (higher education, Research)		France, Germany, Italy, Spain and UK
326	Posters	AARHUS UNIVERSITET	IMPACT OF ENVIRONMENTAL ATTRIBUTES ON CONSUMER PERCEPTIONS OF AQUACULTURE PRODUCTS IN THE UK	20/09/2016	Aquaculture Europe 2016, 20-23 September, Edinburgh, UK	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	UK
327	Oral presentation to a wider public	AARHUS UNIVERSITET	FIND THE FISH: CURRENT OPPORTUNITIES AND CHALLENGES FOR CONSUMER ACCEPTANCE OF AQUACULTURE PRODUCTS	26/02/2018	Bremen, Germany	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	50	France, Germany, Italy, Spain and UK
328	Oral presentation to a wider public	AARHUS UNIVERSITET	AQUACULTURE PRODUCTS FOR THE LONG RUN: Marija Banovic, PhD e-mail: maba@mgmt.au.dk MAPP Centre, De	24/05/2017	Bremen, Germany	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		France, Germany, Italy, Spain and UK

			partment of Management, Aarhus University, Denmark 1stPromotional Workshop Consumer-driven product idea development from Diversify					
329	Oral presentation to a wider public	AARHUS UNIVERSITET	BLUE REVOLUTION: Marija Banovic, PhD e-mail: maba@mgmt.au.dk MAPP Centre, Department of Management, Aarhus University, Denmark 2ndPromotional Workshop Uncovering solutions that drive commercially viable aquaculture products for European market	28/09/2017	El Puerto de Santa Maria, Spain	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		France, Germany, Italy, Spain and UK
330	Oral presentation to a wider public	AARHUS UNIVERSITET	FIND THE FISH: CURRENT OPPORTUNITIES AND CHALLENGES FOR CONSUMER ACCEPTANCE OF AQUACULTURE PRODUCTS	28/02/2018	Verona, Italy	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	30	France, Germany, Italy, Spain and UK
331	Oral presentation to a wider public	AARHUS UNIVERSITET	CURRENT OPPORTUNITIES AND CHALLENGES FOR CONSUMER ACCEPTANCE OF AQUACULTURE PRODUCTS	11/07/2018	Athens, Greece	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		France, Germany, Italy, Spain and UK
332	Oral presentation to a scientific event	AARHUS UNIVERSITET	PERCEIVED CONSUMER VALUE TOWARDS NEW FARMED FISH SPECIES: A PSYCHOGRAPHIC	25/03/2015	Naples, Italy	Scientific community (higher education, Research) - Industry - Civil society		France, Germany, Italy, Spain and UK

			SEGMENTATION IN TOP-FIVE EU MARKETS					
333	Oral presentation to a wider public	AARHUS UNIVERSITET	EXPERIMENTAL CONSUMER TEST OF THE NEW PRODUCTS PRELIMINARY RESULTS	17/01/2017	Annual Coordination Meeting of Diversify, Barcelona, Spain	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		France, Germany, Italy, Spain and UK
334	Oral presentation to a wider public	AARHUS UNIVERSITET	CONSUMER VALUE PERCEPTIONS AND ATTITUDES TOWARDS FARMED FISH PRODUCTS IN TOP-FIVE EU MARKETS	02/02/2016	Annual Coordination Meeting of Diversify, Nancy, France	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		France, Germany, Italy, Spain and UK
335	Oral presentation to a scientific event	AARHUS UNIVERSITET	FISH FOR THE FUTURE: WHAT COULD INFLUENCE EUROPEAN CONSUMER CHOICE OF NEW AQUACULTURE PRODUCTS?	18/10/2018	Aquaculture Europe 2017, 17-20 October, Dubrovnik, Croatia	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	200	France, Germany, Italy, Spain and UK
336	Oral presentation to a wider public	AARHUS UNIVERSITET	THE ROLE OF INVOLVEMENT & INNOVATION IN CONSUMER PERCEIVED VALUE OF NEW AQUACULTURE PRODUCTS	20/09/2016	Aquaculture Europe 2016, 20-23 September, Edinburgh, UK	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	France, Germany, Italy, Spain and UK
337	Oral presentation to a wider public	AARHUS UNIVERSITET	PERCEPCIONES Y ACTITUD DE LOS CONSUMIDORES ANTE NUEVOS PRODUCTOS DE LA ACUICULTURA	18/05/2018	ASAMBLEA GENERAL 2018 CONFERENCIA EMPRESARIAL DE ACUICULTURA, Madrid, Spain	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	80	France, Germany, Italy, Spain and UK
338	Oral presentation to a scientific event	AARHUS UNIVERSITET	WHAT COULD INFLUENCE EUROPEAN CON	30/01/2017	Knowledge Exchange Seminar, MAPP Centre, Aarhus	Scientific community (higher education, Research)		France, Germany, Italy, Spain and UK

			SUMER CHOICE OF NEW AQUACULTURE PRODUCTS? EVIDENCE FROM AN EXPERIMENTAL STUDY WITH LOW AND MEDIUM PROCESSED PRODUCTS		hus University			
339	Oral presentation to a scientific event	AARHUS UNIVERSITET	CUSTOMER PERCEIVED VALUE: PUTTING INVOLVEMENT INTO EQUATION	12/10/2015	Knowledge Exchange Seminar, MAPP Centre, Aarhus University	Scientific community (higher education, Research)		France, Germany, Italy, Spain and UK
340	Oral presentation to a wider public	AARHUS UNIVERSITET	BLUE REVOLUTION: How will consumers eat fish in the future?	23/11/2017	MAPP Conference 2017, Copenhagen, Denmark	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	70	France, Germany, Italy, Spain and UK
341	Articles published in the popular press	HELLENIC CENTRE FOR MARINE RESEARCH	Aquaculture Workshop for grater amberjack (<i>Seriola dumerili</i>)-DIVERSIFY (in greek)	19/11/2018	Fishing News, Vol 436 October 2018, p16-18	Scientific community (higher education, Research) - Industry - Policy makers	500	Greece, Europe
342	Oral presentation to a wider public	INSTITUT DE RECERCA I TECNOLOGIA AGROALIMENTARIES.	MATERIAS PRIMAS SOSTENIBLES EN ALIMENTACIÓN. II. ACUÍCOLAS (ALGAS Y PECES) Y OTROS ANIMALES	19/06/2018	http://www.inia.es/IniaPortal/goUrlDinamica.action?url=http://wwwsp.inia.es/Investigacion/OtrasUni/T	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	177	Spain
343	Web sites/ Applications	Hungarian Aquaculture Association	Introduction of DIVERSIFY Project	01/05/2014	Szarvas, Hungary	Industry	100	Hungary
344	Oral presentation to a wider public	BUNDESVERBAND DER DEUTSCHEN FISHINDUSTRIE UND DES FISC	Presentation of DIVERSIFY activities during the annual general assembly of the German associ	15/06/2018	Kiel, Germany	Industry	60	Germany

		HGROSSHAN DELS E.V.	ation of fish processors and whole salers					
345	Web sites/ Applications	BUNDESVERB AND DER DEUTSCHEN FISHINDUSTRIE UND DES FISC HGROSSHAN DELS E.V.	Translation and up load of 6 technical manuals of DIVERSIFY species	28/11/2018	www.aquakulturinfo.de	Scientific community (higher education, Research) - Industry - Civil society		Germany
346	Oral presentation to a wider public	HAVFOR SKNINGSINSTITUTTET	RAS in juvenile production of Atlantic halibut	15/03/2017	Bergen, Norway - Sats Marint	Scientific community (higher education, Research) - Industry - Policy makers - Medias	100	Norway
347	Posters	HAVFOR SKNINGSINSTITUTTET	SPAWNING PERFORMANCE, EGG QUALITY AND PLASMA CONCENTRATIONS OF FOLLICLE-STIMULATING AND LUTEINISING HORMONES AND SEX STEROIDS, IN FARMED AND WILD-CAUGHT FEMALE ATLANTIC HALIBUT (HIPPOGLOSSUS HIPPOGLOSSUS L.)	05/06/2018	Manaus, Brasil. 11th International Symposium on Reproductive Physiology of Fish	Scientific community (higher education, Research)	250	Global
348	Oral presentation to a scientific event	HAVFOR SKNINGSINSTITUTTET	DIVERSIFY – med fokus på flaskehalser i kveiteoppdrett	19/04/2018	Oslo, Norway. Havbrukskonferansen, Norges Forskningsråd	Scientific community (higher education, Research) - Industry - Policy makers - Medias	100	Norway
349	Interviews	CONSELLERIA DO MAR - XUNTA DE GALICIA	Interview for wreck fish aquaculture	14/11/2018	Radio Galega	Civil society		Spain
350	Organisation of Workshops	HAVFOR SKNINGSINSTITUTTET	Workshop for know-how transfer of Atlantic halibut aquaculture	11/09/2018	Hjelmeland, Norway	Scientific community (higher education, Research) -	30	Norway, EU

			ulture			Industry		
351	TV clips	HAVFOR SKNINGSINSTITUTTET	Norge Rundt - Halibut activity as recurring theme	05/01/2018	Austevoll, Norway	Civil society	600000	Norway
352	Exhibitions	HAVFOR SKNINGSINSTITUTTET	Visit of the Nordic prime ministers at Austevoll	30/05/2017	Austevoll, Norway	Policy makers - Medias	20	Norway, Sweden, Finland, Denmark, Iceland
353	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY evalúa el potencial de la corvina como especie emergente para la diversificación acuícola	28/11/2018	http://www.ctaqua.es/181128-diversify-resultados-corvina-diversificacion-acuicultura.aspx#.W_6PHhKh	Industry - Civil society - Medias	5000	EU, world
354	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY retoma seminarios sobre las especies del proyecto y avanza resultados y ponencias	06/09/2018	http://www.ctaqua.es/180906-diversify-seminarios-ponencias-acuicultura.aspx#.XABm4OhKhPY	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	5000	EU, world
355	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	El potencial de la producción y comercialización de la lisa	26/09/2018	http://www.ctaqua.es/180626-potencial-lisa-diversify-acuicultura-ctaqua.aspx#.XABmsOhKhPY	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	5000	EU, world
356	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Italia acogerá un completo taller sobre el cultivo de la lisa Mugil cephalus	11/04/2018	http://www.ctaqua.es/180411-taller-workshop-lisa-diversify-bari-italia-acuicultura-ctaqua.aspx?id=1	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	5000	EU, world
357	Press releases	FUNDACION CENTRO TECNOLÓGICO	DIVERSIFY con sigue establecer protocolos de	27/02/2018	http://www.ctaqua.es/180227-seriola-dive	Scientific community (higher education, Research) -	5000	EU, world

		ACUICULTURA DE ANDALUCIA	producción para la seriola		rsify-acuicultura.aspx#.XABluhKhPY	Industry - Civil society - Policy makers - Medias		
358	Press releases	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY celebrará su tercer taller promocional en Verona	08/02/2018	http://www.ctaqua.es/180207-diversify-taller-promocional-verona-acuicultura.aspx#.XABn--hKhPZ	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	5000	EU, world
359	Articles published in the popular press	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	Fishing for new ways to expand the EU's aquaculture industry	01/09/2018	Research EU- Results Magazine Nº 75	Scientific community (higher education, Research) - Industry - Civil society - Medias	1000	EU
360	Oral presentation to a wider public	INSTITUTO ESPANOL DE OCEANOGRAFIA	INVESTIGACION EN ACUARIOS PUBLICOS PROYECTO DIVERSIFY	09/03/2018	Centro de educación Ambiental de Cordoba	Scientific community (higher education, Research)	100	Spain
361	Oral presentation to a wider public	UNIVERSIDAD DE LA LAGUNA	LA IMPORTANCIA DEL CONSUMO DE PESCADO EN LA SALUD HUMANA PROBLEMÁTICA ACTUAL EN LA PRODUCCIÓN DE OMEGA-3, DÍA MUNDIAL DE LA PESCA	28/11/2018	ESCUELA DE PESCA, CABILDO DE LANZAROTE, SPAIN	Civil society	50	SPAIN
362	Exhibitions	UNIVERSIDAD DE LA LAGUNA	FLYERS, PPT, LEAFLETS, VIDEO AND BOOK MARKERS OF DIVERSIFY PROJECT	28/11/2019	INNOVAZUL, FIRST INTERNATIONAL MEETING ON KNOWLEDGE AND BLUE GROWTH CÁDIZ	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1200	EU, WORLD
363	Oral presentation to a scientific event	THE UNIVERSITY COURT OF THE UNIVERSITY OF	Diversification of type I interferons in fish	18/06/2018	Santa Fe, USA	Scientific community (higher education, Research)	300	USA, Canada, UK, Spain, Germany, France, Netherland,

		ABERDEEN						Italy, China, Japan, etc
364	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	Coordination meeting of the H2020 project SOCLIMPACT	17/01/2019	HCMR, Crete, Greece	Scientific community (higher education, Research) - Policy makers	20	Europe
365	Flyers	HELLENIC CENTRE FOR MARINE RESEARCH	Blue Economy in Crete, A workshop of EU-funded projects in Crete	18/01/2019	Region Of Crete, Herlakion, Crete, Greece	Scientific community (higher education, Research) - Civil society - Policy makers	60	Greece, Europe
366	Oral presentation to a scientific event	FUNDACION CENTRO TECNOLÓGICO ACUICULTURA DE ANDALUCIA	DIVERSIFY: exploring the biological and socio-economic potential of new/emerging candidate species for the expansion of the European aquaculture industry	27/08/2018	EAS Aquaculture Conference 2018 Montpellier France	Scientific community (higher education, Research) - Industry - Medias	3000	EU, world

Section B (Confidential or public: confidential information marked clearly)

LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, UTILITY MODELS, ETC.					
Type of IP Rights	Confidential	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant(s) (as on the application)

OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND

Type of Exploitable Foreground	Description of Exploitable Foreground	Confidential	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use or any other use	Patents or other IPR exploitation (licences)	Owner and Other Beneficiary(s) involved
General advancement of knowledge	Determination of directive husbandry and environmental factors for the improvement of growth and welfare of juvenile pike perch in cultured conditions.	No	01/02/2019	Rearing protocol	A.3.2.2 Freshwater aquaculture	Immediate	N/A	FUNDP, DTU, UL, ASIALOR, F2B
Commercial exploitation of R&D results	Evaluation of the impact of nutritional quality on growth, ontogenesis of the digestive tract, and skeletal deformities of pike perch larvae.	No	01/02/2019	Rearing protocol and diet formulation	A.3.2.2 Freshwater aquaculture	Immediate	N/A	FUNDP, DTU, UL, ASIALOR, F2B
Commercial exploitation of R&D results	Combination of the best husbandry practices identified during the on-growing experiments with pikeperch juveniles.	No	01/02/2019	Rearing protocol	A.3.2.2 Freshwater aquaculture	Immediate	N/A	FUNDP, DTU, UL, ASIALOR, F2B
Commercial exploitation of R&D results	Insight on genetic variability of pike perch breeders for starting up breeding programs.	No	01/02/2019	Microsatellite loci multiplexes, mitochondrial cytochrome b DNA sequences publicly available to the scientific and industrial community	A.3.2.2 Freshwater aquaculture	Immediate	N/A	HCMR, UL, ASIALOR, F2B, MAHAL, DTU, FUNDP
General advancement of knowledge	Handling of greater amberjack brood stock and rearing of larvae.	No	01/02/2019	Rearing protocols	A.3.2.1 Marine aquaculture	Immediate	N/A	HCMR, GMF, ARGO, CANEXMAR, FORKYS
Commercial exploitation of R&D	Developing methods for inducing	No	01/02/2019	Eggs of greater amberjack	A.3.2.1 Marine aquaculture	Immediate	N/A	HCMR, IEO, FCPCT, ULL, GMF, ARGO,

results	spawning of greater amberjack brood stock using GnRHa therapies.							FORKYS
Commercial exploitation of R&D results	Husbandry methodologies for the on growing of meagre in cages.	No	01/02/2019	Harvest size meagre	A.3.2.1 Marine Aquaculture	Immediate	N/A	HCMR, IRTA, ARGO
Commercial exploitation of R&D results	Husbandry methodologies for the larval rearing of greater amberjack.	No	01/02/2019	Greater amberjack juveniles	A.3.2.1 Marine aquaculture	Immediate	N/A	HCMR, FCPCT, IEO, ULL, FORKYS, GMF, SARC
Commercial exploitation of R&D results	Husbandry methodologies for the on growing of greater amberjack.	No	01/02/2019	Greater amberjack of harvestable size	A.3.2.1 Marine aquaculture	Immediate	N/A	HCMR, IEO, FCPCT, ULL, CANEXMAR, FORKYS, ARGO, SARC
Commercial exploitation of R&D results	Evaluation of the efficacy of different feeding stimuli (light - air bubbles) for the attraction of meagre of different sizes to a feeding area.	No	01/02/2019	Rearing protocols	A.3.2.1 Marine aquaculture	Once a commercial equipment is produced to provide the stimulus in area cages and link to the feeding system (1-2 years)	N/A	HCMR, IRTA
Commercial exploitation of R&D results	Evaluation of different feeding methodologies (self-feeder, programmed feeding and hand feeding) for the growth and performance of meagre during grow out.	No	01/02/2019	Rearing methodology for fattening	A.3.2.1 Marine aquaculture	Immediate	N/A	IRTA, HCMR, ARGO
General advancement of knowledge	Development of the digestive and vision system of wreck fish.	No	01/02/2019	Knowledge base for larval rearing protocols	A.3.2.1 Marine aquaculture	Immediate	N/A	IEO, MC2, CMRM, HCMR
Commercial exploitation of R&D results	Grey mullet brood stock nutrition to improve egg hatch ability as well as larval performance,	No	01/02/2019	Production of robust larvae leading to fast growing juveniles or high quality bottarga	A.3.2. Aquaculture	Immediate	N/A	IOLR, UNIBA, ULL, IRTA

	in terms of survival and swim bladder inflation, and bot targa quality.							
Commercial exploitation of R&D results	Grey mullet larval rearing protocols that achieve good larval survival (>20%) and juvenile production (>200,000 fry in 2017).	No	01/02/2019	Robust, fast growing juveniles	A.3.2. Aquaculture	Immediate	N	IOLR, DOR
Commercial exploitation of R&D results	Grey mullet weaning diet and its impact on gut maturation and growth in juveniles.	No	01/02/2019	Feed formulation for weaning	A.3.2. Aquaculture	Immediate	N/A	IOLR
Commercial exploitation of R&D results	Reduction of expensive marine oils in grey mullet grow out feeds, for fish grown in low salinity water.	No	01/02/2019	Feed formulation for on growing	A.3.2. Aquaculture	Immediate	N/A	IRTA, IRTA, HCMR, DOR, GEI, CTAQUA,
Commercial exploitation of R&D results	Protocol for shipping grey mullet eggs, in order to transport them to larval rearing facilities within Israel and around the Mediterranean region.	No	01/02/2019	Egg shipping protocol	A.3.2. Aquaculture	Immediate	N/A	IOLR, DOR
General advancement of knowledge	Individual spawning cycles in cultured and wild-captured female Atlantic halibut and reproductive performance in terms of spawning period, number of batches, ovulatory interval, number of eggs, egg diameter, fertil	No	04/02/2019	Improved quality and predictability in egg production in farmed breeders of Atlantic Halibut	A.3.2.1 Marine Aquaculture	Immediate	N/A	IMR, SWH

	isation and hatching, cell symmetry and egg steroid concentration.							
Commercial exploitation of R&D results	Testing of GnRHa implantations on F1/F2 Atlantic halibut females, in order to document reproductive dysfunctions, including irregular spawning cycles, low and unstable fertilisation, low gamete survival and lower realised fecundity than wild females.	No	04/02/2019	Protocol for the synchronisation and enhancement of spawning of female Atlantic halibut.	A.3.2.1 Marine Aquaculture	Immediate	N/A	IMR, HCMR, SWH
Commercial exploitation of R&D results	Comparison of production of Atlantic halibut fry in flow through (FT) and recirculation aquaculture system (RAS), and a metagenomic analysis of bacterial composition in water and larvae.	No	04/02/2019	A stabilised rearing system to produce Atlantic halibut juveniles	A.3.2.1 Marine Aquaculture	Immediate	N/A	IMR, SWH
General advancement of knowledge	Muscle and liver transcriptome in meagre to base future physiology, immunology and genetics studies.	No	04/02/2019	Muscle and liver transcriptome available, Microsatellite and SNP markers mined from the transcriptome, indicative QTLs for growth	A.3.2.1 Marine aquaculture	Immediate	N/A	HCMR,IRTA
Commercial exploitation of R&D results	A method for early weaning of Atlantic halibut larvae was developed, indicating the developmental stage at which larvae can be weaned and estab	No	04/02/2019	Protocol for the early weaning of Atlantic halibut	A.3.2.1 Marine Aquaculture	Immediate. Commercial companies are already working with moving time of weaning from 50 to 30 days post first-feeding	N/A	NIFES, IMR, SWH, SARC

	lishing a quantitative difference between how different feeds are accepted by the larvae.							
General advancement of knowledge	DIVERSIFY has established that Artemia ongrown on Oriculture have a better nutrient profile than nauplii, however Atlantic halibut larval growth was not affected. Also, examined the dietary phospholipids (PL) needed in formulated feed for juveniles.	No	04/02/2019	Protocol for larval rearing of Atlantic halibut	A.3.2.1 Marine Aquaculture	Immediate	N/A	NIFES, IMR, SWH, SARC
General advancement of knowledge	Development of assays to measure specific immunity to assist in future vaccine optimisation, by allowing the monitoring of responses to validate vaccine efficacy.	No	04/02/2019	Antibodies to measure IgM/IgT, to allow responses post-vaccination to be determined.	A.3.2 Aquaculture	Already commercialised via Vertebrate Antibodies Ltd.	N/A	UNIABD, FCPCT, IRTA, HCMR
General advancement of knowledge	Identification of immune genes in meagre and greater amberjack and a greater understanding of how they are modulated during development and after stimulation.	No	04/02/2019	Data set of immune genes	A.3.2.1 Marine aquaculture	Immediate	N/A	UNIABD, IRTA, FCPCT, HCMR,
Exploitation of results through EU policies	Greater amberjack growth and size at first maturity.	No	05/02/2019	Knowledge base	A.3.2.1 Marine Aquaculture	Immediate	n/a	UNIBA
Exploitation of results through EU	Grey mullet growth and size at first ma	No	05/02/2019	Knowledge base	A.3.2.1 Marine Aquaculture	Immediate	N/A	UNIBA, IOLR

Commercial exploitation of R&D results	Greater amberjack broodstock susceptibility to handling.	No	05/02/2019	Broodstock management protocol	A.3.2.1 Marine Aquaculture	Immediate	N/A	UNIBA, HCMR, IOLR, ARGO
Commercial exploitation of R&D results	A well balance and adapted broodstock diet for the specific nutritional requirements of greater amberjack during reproduction.	No	05/02/2019	Feed formulation for broodstock	A.3.2.1 Marine Aquaculture	Immediate	N/A	FCPCT, IEO, ULL, SARC
General advancement of knowledge	Spawning induction protocol of hatchery-produced greater amberjack in the Atlantic based on GnRH α implants.	No	05/02/2019	Eggs of greater amberjack	A.3.2.1 Marine Aquaculture	Immediate	N/A	IEO, HCMR, ULL
General advancement of knowledge	Methodology for large-scale production of wreckfish eggs obtained from broodstock kept in captivity	No	05/02/2019	Eggs of wreckfish	A.3.2.1 Marine Aquaculture	Immediate	N/A	IEO, MC2, CMRM, HCMR. IRTA, IFREMER
Commercial exploitation of R&D results	Computer Assisted Sperm Analysis (CASA) for greater amberjack, grey mullet, meagre and wreckfish sperm	No	05/02/2019	CASA protocol for four different fishes	A.3.2.1 Marine Aquaculture	Immediate	N/A	IFREMER, IOLR, HCMR, IRTA, IEO, MC2, CMRM
General advancement of knowledge	Methodology for egg incubation and larval rearing of wreckfish.	No	05/02/2019	Wreckfish larvae and juveniles	A.3.2.1 Marine Aquaculture	Immediate	N/A	IEO, MC2, CMRM, FCPCT
General advancement of knowledge	Sperm storage conditions were established for meagre and wreckfish based on the objective assessment of sperm quality.	No	05/02/2019	Sperm storage protocols for meagre and wreckfish	A.3.2.1 Marine Aquaculture	Immediate	N/A	IFREMER, IEO, IRTA, CMRM, MC2
Commercial exploitation of R&D	Diagnostic and recommendation	No	06/02/2019	A meagre health manual for dia	A.3.2.1 Marine Aquaculture	Immediate	N/A	HCMR, IRTA, FCPCT, UNIABD

results	manual for meagre describing all major diseases and health-related issues studied and recorded during the course of DIVERSIFY project.			gnostic purposes				
General advancement of knowledge	Diagnostic and recommendation manual for greater amberjack describing all major diseases and health-related issues studied and recorded during the course of DIVERSIFY project.	No	06/02/2019	A greater amberjack health manual for diagnostic purposes	A.3.2.1 Marine Aquaculture	Immediate	N/A	HCMR, IRTA, FCPCT, IEO, UNIABD, ARGO
Commercial exploitation of R&D results	Technical manual for meagre, providing information obtained during DIVERSIFY, relevant to the acquisition of new broodstock, broodstock management and control of reproduction, nutrition, larval rearing and grow out husbandry.	No	06/02/2019	Technical manual for meagre production	A.3.2.1 Marine Aquaculture	Immediate	N/A	IRTA, HCMR, FCPCT, UNIADB, IFREMER, ULL, SARC, DTU, ARGO
Commercial exploitation of R&D results	Technical manual for greater amberjack, providing information obtained during DIVERSIFY, relevant to broodstock management and control of reproduction, nutrition, larval rearing and grow out husbandry.	No	06/02/2019	Technical manual for greater amberjack production	A.3.2.1 Marine Aquaculture	Immediate	N/A	HCMR, FCPCT, IOLR, IEO, UNIBA, IFREMER, ULL, SARC, ARGO, ITTICAI, FORKYS, CANEXMAR, GMF
Commercial ex	Technical manual	No	06/02/2019	Technical manual	A.3.2.2. Freshwater	Immediate	N/A	UL, FUNDP, DTU,

exploitation of R&D results	for pikeperch, providing information obtained during DIVERSIFY, relevant to brood stock genetics, nutrition, larval rearing and grow out husbandry.			for pikeperch production	Aquaculture			UL, HCMR, FCPCT, IRTA, ASIALOR, F2B
Commercial exploitation of R&D results	Technical manual for Atlantic halibut, providing information obtained during DIVERSIFY, relevant to brood stock performance and control of reproduction, larval rearing and nutrition and vaccine development.	No	06/02/2019	Technical manual for Atlantic halibut production	A.3.2.1 Marine Aquaculture	Immediate	N/A	IMR, NIFES, SWH, HCMR, ULL, SARC
General advancement of knowledge	Technical manual for wreckfish, providing information obtained during DIVERSIFY, relevant to brood stock acquisition, description of the reproductive cycle, broodstock management and nutrition, induction of spawning and larval rearing and nutrition.	No	06/02/2019	Technical manual for wreckfish broodstock management and larval rearing	A.3.2.1 Marine Aquaculture	Immediate	N/A	IEO, CMRM, MC2, HCMR, IFREMER, IRTA, FCPCT, ULL
Commercial exploitation of R&D results	Technical manual for grey mullet, providing information obtained during DIVERSIFY, relevant to brood stock management and control of reproduction, larval rearing, nutrition and grow out husbandry.	No	06/02/2019	Technical manual for grey mullet production	A.3.2.1 Marine Aquaculture	Immediate	N/A	IOLR, IRTA, FCPCT, CTAQUA, HCMR, UNIBA, IFREMER, ULL, DOR, GEI, IRIDA

	bandry.							
Commercial exploitation of R&D results	A new dry food specifically formulated for wreckfish broodstocks.	No	06/02/2019	Feed formulation for wreckfish broodstock	A.3.2.1 Marine Aquaculture	Immediate	N/A	CMRM, FCPCT, IEO
Commercial exploitation of R&D results	A larval rearing protocol for pike perch, based on an optimal combination of environmental, feeding and population factors.	No	06/02/2019	Larval rearing protocol for pikeperch	A.3.2.1 Marine Aquaculture	Immediate	N/A	UL, DTU, FUNDP
General advancement of knowledge	Dietary lysine requirements for greater amberjack juveniles.	No	06/02/2019	Feed formulation data	A.3.2.1 Marine Aquaculture	Immediate	N/A	HCMR, SARC
General advancement of knowledge	Information to manufacture grow out extruded diets for greater amberjack, meagre, mullet and pikeperch, that will optimize flesh nutritional value.	No	06/02/2019	Nutrient composition of fillets from DIVERSIFY species	A.3.2.1 Marine Aquaculture	Immediate	N/A	FCPCT, CTAQUA, IRTA, HCMR
Commercial exploitation of R&D results	Functional diet for greater amberjack to reduce the infestation of external parasites.	No	06/02/2019	Feed formulation for parasite resistance	A.3.2.1 Marine Aquaculture	Immediate	N/A	FCPCT, UNIABD
Commercial exploitation of R&D results	A large variety of specific processed product ideas have been generated as well as specific selected physical products derived from these ideas have been created and tested for their nutritional value and sensory quality and are available to be exploited / produced by fish pro	No	06/02/2019	Added value products from the six studied species to be commercially produced and commercialised	A.3.2. Aquaculture	Immediate	N/A	HCMR, IRTA, CTAQUA, HRH, AU, APROMAR, ARGO

	cessing industry.							
General advancement of knowledge	Consumer value perceptions and behavioral change in order to comprehend overall value perceptions of consumers with regard to aquaculture fish in general and the DIVERSIFY fish species in particular, to undertake a value-based segmentation study, to evaluate consumer sensory perceptions of the newly developed products, and to optimize the newly developed products in terms of ideal intrinsic-extrinsic product attribute combinations.	No	06/02/2019	Results on market segmentation, new product development, communication	A.3.2. Aquaculture	Immediate	N/A	AU, HRH, DLO/SWR, APROMAR, CTAQUA
General advancement of knowledge	Feasibility studies and business models for grey mullet, pikeperch, greater amberjack and Atlantic halibut.	No	06/02/2019	Business model for grey mullet, pikeperch, greater amberjack and Atlantic halibut	A.3.2. Aquaculture	Immediate	N/A	AU, DLO/SWR, APROMAR, HCMR, CTAQUA, FGM, HCMR, ARGO, GMF, F2B, SWH
Commercial exploitation of R&D results	Development of a web based application for virtual store testing.	Yes	01/02/2021	Electronic platform and application	A.3.2. Aquaculture	Immediate	N/A	HRH, IRTA, CTAQUA, DLO/SWR, AU
General advancement of knowledge	Advances in the knowledge of nutritional requirements of wreckfish larvae.	No	07/02/2019	Live food enrichment media formulation	A.3.2.1 Marine Aquaculture	Within 1-2 years this products can be transferred to interested aquaculture companies	N/A	CMRM, FCPCT, IEO
Commercial exploitation of R&D results	Formulation of an adjusted live prey enrichment product	No	07/02/2019	Live food enrichment media formulation	A.3.2.1 Marine Aquaculture	Immediate	N/A	FCPCT, IEO, ULL

	for greater amber jack larval nutrition.							
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ADDITIONAL TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND

Description of Exploitable Foreground	Explain of the Exploitable Foreground
Determination of directive husbandry and environmental factors for the improvement of growth and welfare of juvenile pikeperch in cultured conditions.	The results defined environmental conditions improving pikeperch welfare that may lead to an increase of productivity by reducing stress and, as a consequence, the negative effects on growth, immunity and disease resistance. Our guidelines should thus be followed by farmers. The expected impact is in increased productivity and efficiency of the industry.
Evaluation of the impact of nutritional quality on growth, ontogenesis of the digestive tract, and skeletal deformities of pikeperch larvae.	The objective of this task was the determination of controlling factors and elements in the feed to improve the overall performance of larvae of pikeperch. A comprehensive study factoring in some of the most important elements for optimal feed formulation were compared, following several performance indicators, such as growth, survival, cannibalism, skeletal malformations, as well as early expression of genes involved in digestion, stress resistance and growth. The nutritional study defined Ca/P ratio and the n-3 long chain polyunsaturated fatty acids (LC PUFA) dietary content (ARA/EPA/DHA) as the directive factors for optimal larval performance. Total P should be considered together with Ca/P ratio in order to develop specific formulated diets. The new optimised diet can be used by pikeperch hatcheries and farmers to optimise growth and survival, and reduce deformities of the fingerlings. Likewise, the formulation is of interest to fish feed companies (BioMar, Skretting, etc.) to include in their product portfolio. Fish 2 Be (P39, F2B) and Sparos S.A., Portugal (a feed company not in the DIVERSIFY consortium) are already working on this to create two novel diets to be tested this year. This will hopefully lead to a commercial diet that can be used for Sander species, such as pikeperch, but hopefully also for other Perch species. Improved survival among these species and more reliable output will improve investment in grow-out operations.
Combination of the best husbandry practices identified during the on growing experiments with pikeperch juveniles.	The combination of the best husbandry practices identified during the grow-out experiments with pikeperch juveniles have been applied under commercial conditions existing in an SME producing pikeperch (F2B), resulting in a reduced level of stress and an improved immune status in the pikeperch stock, as shown by physiological and immunological markers measured regularly during the growing period. Low light intensity and red light spectrum have induced a reduction of stress indicators, as well as an enhancement of some immune markers, suggesting an increased resistance to husbandry conditions and pathogens in pikeperch during the growing phase. The expected impact of the developed rearing protocol is increased growth, better health and welfare, and thus productivity and efficiency of the industry.
Insight on genetic variability of pikeperch breeders for starting up breeding programs.	The objective of DIVERSIFY was to assess the genetic variability of the current captive broodstocks of pikeperch in commercial farms and to also assess the available wild populations. Understanding the genetic variability is an important step to start a selection program in novel species. Results indicated that, in general, domesticated pikeperch breeders do not suffer from inbreeding, with the exception of few with either small sample size or known past of stocks under selection. Thus, attention must be paid in some groups held in captivity, where a lack of heterozygosity can lead to depleted genetic variability. Whereas these groups have already performed in specific conditions, it is also important not to mix too diverse populations with already "improved stocks". Careful selection of future stocks for selective outbreeding to improve adverse traits can be aided by the work performed in DIVERSIFY. Furthermore, we provided evidence and confirmed results generated in previous studies that pikeperch populations in Europe are part of at least two genetically differentiated groups and taking these two groups into account, aquaculture broodstocks analysed seem to contain in general fish of a single origin with only few exceptions. All the above are considered of major importance when aiming to have a long term and sustainable breeding program since it is fundamental to i) ensure sufficient genetic variation within populations, and ii) take into account different zootechnical performances that are due to the geographic differentiations of stocks. For the advancement in genetic improvement, a good heterozygosity analyses is a good starting point. However further research is needed to couple the genetic information to the effective improvement of domesticated stocks. Secondly the markers identified for performing these group analyses do not give a high enough resolution to properly identify parents and individual progeny to directly use them for on-farm selection processes. Most pikeperch farms do not have the resources to raise individual families and thus cannot compare family performances, so only by individual performance com

	pared to the group, phenotypic variance can be determined.
Handling of greater amberjack broodstock and rearing of larvae.	The presence of HCMR's scientists during the handling of the broodstock and the rearing of the larvae of greater amberjack, gave the opportunity to the company's staff (GMF, people not previously involved in broodstock management or larval rearing of this species) to learn many useful things about this new species, how we have to handle mature fish that are ready to spawn, how we should change the lighting conditions and the feeding regimes of the larvae, etc. This can improve the performance of the company staff and make them useful in other activities of the company. Also there were some people that were sent for training to the HCMR's facilities.
Developing methods for inducing spawning of greater amberjack broodstock using GnRHa therapies.	Greater amberjack is a species that grows fast and can reach a large (3-5 kg) marketable size very quickly. The research of this species and its successful production will give to interested aquaculture producers a new product with a lower production cost, a good taste, a high nutritional value and also a quite high market price. For the Atlantic stock (Canary Islands, Spain), we compared the quality of spontaneous spawns of greater amberjack with those obtained by either GnRHa injection or implant protocols. The number of eggs per spawn obtained in the broodstock without hormonal treatment was larger than in those obtained with GnRHa injections or implants. Egg quality was best in broodstock with spontaneous spawning, followed by GnRHa injected fish and then GnRHa implants. Moreover, size of larvae from control and injected broodstock was similar between them and significantly higher ($p < 0.01$) than those from GnRHa implant spawn. Overall, this study showed that it is possible to obtain very high quality spontaneous spawns in greater amberjack in the Atlantic region, providing adequate conditions. Furthermore, GnRHa weekly injections lead to similar egg viability and hatching rates than spontaneous spawn and higher fertilization rates than GnRHa hormonal implants, which is better than in previous studies. On the contrary, spontaneous spawning in the Mediterranean stock was only achieved when fish were reared in sea cages throughout the year. Very limited spontaneous spawning was documented when fish were reared in tanks during the year. Therefore, spawning in this stock was controlled only with exogenous hormonal therapies, mainly focusing on GnRHa implants of sustained release, and then transferring the fish from the sea cages to land-based tanks for spawning and egg collection. The optimal dose and time of the year for the best results were documented, and large quantities of eggs were produced, and sent to a number of hatcheries for larval rearing. The developed methods for the induction of spawning allows any commercial operation in the Mediterranean and the eastern Atlantic area of the EU to produce reliably and consistently large quantities of viable eggs of greater amberjack, which can be either reared in their own hatcheries or sold to other hatcheries that do not have the capacity to maintain broodstocks. This can also include RAS operations in the mainland EU (e.g. Germany) and north Europe (The Netherlands and Denmark) where commercial operations exist already for the production of another congener, the yellowtail kingfish (<i>Seriola lalandi</i>). This will have a positive impact on EU aquaculture production and employment.
Husbandry methodologies for the on growing of meagre in cages.	The objective was the improvement of current rearing methods for meagre, a species with different lifecycle and feeding behaviour than the other commonly reared Mediterranean fishes (i.e. European seabass and gilthead seabream). The grow out parameters that were examined in DIVERSIFY for meagre in sea cages were (a) the volume of cage (i.e. the stocking density), (b) depth, (c) light conditions and (d) feeding method. Production manuals have been produced and are readily available in the website of DIVERSIFY, and contain all relevant information. The developed methodologies can be directly exploited by the private companies collaborating in the consortium and also by all interested parties as the species manual is publicly available. The application at industrial level will improve the biological performance of the species during grow out, thus improving the sustainability of the industry.
Husbandry methodologies for the larval rearing of greater amberjack.	The objective was the development for the first time of larval rearing methods for greater amberjack, a new species in the Mediterranean region and one with different biological characteristics than the commonly reared fishes (i.e. European seabass and gilthead seabream), such as rearing at summer temperature, very fast growth rate and high size variability. Firstly, the description of the eye and the digestive system ontogeny of greater amberjack larvae in relation to the rearing conditions were concluded. This information was used to evaluate the rearing protocols and suggest ways for their improvement by the farmers. The parameters examined during larval rearing related to the light, the volume of tanks and the currents needed during rearing for improved performance and survival. Production manuals have been produced and are readily available in the website of DIVERSIFY, and contain all relevant information. The larval rearing system is based on large tank and low initial stocking of eggs-larvae that improves growth performance and survival. Egg stocking densities >25 eggs l ⁻¹ affect negatively the results. Light conditions of a photo phase of 24 L:00 D from 1 to 20 dph (days post hatching) and 18 L: 06 D between 21 and 30 dph, and light intensities of 800, 1200, 1000 and 500 lux at 3, 6, 12, and 20 dph, respectively were examined. A renewal of filtered sea water (5 μ m) at an increasing rate ranging from 15-40% day ⁻¹ at 1 dph, 30-40% at 10 dph, 100-120% at 20 dph, and 200-240% at 30 dph ensures a good quality of the rearing environment, and maintained the basic physical conditions during the larvae rearing. Dissolved oxygen ranged between 4.9 and 8.2 mg l ⁻¹ , preferably upper than 6.0 mg l ⁻¹ , salinity between 35 and 40 psu, pH between 7.8 and 8.5, and temperature ranged from 22 to 27°C, preferably between 23.5 and 25.0°C. The feeding protocols used have to be coupled with the rearing conditions and larval development. The larvae have to be able to see, ingest and digest the food, and therefore need the coordinated development of vision and digestive system. Larval rearing developed under conditions that allow faster growth have to consider the time of beginning and duration of the feeding periods with the different items. In general, the addition of live

	<p>microalgae at 150-300 x 10³ cell ml⁻¹ from 1 dph, enriched rotifers (<i>Brachionus</i> sp.) two times a day, from 3 to 25 dph, at densities between 3 and 10 rot ml⁻¹, <i>Artemia</i> AF nauplii at 12 dph, during 5-7 days and enriched <i>Artemia</i> EG 1-day at 14-18 dph, and weaning diet (200-800 µm) from 18 dph look is a good sequence. Moreover, the enriched emulsions of prey supplemented with phospholipids, carotenoids, arachidonic acid (ARA) and immune modulators such as Echium oil and black cumin oil improve the larval rearing of greater amberjack, so enriching would give better results in the larval performance of greater amberjack. During larval rearing and especially following 20 dph, high size variability occurred in all rearing systems tested. This high variability is confronted until now with early sorting of the reared groups in to appropriate size classes. Applying standard methods and equipment available in all hatcheries, the sorting procedure results in significantly higher survival compared to unsorted groups. Unsorted groups between 20 and 30 dph present mortality of more than 90%, while for the sorted groups is limited to approximately 10%. During sorting, transport of the individuals is also a requisite. Individuals of less than 15 mm in total length do not tolerate netting and transfer should be performed with care. Avoid larval air exposure. After reaching 20 mm in total length individuals can be netted normally. Husbandry practices with larger individuals (>0.5-1 gr) are easier, although in some cases light anesthesia may help. The developed methodologies are already exploited by the private companies collaborating in the consortium. They are also available to all interested parties as the Technical Production Manual for this species is public. There is room for further improvements in the larval rearing methods and research is required to better understand the mechanisms implicated in, and the control of the high size variability present today. Additional studies focusing on the rearing temperature and the feeding protocol are considered necessary in order to achieve better rearing results in the greater amberjack larval rearing. The application of this foreground has resulted already in the beginning of a commercial activity in Greece and the Canary Islands.</p>
Husbandry methodologies for the on-growing of greater amberjack.	<p>The objective was the development for the first time of on-growing rearing methods for greater amberjack, a new species in the Mediterranean region and one with different biological characteristics than the commonly reared fishes (i.e. European seabass and gilthead seabream), such as fast growth and large body size, and high temperature preferences. The parameters examined during grow out were husbandry practices (health treatments, sampling, feeding, etc.) and rearing temperatures (17, 22 and 26°C). Rearing temperature was shown to also induce changes in fish morphology which resulted in a higher caudal propulsion efficiency index for fish reared at 26°C. Based on these results, we conclude that greater amberjack fingerlings perform better at 26°C than at 22°C or 17°C. Production manuals have been produced with the obtained information and are readily available in the website of DIVERSIFY. The developed methodologies are already exploited by the private companies collaborating in the consortium. They are also available to all interested parties as the Technical Production Manual for this species is public. The developed methodologies are already exploited by the private companies collaborating in the consortium, but also a number of other companies who either obtained eggs from DIVERSIFY and produced their own juveniles, or acquired juveniles from DIVERSIFY. The rearing methods can be further improved and research is required targeting issues related to the monogenean parasites that infect the species and the possible treatments. The introduction of the species in the Mediterranean aquaculture is expected to have a significant positive impact in expanding the industry in a sustainable way.</p>
Evaluation of the efficacy of different feeding stimuli (light - air bubbles) for the attraction of meagre of different sizes to a feeding area.	<p>The aim was to study the effect of different stimuli and their combination on meagre feeding behaviour, in order to develop husbandry methods useful for the industry. The knowledge that was acquired from this study will contribute to the development of the appropriate technology and methodology for feeding management of meagre in land-based facilities, but more importantly, in sea cages. Both air bubbles and light, or a combination of them can be used as a stimuli in an industrial setting, as they can be manufactured, implemented and managed easily from the farmers with existing technologies in sea cages. Additional studies using different stimuli would be considered necessary as the general information about the behavior of meagre is considered limited. For example, it might be advisable to study the response of meagre in other types of stimuli, such as acoustic stimuli and test their effectiveness for feeding. Improvements in feeding methods will have a positive impact on improving feed conversion efficiency, and thus reduce the cost of production of the industry and increase its sustainability.</p>
Evaluation of different feeding methodologies (self-feeder, programmed feeding and hand feeding) for the growth and performance of meagre during grow out.	<p>The aim was to evaluate in meagre, different feeding methodologies such as self-feeder, programmed feeding and hand feeding for the rearing during the grow out phase. The results of this study clearly indicate that the development of a feeding methodology based on an automatically programmed feeding system can be used for meagre in land-based and sea cage rearing facilities. The knowledge associated with feeding behaviour and the functions of the digestive system should be taken into consideration. This will offer further optimization of production indices. Shadowing of the sea cages is proposed as an additional process that could increase the effectiveness of an automated feeding system for meagre. Additional studies focusing on the optimisation of feeding tables of meagre are considered necessary. Improvements in feeding methods will have a positive impact on improving feed conversion efficiency, and thus reduce the cost of production of the industry and increase its sustainability.</p>
Development of the digestive and vision system of wreckfish.	<p>The aim was the description of the eye, and the digestive system ontogeny of wreckfish, a completely new fish proposed for the Mediterranean aquaculture. The information will be used for the improvement of the rearing protocols for the successful wreckfish larval production. Additional studies that will be related with the optimisation of the larval feeding protocol, rearing conditions, such as the tank hydrodynamics, the temperature during rearing and the photic</p>

	conditions, are considered necessary for the development of the wreckfish larval rearing protocol. It is still too early to have an impact in the industry, but the work of DIVERSIFY will certainly assist in the development of further research with this fish with a high potential for the industry.
Grey mullet broodstock nutrition to improve egg hatchability as well as larval performance, in terms of survival and swim bladder inflation, and bottarga quality.	The purpose of this foreground was to improve the reproductive function of grey mullet by the formulation of new extruded diets for broodstock and to improve the nutritional quality of roe (bottarga) in terms of n-3 long chain polyunsaturated fatty acids (LC PUFA) and carotenoids (for bottarga color acceptability). Broodstock diets were developed that enhanced egg production and quality, larval performance, as well as female gonadal maturation for bottarga production. Captive-reared grey mullet have been shown to suffer significant reproductive dysfunctions with impaired oogenesis and spermatogenesis. Contributions of DIVERSIFY to the design of adequate feeding regimes for broodstock to optimize reproduction success, and further assessment based on the comparative evaluation of captive and wild fish gonads, and eggs in terms of lipids and carotenoids, confirmed a more stable and consistent composition of female gonads, a better egg and larval quality and an improved quality of bottarga, which is a highly prized delicacy in Japan and around the Mediterranean. These results would lead to higher larval survival and juvenile production, and improve bottarga production. The results can be exploited by feed manufacturers, grey mullet hatcheries and bottarga producers, and will enable the use of captive fish for the production of bottarga, as opposed to relying on wild fish from the fishery.
Grey mullet larval rearing protocols that achieve good larval survival (>20%) and juvenile production (>200,000 fry in 2017).	An important part of the larval rearing protocol of grey mullet is knowing the algae type and concentration needed to "green" larval rearing tanks. Moreover, it was found that lyophilized micro algae was just as effective as live algae, in terms of larval growth and survival. Dry or lyophilized algae is more convenient and would be a major saving in infrastructure and labor in commercial hatcheries. It is similarly important to know the enrichment conditions of rotifers and Artemia in essential fatty acids and taurine, that produce good larval growth and survival. These advances would lead to better production and higher profitability for the industry.
Grey mullet weaning diet and its impact on gut maturation and growth in juveniles.	The accrued knowledge of the ontogeny of pancreatic, brush border and intracellular digestive enzymes of developing juvenile grey mullet, that are transitioning from carnivores to omnivores, provided the rationale to explain the better growth, survival and size distribution of juveniles weaned onto a more economical, low protein-high carbohydrate diet. Feeding this omnivorous diet would improve the production of robust juveniles for grow-out in commercial farms.
Reduction of expensive marine oils in grey mullet grow out feeds, for fish grown in low salinity water.	The reduction of expensive marine oils that contain n-3 long chain polyunsaturated fatty acids (LC PUFA) in grow-out feeds, provided the fish are grown in low salinity water, resulted in improved growth. The objective was to examine the possibility of reducing the use of PUFA in grey mullet diets. As >50% of the expense of grow-out is fish feed, this finding reduces this significant expense. DIVERSIFY demonstrated that juvenile grey mullet reared in low salinity water, and not in full strength seawater, have the capability to biosynthesize LC PUFA from shorter chain precursors. This means that the use of expensive fish oils containing n-3 LC PUFA can be reduced lowering the cost of the feed for grow-out. On the other hand, further studies must be carried out to determine the quantitative reduction of these fish oils in feeds for grey mullet. In addition, the reduction of fish oil makes this diet more sustainable and eco-friendly. Having said this, fish oil provides an advantage for broodstock during the reproductive season.
Protocol for shipping grey mullet eggs, in order to transport them to larval rearing facilities within Israel and around the Mediterranean region.	The project developed an egg transport protocol for the successful shipment of live grey mullet eggs (at gastrula 1 stage). The protocol uses 20 l cubitainers stocked with a maximum of 15,000 eggs/l and should not exceed a total sea water volume of 10 l (total of 150,000 eggs). The protocol includes the use of ice packs. This procedure will ensure, after a 26 h transit time, a high proportion of viable eggs with a good hatching rate and survival to hatching. This means shipments could be sent successfully to grey mullet farms in other countries that do not have an on-site hatchery.
Individual spawning cycles in cultured and wild-captured female Atlantic halibut and reproductive performance in terms of spawning period, number of batches, ovulatory interval, number of eggs, egg diameter, fertilisation and hatching, cell symmetry and egg steroid concentration.	Empirical data suggest a significant difference in spawning performance between wild-captured and farmed Atlantic halibut females, but currently there is a lack of systematic documentation. The purpose of this work was to improve spawning predictability and identify possible reproductive problems in wild-caught and farmed female Atlantic halibut. Consequently, individual spawning cycles in cultured and wild-captured females and reproductive performance were documented. This information can be exploited by the farming industry, as it provides a basis for better selection of broodstock, from both farmed and wild populations. All results will be published in open sources. For commercial, as well as breeding purposes, it is not practical to rely on wild-caught females. However, both at P7. IMR and at P22. SWH, relatively few farmed females produced consistently eggs with fertilization rates >80-85%. As a consequence, it may be necessary to include wild-caught breeders also in future breeding groups in order to ensure a broad enough genetic material. Further research is needed, to identify gene markers for broodstock selection. Identifying potential high-quality breeders and concentrating the strip-spawning effort on those females may be useful in order to reduce the very considerable work load connected with spawning and egg collection of Atlantic halibut.
Testing of GnRH α implantations on F1/F2 Atlantic halibut females, in	Atlantic halibut females are periodic spawners that release their eggs in 5-10 batches during the annual spawning season. Wild-captured females mature and release eggs of good quality in captivity. However, sometimes females of the F1/F2 generation have been reported to display reproductive dysfunctions, in

<p>order to document reproductive dysfunctions, including irregular spawning cycles, low and unstable fertilisation, low gamete survival and lower realised fecundity than wild females.</p>	<p>cluding irregular spawning cycles, low and unstable fertilization, low gamete survival and lower realized fecundity than wild females. One way of mitigating these dysfunctions might be to use a hormonal therapy using gonadotropin releasing hormone agonists (GnRH_a). The purpose of this work was to improve spawning output, and to advance and synchronise spawning in farmed Atlantic halibut females. GnRH_a implantation did not advance spawning time significantly, but in two of the trials there was an apparent synchronization in spawning time between individuals. This can be exploited in commercial production, as synchronization between individuals can be an advantage as staff efforts can be concentrated to a relatively short period. The results will be published in open sources. More research is needed to develop optimised protocols for implantation and/or injection of GnRH_a. The potential impact of GnRH_a implantation is that it offers a logistic advantage to the commercial broodstock management of the species, by reducing the spawning season. It may also be a useful tool to ensure that all females in a broodstock group reach maturation and ovulation, increasing parentage contribution to the next generation and increasing overall broodstock fecundity.</p>
<p>Comparison of production of Atlantic halibut fry in flow through (FT) and recirculation aquaculture system (RAS), and a metagenomic analysis of bacterial composition in water and larvae.</p>	<p>The purpose of this work was to compare recirculating aquaculture systems (RAS) to flow-through (FT) systems in producing Atlantic halibut juveniles. Currently, commercial production is carried out in FT, while there is a growing consensus that a RAS would offer more stable environmental and chemical water parameters that would lead to improved larval performance in terms of better survival and growth. The yolk sac and first feeding stages are performed in different rearing systems. RAS systems for yolk sac and first feeding stages were tested and a metagenomic analysis of bacterial composition in water and larvae was carried out. This can be exploited by the farming industry, as a means to improve stability and decrease use of antibiotics. All results will be published in open sources. It is not clear whether the intestinal microflora of Atlantic halibut larvae is determined by the feed or by water quality parameters and more research is needed both to optimise rearing systems and to identify bacteria with probiotic effect. The potential impact on commercial production is development of more stable and predictable systems, with better larval performance in terms of health, survival, growth and welfare. In addition, RAS can contribute to a more sustainable production as water consumption can be reduced.</p>
<p>Muscle and liver transcriptome in meagre to base future physiology, immunology and genetics studies.</p>	<p>The objective of this task was to characterise for the first time the muscle and liver transcriptome in meagre to base future physiology, immunology and genetics studies. This was performed through transcriptome sequencing and RNA-Seq which is one of the most applicable methodologies to date; the assembled transcripts were assigned to a wide range of biological processes including growth, reproduction and behavior. Construction of a genetic linkage map in meagre and preliminary QTL analysis: Through the ddRAD methodology, we constructed a genetic linkage map which included 731 markers organized in 27 linkage groups. Last, we completed a genome scan for QTLs that affect body weight (BW) and total length (TL) in fish from five full-sib families using the markers developed for the linkage map of meagre distributed across 27 linkage groups. Model mapping from the two larger families identified 5 QTLs on only two LGs (11 & 20) which exhibited significant evidence of linkage at the genome level. Multiple QTLs on LG20 seem to affect both BW and TL and are located at close positions, suggesting that the same genetic factors may control variability in these traits and are expected to be of great value in future Marker Assisted Selection (MAS) programmes. The data will enable breeding selection programs in meagre, thus enhancing the performance and sustainability of the industry.</p>
<p>A method for early weaning of Atlantic halibut larvae was developed, indicating the developmental stage at which larvae can be weaned and establishing a quantitative difference between how different feeds are accepted by the larvae.</p>	<p>The purpose of this study was to reduce the period of Artemia feeding in Atlantic halibut larvae and find the best weaning diet on the commercial market. The work on Atlantic halibut established a method for early weaning of larvae, indicating at which developmental stage larvae can be weaned and established a quantitative difference between how different feeds are accepted by the larvae. The results on feed quality confirm the existing industry experience. The industry can experiment with weaning at around 28 days after first-feeding, using the feed Otohime which was best accepted by the larvae. This is one step towards early weaning of Atlantic halibut larvae. The ability to use formulated feeds in larval rearing will lower costs and increase efficiency for commercial hatcheries.</p>
<p>DIVERSIFY has established that Artemia ongrown on Oriculture have a better nutrient profile than nauplii, however Atlantic halibut larval growth was not affected. Also, examined the dietary phospholipids (PL) needed in formulated feed for juveniles.</p>	<p>The objective of this study was to examine if in Atlantic halibut larval rearing, on-grown Artemia can be used to enhance growth and survival, and if addition of phospholipids (PL) improved growth and performance in juveniles. The results showed that on-grown Artemia fed on Oriculture had a better nutrient profile than nauplii, however larval growth was not affected. Pigmentation and eye migration in juveniles were almost 100% normal both with nauplii and on-grown Artemia. Our conclusion is that Artemia nauplii produced and enriched with modern methods have sufficient levels of nutrients to cover the requirements of Atlantic halibut larvae. Furthermore, DIVERSIFY has established that dietary PL in formulated feeds for Atlantic halibut juveniles (1 g, 9-31% PL of total lipid) did not affect growth, survival or lipid composition in muscle, liver or intestine 24 hours after a meal. In the intestine, 1 and 4 hours after the meal, there was a higher concentration of neutral lipids than at 24 hours, reflecting the absorption of fat. It appears that Atlantic halibut juveniles regulate their lipid species composition to be independent of the diet when a range of PL/TL as in the present study is applied.</p>
<p>Development of assays to measure</p>	<p>The development of assays to measure specific immunity (e.g. antibody titres) in fish will help future vaccine optimisation, by allowing the monitoring of</p>

specific immunity to assist in future vaccine optimisation, by allowing the monitoring of responses to validate vaccine efficacy.	responses to validate vaccine efficacy. Determination of immune responses post-vaccination is an important measure of the effectiveness of a particular vaccine, and a good adjunct to challenge studies where fish are directly exposed to a pathogen. Thus establishment of antibody assays helps vaccine development and potentially reduces animal use for challenge studies in the future. These antibodies will be commercialised via Vertebrate Antibodies Ltd, so both the research community and commercial vaccine development companies can have access to them.
Identification of immune genes in meagre and greater amberjack and a greater understanding of how they are modulated during development and after stimulation.	The advance in identification of immune genes and a greater understanding of how they are modulated during development and after stimulation will aid in the establishment/optimisation of methods to increase particular pathways during times of stress/challenge in meagre and greater amberjack, as seen with dietary immunostimulants (IS) in other species. Feed companies may use the obtained knowledge to allow screens of new products (e.g. functional feeds or IS containing feeds) for meagre or greater amberjack, to establish which are most useful to elevate immunity in these fishes. Better health will result in better growth and less mortality, thus improving the performance and profitability of the aquaculture industry.
Greater amberjack growth and size at first maturity.	The state of conservation of the greater amberjack population(s) in the Mediterranean Sea is unknown. Conservation measures for this species have been undertaken only in the USA. Fish growth rate and size/age at first sexual maturity are essential components of models used in stock assessment of fish populations. Therefore, the information on body growth and size at sexual maturity provided in DIVERSIFY will represent an important base of knowledge if any grey mullet fishery management measures will be undertaken at the EU or national level. Moreover, wild fish growth rate and size/age at first sexual maturity are essential basic information in aquaculture.
Grey mullet growth and size at first maturity.	The grey mullet is a widespread fishery resource worldwide, with no known major threats. However, fishery management measures are in force in Mexico and the USA. Fish growth rate and size/age at first sexual maturity are essential components of models used in stock assessment of fish populations. Therefore, the information on body growth and size at sexual maturity provided in DIVERSIFY will represent an important base of knowledge if any fishery management measures will be undertaken at EU or national level. Moreover, wild fish growth rate and size/age at first sexual maturity are essential basic information in aquaculture.
Greater amberjack broodstock susceptibility to handling.	The objective of DIVERSIFY in the area of Reproduction for greater amberjack, was to develop management methods that will enable the production of good quality eggs by captive broodstocks. Wild immature greater amberjack were collected from the fishery and were reared in sea cages to examine their reproductive cycle in captivity and to evaluate their maturation potential. It was found that handling of greater amberjack broodstock reared in the Mediterranean during early and advanced gametogenesis phase resulted in severe gametogenesis impairments, i.e. extensive atresia of vitellogenic follicles in females and reduced proliferation and increased apoptosis of germ cells in males. As a consequence of dysfunctional spermatogenesis, greater amberjack males produced low quality sperm. These results represent useful information in order to improve rearing technology of this species and minimize reproductive dysfunctions. In response to these results, a method for managing greater amberjack broodstock was developed and used successfully for the production of eggs during the course of DIVERSIFY.
A well balance and adapted broodstock diet for the specific nutritional requirements of greater amberjack during reproduction.	The objective of this work was to gain more knowledge on the nutritional requirements of greater amberjack breeder, in order to manufacture a specific and adjusted greater amberjack broodstock extruded diet. Captive-reared greater amberjack have been shown to suffer significant reproductive dysfunctions with impaired oogenesis and spermatogenesis. Data from the description of the reproductive cycle, based on the comparative evaluation of captive and wild fish gonads, liver and muscle, in terms of broodstock nutritional status and later from the results of the work on new DIVERSIFY diet for broodstock to optimize reproduction, DIVERSIFY confirmed a more stable and consistent composition of female gonads which denotes a more homogenous transfer of phospholipids, cholesterol and sterol esters but also of essential fatty acids (EFA) and carotenoids to the developing oocyte from the DIVERSIFY diet. Also, a diet containing 14-15 % EPA+DHA of total fatty acids (corresponding to 2.5-3 % in a dry diet) resulted in the best spawning performance in greater amberjack broodstock obtained as wild caught juveniles in the Atlantic Ocean (Canary Islands). Increasing dietary EPA+DHA contents did not improve spawning performance. In contrast, there seems to be some advantages on the reproductive status of young F1 greater amberjack broodstock fed a diet with higher contents of EPA+DHA (26.5 % of total fatty acids) and ARA and lower levels of 18:2n-6 and 18:1n-9. However these findings must be tested for a longer period since no spawning was obtained. The proposed Histidine contents in broodstock diets is 1 to 1.5%. Taurine in broodstock diets was shown to increase the reproductive performance of greater amberjack. This foreground can be exploited by feed manufacturers producing broodstock diets for marine fish. A well balance and adapted diet to the specific nutritional requirements of greater amberjack breeders would contribute to optimize reproduction and spawning quality. Further research needed: specific and deeper analysis of polar lipids have been carried by DIVERSIFY partners to confirm a potential correlation of the dietary deficiency of specific nutrients and a lower production of vitellogenin receptors at early gametogenesis Since in captive reared females and males reproductive dysfunction occurs during the early gametogenesis --coinciding with the gonadal deficiency of specific lipid classes and essential fatty acids-- a long term trial by testing the new formulated diet is needed to ensure that all these nutrients are available to be mobilized in time for

	reproductive success.
Spawning induction protocol of hatchery-produced greater amberjack in the Atlantic based on GnRH α implants.	The objective of the work was to examine if hatchery produced (F1) greater amberjack breeders of the Atlantic stock undergo proper gametogenesis and are able to be induced to spawn and produce fertilized eggs. The developed reproduction control method shows great potential to advance the commercial production of greater amberjack, by enabling the use of hatchery-produced broodstocks for further breeding selection. The technology could be applied in the industry immediately.
Methodology for large-scale production of wreckfish eggs obtained from broodstock kept in captivity	Lack of reproduction control and of established larval rearing protocols have been the major bottlenecks preventing wreckfish aquaculture so far. Limited egg collection has been achieved from captive spawners using hormonal induction or stripping of naturally maturing fish. The objective of DIVERSIFY was to study the reproductive function of the species in captivity and produce fertilized eggs. Four different broodstocks with variable number of breeders collected as juveniles from the wild were maintained in research facilities in Greece and Spain. The results from DIVERSIFY showed that wreckfish females can adapt to captivity, mature and produce eggs both under fluctuating natural and under constant low temperatures. In response to the new specific broodstock diet developed during DIVERSIFY, better maturation of broodstocks has been observed, leading to improved fecundity and egg quality. Although spawning induction methods were developed and resulted in the production of fertilized eggs, it was concluded that spontaneous spawning offers the best option for the production of high quality eggs over a long period of time in this species, so efforts should focus on exposing the broodstock to the optimal rearing conditions (environmental and nutritional). The impact of this foreground is that from now on egg production is not a limitation in the efforts for the domestication of wreckfish and the development of larval rearing.
Computer Assisted Sperm Analysis (CASA) for greater amberjack, grey mullet, meagre and wreckfish sperm	The objective of this work was to develop a reliable, objective and rapid method/tool for the evaluation of sperm quality in the studied fishes. The method was based on the use of Computer Assisted Sperm Analysis (CASA) software. For the four mentioned species the foreground is a starting point description of sperm that shows significant variations according to species, season and husbandry or treatment. This pool of original objective data can be used by scientific institutes, as well as industrial end users for the assessment and understanding of external factors in aquaculture, as well as for the assessment of human progress in the control of fish reproduction. The best adapted CASA parameters for sperm analyses were determined and reported to end users to optimize their abilities to check fertility potential of the semen in the course of their future spawning induction experiments. A movie describing the procedure of sperm activation and CASA analysis was prepared and made available on the website of the project.
Methodology for egg incubation and larval rearing of wreckfish.	Due to the characteristics of wreckfish eggs (~2 mm in diameter), important changes were made in the methodology and technology of incubating their eggs. With these modifications, high hatching rates and improvements in larval quality were achieved, with fewer problems caused by deformities and better survival. The methodology of the larval culture was adjusted based on the data obtained on larval development of the digestive tract and vision. Adjustments in the feeding sequence and the environmental conditions of the culture have increased larval survival until weaning and the juvenile phase. A larval feeding sequence was defined based on live feed (rotifer and Artemia) until weaning with inert feed (commercial feed).
Sperm storage conditions were established for meagre and wreckfish based on the objective assessment of sperm quality.	The main goal of this foreground was to provide a short and long-term storage method (cryopreservation) for sperm of meagre and wreckfish. The work described the media and improved fertilizing protocols (dilution rate, type of straw and cooling rate), and in the case of meagre the concentration of thawed sperm maximizing fertilization success. To allow the use of parts of a same fish ejaculate in similar conditions, conservation of sperm must be optimized. For this, the use of a modified cell culture medium (Leibovitz L15) as a cryoprotectant and an adapted temperature decrease until -196°C allowed excellent recovery of sperm motility in both species. The protocol was also perfectly efficient in meagre in terms of sperm ability to fertilize. The method has been already transferred to and used by a private hatchery (outside the DIVERSIFY consortium) who participated in the experiments and final workshops. The cryopreservation is already used for large factorial crosses in genetics for scientific and industrial purposes in meagre. This foreground will have a significant positive impact in the implementation of breeding selection programs.
Diagnostic and recommendation manual for meagre describing all major diseases and health-related issues studied and recorded during the course of DIVERSIFY project.	The objective of this Technical Manual for Meagre Health was to describe all major diseases and health-related issues studied and recorded during the course of DIVERSIFY. One of the major obstacles of integrating a new fish species into the commercial rearing procedures and production is the emerging and new pathologies that may arise. The manual is organized in chapters describing the major diseases of the species with original photographic material, epidemiological and pathological data. It is divided in two sections; the first, containing the non-infectious diseases that have been studied within DIVERSIFY --namely Systemic Granulomatosis and Chronic Ulcerative Dermatopathy. The second, included infectious diseases from Nocardia and other bacteria, as well as parasites such as Sciaenacotyle panceri and Diplectanum sciaenae. The manual is based on the findings obtained during the course of the project and is compiled from input from all participating partners. It has been published in electronic format (pdf file) and uploaded in the project website, and has been freely available for the public. The manual should have a significant positive impact in the development of the aquaculture industry for this new species.

<p>Diagnostic and recommendation manual for greater amberjack describing all major diseases and health-related issues studied and recorded during the course of DIVERSIFY project.</p>	<p>The objective of this Technical Manual for greater Amberjack Health was to describe all major diseases and health-related issues studied and recorded during the course of DIVERSIFY. The manual is divided in two sections; the first, containing the bacterial diseases that have been studied within DIVERSIFY, and the second, dealing with parasitic diseases from <i>Zeuxapta seriolae</i> and <i>Neobenedenia girellae</i>. The manual is based on the findings obtained during the course of the project and is compiled from input from all participating partners. The manual has been uploaded at the website of the project as a pdf that can be downloaded freely. This manual is a practical diagnostic tool and recommendation guide for greater amberjack health issues targeted to fish health specialists and aquaculture scientists and producers. The manual contains original photographic material, epidemiological and pathological data. The manual should have a significant positive impact in the development of the aquaculture industry for this new species.</p>
<p>Technical manual for meagre, providing information obtained during DIVERSIFY, relevant to the acquisition of new broodstock, broodstock management and control of reproduction, nutrition, larval rearing and grow out husbandry.</p>	<p>The meagre has attractive attributes for the market that include large size, good processing yield, low fat content, excellent taste and firm texture. The species also has the biological characteristics required for commercial aquaculture using well-established culture technologies. The purpose of the present Technical Manual, is to provide information obtained during DIVERSIFY, relevant to the genetic diversity of available stocks, management and control of reproduction, nutrition, larval rearing and grow out husbandry. Data obtained indicates that generally the genetic variation in captive broodstocks is adequate to form a base population. Paired spawning protocols, as well as in vitro fertilization methods have been developed in order to enable the implementation of breeding selection programs. Larval and juvenile nutrition was examined, and an effort was made to speed up weaning to artificial diets. The establishment of well-balanced diets that meet nutrient requirements is important to optimize a large-scale production of new aquaculture species. A feeding trial was performed with meagre fingerlings (2.8 g ± 0.23) testing 5 increasing dietary n-3 LC PUFA levels (0.8, 1.4, 2.0, 2.6 and 3.6% DM) with the purpose of evaluating the n-3 LC-PUFA requirements for fast growth of meagre fingerlings. Meagre reflected very high specific growth rates (4.1 to 4.6%) and low feed conversion ratios (0.7 to 0.8), thus highlighting its great potential for aquaculture production. Fish fed 0.8% n-3 LC PUFA showed the lowest growth, which was significantly improved by increasing the dietary n-3 LC PUFA levels up to 2.0–2.6%. DHA and ARA were preferentially retained over EPA in whole fish body. Fish fed 0.8% n-3 LC PUFA showed an up-regulation of <i>fads2</i> and <i>elov15</i> relative gene expressions. Thus, meagre seems to have active $\Delta 6$ desaturases and <i>Elovl5</i>, but their activities being insufficient to produce DHA and EPA from PUFA precursors to sustain fast growth, at least under the experimental conditions tested. Young meagre shows a typical marine requirement for n-3 LC-PUFA, estimated to be, at least, 2.0% DM of the diet. Significant effort has been made to study the effect of sea cage rearing conditions on performance and welfare. Feeding behavior was documented in order to develop methods to optimize feeding and performance in sea cages. The first step was to test in tanks whether meagre responds to different feeding stimuli (mechanical, optical, etc) and also to test different feeding methods. The second step was to test in cages different feeding periods related to the presence of light (day-night) and also different feed distribution methods. The third step was the comparison of automatic and demand type feeding in tanks for a production cycle. Comparison in each season of the year of (a) demand feeding and (b) feeding with automatic feeders programmed to follow the feeding routines that are used customarily in meagre cage farms. The information contained in the manual is targeted towards commercial operations, that are interested in improving the performance of meagre in their facilities, both by improving husbandry methods, but also by implementing breeding selection programs.</p>
<p>Technical manual for greater amberjack, providing information obtained during DIVERSIFY, relevant to broodstock management and control of reproduction, nutrition, larval rearing and grow out husbandry.</p>	<p>Greater amberjack is a leading candidate species for enhancing European aquaculture, showing growth rates ten times higher than the European seabass. The objective of this manual was to present to potential farmers the majority of relevant production methods obtained in DIVERSIFY, and we believe it would prove to be a valuable resource for the incorporation of greater amberjack in the Mediterranean aquaculture industry. The manual contains information on broodstock management, nutrition and reproduction control for the production of fertilized eggs. It includes protocols for the larval rearing of greater amberjack and information on larval nutrition, ontogeny of the digestive and vision systems, and a proposed industrial protocol for the intensive production of juveniles. Information is also included on the grow out husbandry information obtained, including feeding and rearing methods. Although this manual does not include all the possible information that a farmer may need for the successful rearing of this new species, we believe it would have a significant positive impact on the effort of the industry to incorporate greater amberjack in its production.</p>
<p>Technical manual for pikeperch, providing information obtained during DIVERSIFY, relevant to broodstock genetics, nutrition, larval rearing and grow out husbandry.</p>	<p>Pikeperch is considered to have the highest potential for inland aquaculture diversification in Europe. The major bottlenecks for further expansion of pikeperch culture are (a) high sensitivity to stressors, handling and husbandry practices that result in high and sudden mortalities, (b) low larval survival (typical 5-10%) and high incidence of deformities and (c) lack of knowledge of the genetic variability of the used broodstocks. Therefore, work in DIVERSIFY reported in this manual includes the use of genetic markers to evaluate population genetic parameters (allelic richness, heterozygosity indices, inbreeding coefficients) in captive broodstocks from commercial farms and compare them to those estimated in wild pikeperch populations. The main conclusion of the study is that the majority of the populations shows medium to low levels of genetic diversity and some of them may suffer from inbreeding, while heterozygosity and allelic richness are not significantly different between wild and domesticated populations. Understanding the factors that create elevated stress in this species and the mechanisms around, will lead to better designed systems, where fish will thrive better. Therefore, in the area of larval and juvenile husbandry, multifactorial design studies have evaluated the combined effects of a number of environmental, nutritional and population variables, and</p>

	<p>a commercial rearing protocol has been proposed. A new optimised diet can be used by pikeperch hatcheries and farmers to optimise growth and survival and reduce deformities of produced fingerlings. The pikeperch manual was already translated into a number of other languages, in addition to English, and the knowledge provided will improve the industry. The foreground will be a tool for the farmers that are growing pikeperch to get better performing systems and with a higher and more stable yield. If further improvements are done, and the growing conditions for juvenile pikeperch and the supply of fingerlings becomes stable, this is a sector with great potential, where annual production can lead for the whole of Europe up to around 10,000 ton.</p>
<p>Technical manual for Atlantic halibut, providing information obtained during DIVERSIFY, relevant to broodstock performance and control of reproduction, larval rearing and nutrition and vaccine development.</p>	<p>The Atlantic halibut is highly prized at markets worldwide, but availability of wild fish is decreasing. Norwegian stocks are classified as viable, but fisheries are subject to strict regulation. This has led to a higher market demand for Atlantic halibut than cannot be met by fisheries alone. The manual produced by DIVERSIFY has generated knowledge with commercial applications for Atlantic halibut. These results are in the fields of reproduction and broodstock management for the acquisition of consistently high quality eggs, as farm still rely on the use of wild-caught breeders. Also work in nutrition and larval husbandry has produced results that are important for the production of robust juveniles. The results will help to improve the efficiency of production and overcome past production bottlenecks.</p>
<p>Technical manual for wreckfish, providing information obtained during DIVERSIFY, relevant to broodstock acquisition, description of the reproductive cycle, broodstock management and nutrition, induction of spawning and larval rearing and nutrition.</p>	<p>Wreckfish is a deep-water fish found almost throughout the world and is one of the largest Serranid species, reaching a size of 100 Kg. It acclimatizes easily to captivity, accepts inert food easily and wild-caught individuals were shown to grow from 1 kg to 5 kg in a period of 10 months. Lack of reproduction control and of established larval rearing protocols have been the major bottlenecks preventing wreckfish aquaculture so far. Therefore, in the present Technical Manual, we provide all the information obtained during DIVERSIFY, relevant to the acquisition of new broodstock, broodstock management and control of reproduction, nutrition and larval rearing. This information is targeted towards commercial and research organizations, that are interested in investigating the potential of wreckfish for aquaculture. Although spawning has been achieved and larval rearing resulted in the production of a small number of juveniles, the available expertise is not considered adequate for the commercial exploitation of wreckfish in aquaculture. We expect that the knowledge acquired by DIVERSIFY will encourage further research efforts for the domestication of this fish with a very high potential for the aquaculture industry.</p>
<p>Technical manual for grey mullet, providing information obtained during DIVERSIFY, relevant to broodstock management and control of reproduction, larval rearing, nutrition and grow out husbandry.</p>	<p>Farming of grey mullet has been practiced for centuries worldwide, but production of this potentially invaluable source of animal protein in Europe has been small and non-intensive. It is a euryhaline species, found throughout the world and is a rapid-growing, omnivorous teleost that can be reared over the wide geographical and temperature range of the Mediterranean basin. Therefore, it can be an excellent candidate for the enhancement of aquaculture in earthen ponds and coastal lagoons and estuaries that exist throughout the EU Mediterranean countries. DIVERSIFY addressed the major bottlenecks for the development of a true aquaculture industry for the species, one that will not rely on the acquisition of wild juveniles. The manual includes information on methods for controlling the reproductive cycle and improving egg quality via broodstock management and nutrition. This is necessary not only for the production of robust larvae, but also for producing high value bottarga (egg row), which is an important value added production of grey mullet culture. Information is also included on the development of a larval rearing protocol, which is necessary to reduce early mortalities, size dispersion as well as increasing metamorphic synchrony, which will lead to a supply of high quality juveniles. Finally, results are presented from the efforts to develop a sustainable, economical, fish meal-free grow out feed, which would perform well under different environmental conditions of temperature, pond type, and water quality, thus broadening the geographical range of grey mullet aquaculture in Europe. Although further research is needed to establish mono culture methods for grey mullet, and to optimize feeding methods and diets, the manual includes important information that a farmer interested in producing juveniles of this new species, and we believe it would have a significant positive impact on the industry.</p>
<p>A new dry food specifically formulated for wreckfish broodstocks.</p>	<p>The nutritional requirements of wreckfish were unknown so far and there were only a few references related to feeding habits from commercial captures. The development of broodstock diets for wreckfish is essential for the future of the aquaculture of this species. Dietary lipids and especially fatty acids play a critical role in the successful production of high quality gametes and eggs of marine fish. Therefore, the objective of this foreground was to develop a new dry food formulated specifically for wreckfish broodstocks. We first studied the biochemical composition of some tissues of wild wreckfish and compared it to the biochemical composition of tissues of captive-reared wreckfish, in order to establish the target nutrient composition of a new diet. Then we examined the biochemical composition of different broodstock feeds with special attention to the fatty acid contents. Then we evaluated the effect of different feeding regimes based on fresh and commercial dry feeds on oocyte and egg fatty acid composition. Finally, once the new broodstock diet was formulated, the effect of feeding regimes on fecundity, and egg and sperm quality was evaluated. The first results obtained about the relative fecundity (eggs/Kg of female) and number of spawns of females fed with different diets show that those fed with the new dry food have the highest fecundity and the largest number of spawns per female. We expect that the development of this specific dry food for wreckfish broodstock will contribute to the better maturation of wreckfish leading to improve quality and quantity of eggs.</p>

<p>A larval rearing protocol for pike perch, based on an optimal combination of environmental, feeding and population factors.</p>	<p>Until now several bottlenecks have prevented the success of the rearing of the pikeperch larvae. Three major bottlenecks have been identified: (1) high mortality due mainly to cannibalism, (2) high rate of deformities and (3) a large size heterogeneity between larvae cohorts at various ontogenic development stages. The objective of this foreground related to the use of a pilot scale larval rearing system based on RAS and based on existing protocols used by the SMEs, to undertake successive experiments using factorial designs. These factorial designs are efficient methods to successfully optimize larval protocols. This methodology allows (i) to integrate the effects of each simple factor tested and interactions between them, (ii) to rank and evaluate the effects induced by factors or interactions, (iii) to identify rapidly an optimal combination of factors that increase larval survival, and (iv) to establish a first modeling of the complex multifactorial determinism of output variables. Here we examined the effects of the light intensity (5 or 50 lx), water renewal rate (50 or 100% per hour), water current direction (at the bottom or the surface of the tank) and time of tank cleaning (morning or afternoon). The developed protocol can be used by fish farmers of new projects related to pikeperch culture, especially for the design of hatchery - nursery facilities and buildings. It will also help them to elaborate their business plan, because we have quantified the production cost of a juvenile using this system.</p>
<p>Dietary lysine requirements for greater amberjack juveniles.</p>	<p>The high dependency of the aquaculture sector on fish meal and fish oil produced from wild fish as protein and fatty acid sources in the feeds is questioning its sustainability and has a negative impact on world fisheries. This has indeed led to a definite shift in the European aquaculture industry with a major emphasis on the use of plant-based aqua feeds (terrestrial plants or plant by-products) and other alternative fish feeds without affecting productivity, besides addressing issues of nutritional value, food safety or environmental impacts. Knowledge of essential amino acids (EAA) requirements is of paramount importance in order to reduce the actual reliance on fishmeal for greater amberjack feeds. Data on EAA requirements are mostly important for the correct evaluation of alternative plant protein sources to fishmeal as these are usually deficient in one or more EAA. Indeed, diets in which EAA and protein levels meet - but do not exceed - the requirements are key factors to improve protein utilization for growth, therefore reducing nitrogen waste. The objective of this foreground is the presentation of the minimum lysine requirements of greater amberjack during early juvenile rearing. The data on dietary lysine requirements presented in the current study will be useful in developing balanced commercial diets for greater amberjack, particularly when fishmeal is replaced by plant protein blends.</p>
<p>Information to manufacture grow out extruded diets for greater amberjack, meagre, mullet and pike perch, that will optimize flesh nutritional value.</p>	<p>The purpose of this foreground was to improve our general knowledge necessary to attain a sustainable and properly labelled final product, of high sensory and nutritional qualities in any of the DIVERSIFY selected species. The results obtained provide a general advancement of knowledge on the effect of available commercial diets on greater amberjack, meagre, mullet, and pikeperch development and flesh final nutritional quality. The results from monitoring the technical quality of the final products from these species (harvested fish), displayed a specific dossier per fillet product, including protein, fat and w-3 contents taking into account the fish origin, the rearing conditions and the feeding regimes of the four species. The foreground can be exploited by farmers, feed manufacturers and marketing experts. Since the assayed commercial diets are not adapted to the nutritional requirements of the species, it is a clear objective to continue the collaboration among all DIVERSIFY's partners, including nutritionists and any other aquaculture specialist, sensory evaluators, farmers, feed producers and marketing experts, in further research to optimise the final product quality. The identification and use of sustainable, nutritious and balanced ingredients to ensure a stable and high quality and sustainable final product must be a priority in European Aquaculture.</p>
<p>Functional diet for greater amberjack to reduce the infestation of external parasites.</p>	<p>The objective of this study was to determine the effect of two forms of mannan oligosaccharides (MOS: Bio-Mos® and cMOS: Actigen®, Alltech Inc, USA) and their combination on greater amberjack (<i>Seriola dumerili</i>) growth performance and feed efficiency, immune parameters and resistance against ectoparasite (<i>Neobenedenia girellae</i>) infection. Fish were fed for 90 days with 5 g/kg#1 MOS, 2 g/kg#1 cMOS or a combination of both prebiotics, in a greater amberjack commercial diet (Skretting, Norway). At the end of the feeding period, no differences were found in growth performance or feed efficiency. Inclusion of MOS also had no effect on lysozyme activity in skin mucus and serum, but the supplementation of diets with cMOS induced a significant increase of serum bactericidal activity. Dietary cMOS also reduced significantly greater amberjack skin parasite levels, parasite total length and the number of parasites detected per unit of fish surface following a cohabitation challenge with <i>Neobenedenia girellae</i>, whereas no effect of MOS was detected on these parameters. Of 17 immune genes studied cMOS dietary inclusion up-regulated hepcidin, defensin, Mx protein, interferon-γ (IFNγ), mucin-2 (MUC-2), interleukin-1β (IL-1β), IL-10 and immunoglobulin-T (IgT) gene expression in gills and/or skin. MOS supplementation had a larger impact on spleen and head kidney gene expression, where piscidin, defensin, iNOS, Mx protein, interferons, IL-1β, IL-10, IL-17 and IL-22 were all upregulated. In posterior gut dietary MOS and cMOS both induced IL-10, IgM and IgT, but with MOS also increasing piscidin, MUC-2, and IL-1β whilst cMOS induced hepcidin, defensin and IFNγ. In general, the combination of MOS and cMOS resulted in fewer or lower increases in all tissues, possibly due to an overstimulation effect. The utilization of cMOS at the dose used here has clear benefits on parasite resistance in greater amberjack, linked to upregulation of a discrete set of immune genes in mucosal tissues, and could have a positive impact on the profitability of the industry, by reducing mortalities and enhancing growth.</p>
<p>A large variety of specific pro</p>	<p>The purpose was to diversify, besides fish species, also products, market alternatives, in order to expand aquaculture market in the EU. Specific suggestions</p>

<p>cessed product ideas have been generated as well as specific selected physical products derived from these ideas have been created and tested for their nutritional value and sensory quality and are available to be exploited / produced by fish processing industry.</p>	<p>in relation to the ideal conditions for processing and storing/commercializing and optimization of quality have been suggested. The processing technology for all proposed ideas / products exist. Thus, implementation can be immediate in many cases. This means that fish processors can directly use this information for producing the products subject to the availability of adequate quantities of raw material (fish fillets) produced by fish farming. Further research in this foreground would include fine-tuning optimization of product processing, specific freshness and quality issues related to the new species and products, optimization of processing techniques. The expected impact is boost of product variety available for European consumers, the potential for increase of local EU production and decrease of imports (percentage to be achieved is subject of further market research), economic boost in the branch of fish processing especially for SMEs and companies producing special-niche products (delicacies, local name-of-origin fish products such as bottarga). The information provided by the study of European consumers acceptance of these aquaculture products can be used by producers associations, government, etc to promote marine fish cultured species.</p>
<p>Consumer value perceptions and behavioral change in order to comprehend overall value perceptions of consumers with regard to aquaculture fish in general and the DIVERSIFY fish species in particular, to undertake a value-based segmentation study, to evaluate consumer sensory perceptions of the newly developed products, and to optimize the newly developed products in terms of ideal intrinsic-extrinsic product attribute combinations.</p>	<p>The objective of the study on "Consumer value perceptions and behavioral change" was to comprehend overall value perceptions of consumers with regard to aquaculture fish in general and the DIVERSIFY fish species in particular, to undertake a value-based segmentation study, to evaluate consumer sensory perceptions of the newly developed products, and to optimize the newly developed products in terms of ideal intrinsic-extrinsic product attribute combinations. The segmentation results showed that the future of aquaculture is less dependent on geography and more dependent on consumer lifestyles and their psychographic profiles. The results on overall acceptability and preference of DIVERSIFY products showed that products with lower degree of processing generate higher overall acceptability of the consumer, while products having a higher degree of processing are more appropriate for consumers who do not like fish. The experimentation with newly developed product mock-ups from DIVERSIFY fish species showed that use of ASC label to signal consumers that products come from a "controlled", certified and responsible aquaculture source increases the probability of consumers' choice. For the general public, the use of nutrition and health claims helps EU consumers to make more informed choices, aligned with their preferences, stimulating health-related behavior. The evaluation of communication effectiveness showed that use of specific messages that promote unique production process and increase visibility of products as being traceable, healthy and tasty alternatives for modern diets increase consumer acceptance of Diversify products. In addition to the area A3.2 Aquaculture, the results obtained in these areas can be exploited further in areas of M72.2.0 - Research and experimental development on social sciences and humanities, M73 - Advertising and market research, M73.1 – Advertising, M73.2 - Market research and public opinion polling.</p>
<p>Feasibility studies and business models for grey mullet, pikeperch, greater amberjack and Atlantic halibut.</p>	<p>The objective of the work in this area was the acquisition of the relevant information from consumer research/virtual markets, to enable the aquaculture industry producing the new/emerging species included in DIVERSIFY to better target and determine value proposition of products and develop business models for the new species. Since the data pertains to the five main EU target markets, companies working in or aiming for these markets will benefit to great extent. The foreground knowledge can be exploited by suppliers of the new species/farmers. This was already taking place for insights regarding business models and supply chain relationship development insights (e.g. Portuguese firms aiming to introduce meager in the market benefited from market data provided by DIVERSIFY). Providers/farmers and investors can profit from this. Particularly those currently working in this area or those considering expanding in this direction. For the species that require more development, predictions/specification of business models are still limited and open to change. More work here will be required in the near future. Similarly we anticipate providers/farmers and their business partners can use the information about market predictions and (international) launch strategies for the new species and their products. Current results focused on greater amberjack and thus benefit firms involved in further developing and marketing this species. However, more work is needed to demonstrate generalization to the other species. The data /information is directly applicable and useful and should benefit suppliers and channel members trying to commercialize these products. Extra work using actual products and test markets would be useful, and might include studies on how to better protect competitive advantage after entering the market (e.g. via some forms of collaboration/cooperation and branding).</p>
<p>Development of a web based application for virtual store testing.</p>	<p>The purpose of this foreground was to enable the conduct of various types of experimental tests. The participants to these tests are buyers who purchase in a web simulated context. The specific product could be used for various marketing research applications by marketers and the market research experts.</p>
<p>Advances in the knowledge of nutritional requirements of wreckfish larvae.</p>	<p>Very little knowledge on the larval rearing of wreckfish was available at the start of DIVERSIFY. Identification of nutritional requirements during live prey feeding stages, particularly those related with n-3 LC PUFA would help to formulate specific diets for this species improving larval survival. The objective of the present work was to develop enrichment media for the live food necessary for the larval culture of wreckfish. Advances in the knowledge of nutritional requirements of wreckfish were obtained. Two new live food enrichment products for feeding larvae were developed and these products had a good acceptance by wreckfish larvae. The development of live food enrichment products will contribute to better nutritional regimes for larvae leading to a higher production and a good commercialization of this species in the future.</p>

Formulation of an adjusted live prey enrichment product for greater amberjack larval nutrition.

Elevated mortality during early stages and high occurrence of skeletal anomalies are major concerns in greater amberjack juvenile production. Identification of nutritional requirements during live prey feeding stages, particularly those related with n-3 HUFA would help to formulate specific diets for this species improving larval survival and reducing skeletal anomalies. The purpose of this studies were to improve the unreliable production of juveniles by the formulation of new and specific live prey enriching products. A specific formulation and protocol to enrich rotifers was prepared and tested based on the lipid profiles and carotenoids contents of greater amberjack female gonads and eggs, resulting in an improvement of the species larval performance compared to tested commercial enriching emulsions. Larvae were reared from 17 to 35 days post hatching (dph) and were fed Artemia containing five different n-3 HUFA levels from 2.7 to 20.5% TFA. Growth, survival, skeletal anomalies occurrence and larval biochemical composition were determined. Best growth, final survival and survival after air stress test were achieved in the range of dietary n-3 HUFA concentrations, between 5 and 20%TFA. The lowest occurrence of skeletal anomalies was achieved in fish fed 12% n-3 HUFA content in Artemia, and the occurrence of cranial anomalies was correlated to increased dietary n-3 HUFA levels. Besides, whole body larval fatty acid profiles showed a positive correlation with dietary n-3 HUFA. Based on the overall results the recommended n-3 HUFA dietary level during Artemia feeding for larval greater amberjack was suggested between 12 and 17% TFA. The foreground may be exploited by manufacturers of live prey enriching products (feed manufacturers). Further research needed includes the collaboration with a commercial manufacturer to prepare a complete formula that will also include other nutrients, since the rotifer experimental enrichment emulsion examined only based lipids and carotenoids.

4.3 Report on societal implications

B. Ethics

1. Did your project undergo an Ethics Review (and/or Screening)?	No
If Yes: have you described the progress of compliance with the relevant Ethics Review/ Screening Requirements in the frame of the periodic/final reports?	
2. Please indicate whether your project involved any of the following issues :	
RESEARCH ON HUMANS	
Did the project involve children?	No
Did the project involve patients?	No
Did the project involve persons not able to consent?	No
Did the project involve adult healthy volunteers?	No
Did the project involve Human genetic material?	No
Did the project involve Human biological samples?	No
Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
Did the project involve Human Embryos?	No
Did the project involve Human Foetal Tissue / Cells?	No
Did the project involve Human Embryonic Stem Cells (hESCs)?	No
Did the project on human Embryonic Stem Cells involve cells in culture?	No
Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
Did the project involve tracking the location or observation of people?	No
RESEARCH ON ANIMALS	

Did the project involve research on animals?	Yes
Were those animals transgenic small laboratory animals?	No
Were those animals transgenic farm animals?	No
Were those animals cloned farm animals?	No
Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	
Did the project involve the use of local resources (genetic, animal, plant etc)?	No
Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	No
DUAL USE	
Research having direct military use	No
Research having potential for terrorist abuse	No

C. Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

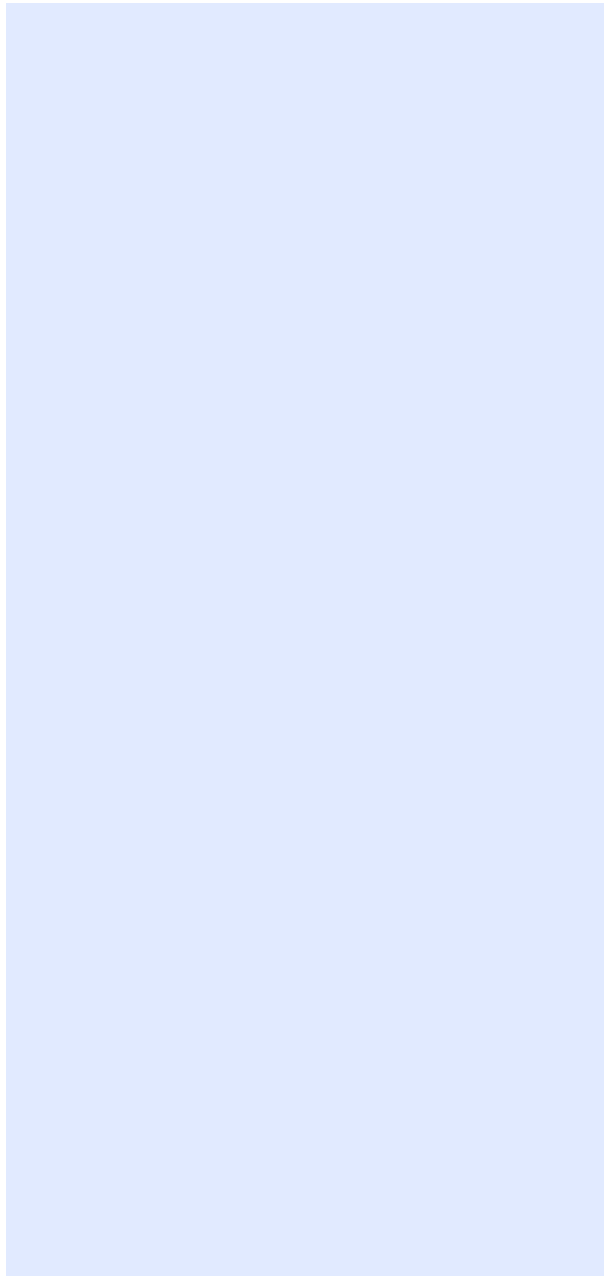
Type of Position	Number of Women	Number of Men
Scientific Coordinator	15	24
Work package leaders	7	17
Experienced researchers (i.e. PhD holders)	31	47
PhD student	14	8
Other	83	100

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	44
Of which, indicate the number of men:	22

D. Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project ?	Yes
6. Which of the following actions did you carry out and how effective were they?	
Design and implement an equal opportunity policy	Very effective
Set targets to achieve a gender balance in the workforce	Not Applicable
Organise conferences and workshops on gender	Not Applicable
Actions to improve work-life balance	Not Applicable
Other:	<p>(For a properly formatted version of this section, please see the uploaded attachment "DIVERSIFY Final Report Appendix I.pdf"). Although gender equality in the European work force has been advocated as a core policy since 1957 (Rome treaty), the reality is different. During FP5 and FP6 women were systematically under-represented in research projects. For FP7, the EU has set a target of at least 40% women participation at all levels of research in order to encourage equal opportunities under gender sensitive working conditions. It is worth mentioning that Aquaculture (especially land-based hatcheries) is among the industrial and scientific activities with a greater presence of women. In DIVERSIFY, several issues will be addressed regarding equal participation of women as RTD researchers and SME staff, and a commitment to use gender-impartial language will be made. Particular attention will also be given to gender-sensitive issues when organising the project, such as scheduling annual meetings that require mobility. Work from men and women will be valued equally. In the current project women participate as Species Leaders (2 of 6; IRTA and IMR), Group Work package Leaders (3 of 8; FCPCT, LEI and CTAQUA), Work package Leaders (12 of 31; from FCPCT, IRTA, DLO/LEI, IMR, NIFES, CTAQUA, CMRM) and the Principle Investigators in charge for the Partners (10 of 38; FCPCT, IRTA, DLO/LEI, IMR, ULL, NIFES, CTAQUA, CMRM, ANFACO, HRH). In terms of Researchers and Technicians, the overall participation of women in all the work packages is 42.5%. Several of the participating institutions (Partner No 1, 2, 3, 4, 5, 7, 13, 14, 15, 20, 21, 22, 25) have policies targeting gender equity at work. The hiring process for new personnel (technicians, graduate students, post-doctoral fellows) will be based on equal gender opportunity in order to contribute to the advancement of women in post-doctoral and top decision-making positions. The SMEs</p>

participating in this proposal employ women, mainly in land-based facilities in activities that include broodstock management, live food production, hatchery, nursery and pathology. Finally, when performing the consumer demand studies, results will be presented by gender and when required they will be analysed separately. In an attempt to perform gender-sensitive research, the scheduling and organizing of meetings and other activities requiring mobility take into account gender issues and places for such activities are chosen taking into account not only practical logistics, but also requests from parents with limited mobility. As proposed during the proposal stage, DIVERSIFY has appointed Dr. Ana Roque from P3. IRTA to deal with gender issues, should they arise. With that in mind, Dr. Ana Roque prepared a questionnaire and sent it to participating Partners to find out whether participating researchers, especially women have limited availability to travel and which time of the year and for how long is convenient to travel. We have obtained 24 individual responses from female researchers from 20 partners. Below are the questions and the responses obtained: Q1: Do you feel there are gender inequality issues that have not been addressed during the definition of the roles and tasks of each participant of the DIVERSIFY project? All female participants replied “No” Q2: Within the DIVERSIFY project we have as Species leaders 2 female participants out of 6, as Group Work Package leaders 3 female participants out of 8 and as Principle Investigators 11 female participants out of 38. Do you think this is because of : • Interest - 4, Out of the 25 female participants who answered the questionnaire 4 think (opinion) the reason was female participants were not interested in undertaking these responsibilities • Will – 9 female participants simply don’t want to do it • Freedom – 6 female participants don’t have enough freedom to do it • Confidence – 2 female participants are not confident enough to do it • Qualities - 0, nobody doubts that female participants are well qualified to perform these roles Q3: As a participant in the DIVERSIFY project, can you travel anytime of the year? • Yes - 15 female participants can travel when they want • No – 5 female participants cannot travel anytime of the year • Some female participants did not answer this question Q4: How easy is it for you to organize your trip? • Entirely personal decision - 9 female participants stated they do not need to consult with anybody • Need to arrange with Spouse/ Partner - 12 female participants stated they need to consult with others • Need to consider their dependents - No female participant needs to arrange directly with dependents Q5: How long could you travel away for the needs of DIVERSIFY? • 1 day - 2 female participants can go for a 1-day



activity • 3 days - 3 female participants can go for a 3-day activity • 7 days - 9 female participants can go for a week-long activity • 30 days - 6 female participants can go for more than 1-month activity Q6: How many meetings of the project do you see yourself attending? • 0 meetings - 3 female participants state they will not attend any meeting of the project • 1 meeting - 2 female participants will attend one meeting • 3 meetings- 3 female participants will attend meetings • All-12 female participants will attend all meetings Q7: If the answer above was not “all of them”, why? • Because of the dates of the meetings • Because the female participant responding is not the Partner’s Principle Investigator • Because of budget limitations Q8: If the answer to the above was “None”, why? Here 2 answers were due to the fact that the female participant responding is a technician and the other because the female participant has a small participation in the project compared to her colleagues. Q9: Do you have any comments regarding Gender Issues in DIVERSIFY? We obtained only the 6 comments below: - In DIVERSIFY there are a lots of partners, so it is difficult for me to evaluate some aspects about Gender Issues. - I think that this project have gender equity in general. - Question Q2 should contain information about how many researchers are in DIVERSIFY and sex proportions. I have the impression that we are less women than men and this could be the reason why there are less leader women. - Yes. I think the survey is discriminatory because is only for women, should be addressed to men as well. - This questionnaire should be applied to all. - In the project as such, I do not see that there are a lot of issues. There might be issues in some of the groups, but I am not sure what would be the best way to address this.

7. Was there a gender dimension associated with the research content - i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

Yes

If yes, please specify:

(For a properly formatted version of this section, please see the uploaded attachment "DIVERSIFY Final Report Appendix I.pdf"). In consumer research gender issues are always considered, since it is important to have representative samples in research, to make extrapolation to the target group. In DIVERSIFY, we have done several consumer studies with different target groups per study. Therefore, the gender issue was considered every time when designing the sample distribution for all consumer surveys involved in the Socioeconomics Work packages (WP 28-30).

Based on the segmentation study, which showed that consumption of fish is equal between men and women, the target in quantitative studies was equal. For the quantitative consumer surveys in DIVERSIFY, the data collection design was strictly controlled during the fieldwork. More specifically the gender distribution by survey involved and selected country was 50:50. Only in the qualitative surveys (similar to the focus groups) no targets were defined for gender distribution. Due to other qualification criteria, ultimately more women were recruited as the percentage of female buyers and cookers of fish seemed to be higher. The quota male/female was 60%- 40% in favor of females.

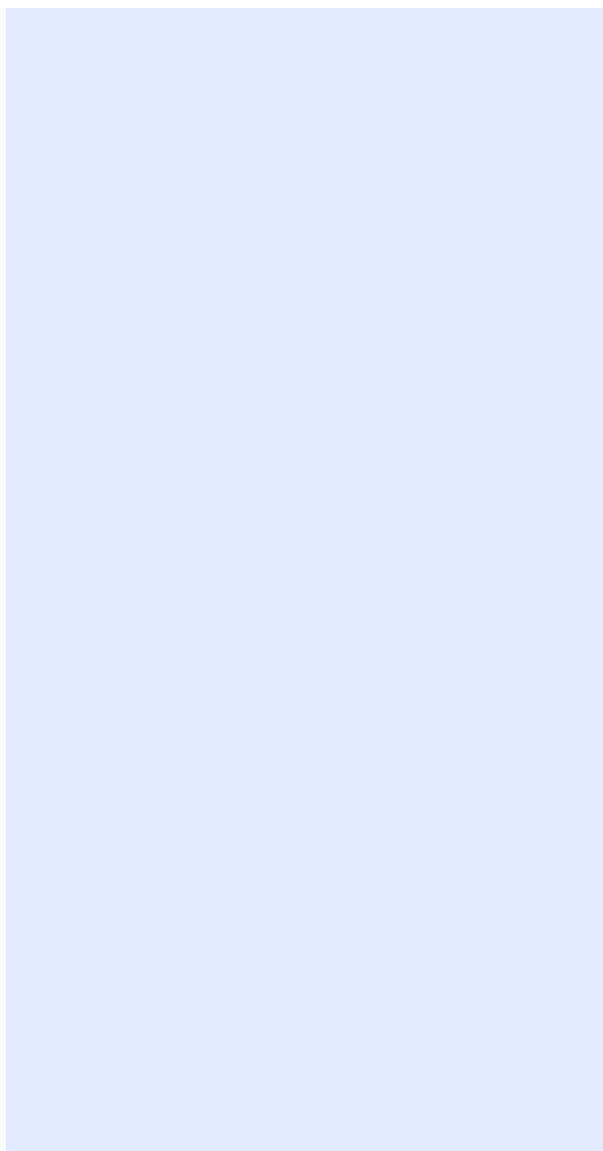
E. Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

Yes

If yes, please specify:

(For a properly formatted version of this section, please see the uploaded attachment "DIVERSIFY Final Report Appendix I.pdf"). Partner 1. HCMR (Greece), P4. IOLR (Israel), P7. IMR (Norway), P9. UL (France) P16. University of Namur (FUNDP) and P21. DTU (Denmark) hosted a number of PhD, MSc and BSc students, whose thesis/dissertations were based on a task from DIVERSIFY WPs. There was also a high school student that carried out a project on the effect of algae-produced water turbidity on larval prey consumption, growth and survival (P4. IOLR). This student won 2nd prize for his project in a state-wide competition in Israel that included hundreds of students. Partner 5. University of Aberdeen (UNIABD, Scotland) has presented the project in its Open Days and contributes to outreach activities locally such as TechFest. Partner 8. IEO (Spain) has been involved in the European Researchers' Night (September 2018), Spanish Aquaculture day (30th November 2013-2018), open days, IEO centenary celebration with open days and science events. During these events we explained to the students and school pupils (6 to 16 y.o.) our work in the project. Partner 11. University of Aarhus (AU, Denmark) has provided students with the opportunity to learn from the synthesized knowledge of DIVERSIFY and critically reflect on different subjects, as well as apply this knowledge to the real-life situations through case studies, in courses such as Economic Psychology. Partner 15 University of La Laguna (ULL, Spain), have disseminated the activities of DIVERSIFY to a large student forum, not only at the graduate level (MSc or PhD), but also at secondary and primary school



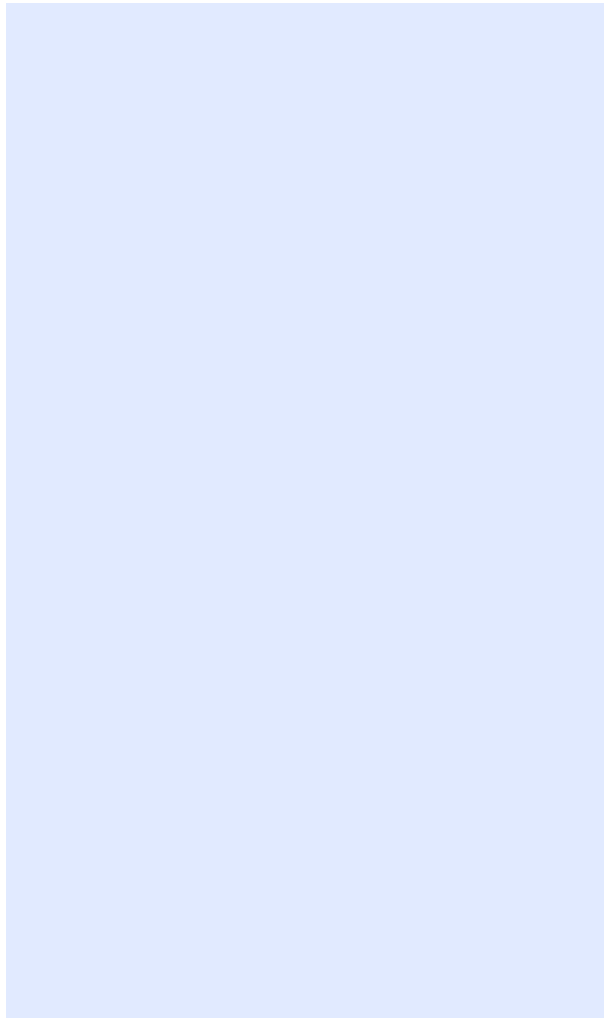
through either technical visits in the centers or through more than 20 different activities including open days, science events and social open family fairs most of them organized by the university and the ULL foundation (<https://ciencia.fg.ull.es/>). Partner 19 CMRM (Spain), has given the opportunity to students from "Instituto Galego de Formación en Acuicultura (IGAFA) to be involved in some tasks of the project, such as feeding and sampling of wreck fish broodstock, and in the larval culture of this species. Partner 29. ASIALOR (France) together with P9. UL, and P40. GMF (Greece) has welcomed students and groups to visit their fish farms during open days, taking advantage to present also the DIVERSIFY project. Partner 34. BVFi (Germany) has participated in the Fair "International Green Week", Berlin, Germany, January 2015: Informing consumers - including students - about the project, distributing flyer/bookmarks of DIVERSIFY. Partner 35. MAHAL has disseminated information about the DIVERSIFY Project to Hungary and Eastern Europe as follows: (1) Scientific Days of the Research Institute for Fisheries and Aquaculture (HAKI); (2) "Night of the Scientists" event for children; (3) Workshops of the Network of Aquaculture Centers in Central and Eastern Europe (NACEE). Finally, presentations have been given on various aspects of aquaculture, and specifically for DIVERSIFY to school children of different ages, as part of our open days in the different partners. Also, some researchers have given presentations to students in different locations (schools, natural history museum, etc.).

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

Yes

If yes, please specify:

(For a properly formatted version of this section, please see the uploaded attachment "DIVERSIFY Final Report Appendix I.pdf"). Technical Production Manuals have been produced for all six species included in DIVERSIFY. In addition, Fish Health Manuals have been produced for greater amberjack and meagre. The manuals include a large part of the work of DIVERSIFY, in a format and to the extent that the information is useful both for education purposes, but also for professional purposes by the aquaculture industry. All are freely available in the project's website. Partner P10. TU/e (The Netherlands) have used DIVERSIFY examples in lectures on marketing/market research. Mention of project in examples of grant projects in open days. At P11. AU, case studies have been developed for the students, and all findings from DIVERSIFY have been stored on the MAPP's website: ht



tp://mgmt.au.dk/research/marketing/mapp/projects/ Partner 14. IFREMER has produced a free training movie about the use of Computer Assisted Sperm Analysis (CASA) applied to fish spermatozoa, which is freely available on the DIVERSIFY site. At P.15 University of La Laguna (ULL, Spain) several presentations have been created for teaching various subjects in the Degree in Biology (100 students each year) and Environmental Sciences (50 students each year), and particularly for subjects of Sustainable Aquaculture and Quality Control of Aquaculture Products in the Master's Degree in Marine Biology (21 students each year). In these presentations, a number of slides and videos from DIVERSIFY work, its techniques and results have been included. Some material has been generated for the local schools in relation to the health of fish consumption and benefits of aquaculture products, with information DIVERSIFY. Finally, some bookmarkers containing the project web site were distributed in the last ULL open days performed to disseminate science and research vocation to the youth sector. Partner 37. EUFIC (Belgium) disseminated relevant, current information from the project to consumers, through a specific link on EUFIC's website, two leaflets, an article on farmed fish, and the recording of interviews and the final presentations of the project. All this material helped to create awareness of the project and its outcomes.

F. Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?	
Main discipline:	4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
Associated discipline:	1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)
Associated discipline:	5.2 Economics

G. Engaging with Civil society and policy makers

11a. Did your project engage with societal actors beyond the research community? (if 'No', go to Question 14)	Yes
11b. If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?	Yes, in communicating /disseminating / using the results of the project
11c. In doing so, did your project involve actors whose role is mainly to organise the dia	No

logue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	
12. Did you engage with government / public bodies or policy makers (including international organisations)	Yes, in communicating /disseminating / using the results of the project
13a. Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?	Yes - as a secondary objective (please indicate areas below - multiple answer possible)
13b. If Yes, in which fields?	
Agriculture	Yes
Audiovisual and Media	No
Budget	No
Competition	No
Consumers	Yes
Culture	No
Customs	No
Development Economic and Monetary Affairs	No
Education, Training, Youth	Yes
Employment and Social Affairs	No
Energy	No
Enlargement	No
Enterprise	No
Environment	No
External Relations	No
External Trade	No
Fisheries and Maritime Affairs	Yes
Food Safety	Yes
Foreign and Security Policy	No
Fraud	No
Humanitarian aid	No
Human rightsd	No
Information Society	No
Institutional affairs	No
Internal Market	No
Justice, freedom and security	No
Public Health	No
Regional Policy	No

Research and Innovation	Yes
Space	No
Taxation	No
Transport	No
13c. If Yes, at which level?	European level

H. Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	91
To how many of these is open access provided?	48
How many of these are published in open access journals?	9
How many of these are published in open repositories?	9
To how many of these is open access not provided?	42

Please check all applicable reasons for not providing open access:

publisher's licensing agreement would not permit publishing in a repository	Yes
no suitable repository available	No
no suitable open access journal available	No
no funds available to publish in an open access journal	Yes
lack of time and resources	No
lack of information on open access	No
If other - please specify	

15. How many new patent applications ('priority filings') have been made? ('Technologically unique': multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).	0
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16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).

Trademark	0
Registered design	0
Other	0

17. How many spin-off companies were created / are planned as a direct result of the project?	0
Indicate the approximate number of addition	0

al jobs in these companies:	
18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:	Increase in employment, In small and medium-sized enterprises
19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:	143

I. Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?	Yes
21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?	No
22. Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?	
Press Release	Yes
Media briefing	No
TV coverage / report	Yes
Radio coverage / report	No
Brochures /posters / flyers	Yes
DVD /Film /Multimedia	Yes
Coverage in specialist press	Yes
Coverage in general (non-specialist) press	Yes
Coverage in national press	Yes
Coverage in international press	Yes
Website for the general public / internet	Yes
Event targeting general public (festival, conference, exhibition, science café)	Yes
23. In which languages are the information products for the general public produced?	
Language of the coordinator	Yes
Other language(s)	Yes
English	Yes

Attachments	DIVERSIFY Final Report Appendix I.pdf
Grant Agreement number:	603121
Project acronym:	DIVERSIFY
Project title:	Exploring the biological and socio-economic potential of new/emerging candidate fish species for the expansion of the European aquaculture industry
Funding Scheme:	FP7-CP-TP
Project starting date:	01/12/2013
Project end date:	30/11/2018
Name of the scientific representative of the project's coordinator and organisation:	Dr. Constantinos Mylonas HELLENIC CENTRE FOR MARINE RESEARCH
Name	
Date	08/02/2019

This declaration was visaed electronically by Constantinos MYLONAS (ECAS user name nmylocon) on 08/02/2019