Deliverable Report

Deliverable No:	D1.9		**Delivery Month:**	40
Deliverable Title	Annual Coordination Meeting for Y4			
WP No:	1		**WP Lead beneficiary:**	P1. HCMR
WP Title:	Project Management			
Task No:	1.3		**Task Lead beneficiary:**	P1. HCMR
Task Title:	Annual Coordination meeting			
Other beneficiaries:	P2. FCPCT	P3. IRTA	P4. IOLR	P5. UNIABDN
P6. SWR (DLO)	P7. IMR	P8. IEO	P9. UL	P10. TU/e
P11. AU	P12. APROMAR	P13. UNIBA	P14. IFREMER	P15. ULL
P16. FUNDP	P17. NIFES	P18. CTAQUA	P19. CMRM	P20. SARC
P21. DTU	P22. SWH	P23. ARGO	P24.	P25. DOR
P26. GEI	P27. FORKYS	P28. CANEXMAR	P29.	P30.
P31. IRIDA	P32. MC2	P33. FGM	P34. BVFi	P35. MASZ
P36. ANFACO	P37. EUFIC	P38. HRH	P39. F2B	P40. GMF
Status:	Delivered		**Expected month:**	37
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Lead Scientist preparing the Deliverable: Mylonas, C.C. (P1. HCMR),
Other Scientists participating: Fakriadis, Y. (P1. HCMR), Duncan, N. (P3. IRTA), Montero, D. (P2. FCPCT), Koven, W. (P4. IOLR), Papandroulakis, N. (P1. HCMR), Secombes, C. (P5. UNIABDN), Tacken, G. (P6. SWR), Robles, R. (P18. CTAQUA)

Objective: The objectives of the Annual Coordination Meeting (ACM) were to

(a) present Task-specific presentations of the accomplished work during Y2 and 3 to the consortium members, as well as to a number of invited guests,
(b) closely review and evaluate the work carried out in each of the six Scientific Disciplines
(c) plan the work to be implemented in the following year,
(d) present the dissemination activities of the consortium,
(e) organize the preparation of the upcoming Deliverables and Dissemination activities, including the intensification of preparation of manuscripts for scientific articles.

Description: The ACM 2017 was hosted by Dr. Alicia Estevez of the Instituto de Recerca y Tecnologia Agronomica (P3. IRTA) and was held at two venues between 17-19 January 2017. The task-specific presentations during Days 1 and 2 took place at Palau Macaya. The Group Work Package (GWP) workshops took place at the Campus Del Mar of the University Pompeu Fabra. In addition, a half day meeting took place at the Hotel Ayre Rosellon on Friday 20 January 2017, for the participants of WP 30 Business model and marketing strategy development. The 3-day meeting was attended by 85 persons: 78 coming from the DIVERSIFY consortium and 8 invited guests from outside the consortium. No representative attended from three Beneficiaries (P26. GEI, P28. CANEXMAR and P37. EUFIC).

As for all previous ACMs, information regarding the meeting was uploaded continually on the project's web site (http://www.diversifyfish.eu/2017-annual-coordination-meeting-jan.html) to ensure that all participants had access to the most updated information. The Agenda (**Tables 1, 2 and 3**) was developed with assistance from GWP leaders and consisted of:

(a) DAY 1 and 2: a common session for all participants (including invited guests) presenting Task-specific presentations from various WPs, and presentations from invited guests,
(b) DAY 2: a presentation of the WP 31 Dissemination presenting the dissemination activities of the consortium, and organizing the preparation of Deliverables as well as of manuscripts for scientific articles, and
(c) DAY 3: a common session dealing with Dissemination, Scientific and Financial Reporting, and Management.
(d) In addition a brief meeting of WP 30 meeting was held on Friday 20 January

Table 1. Agenda of DAY 1 of the Annual Coordination Meeting 2017, which took place on the 16-19 January 2017, at the Palau Macaya, Barcelona, Spain.

DAY 1		17-Ιαν	Tuesday (Open Day presentations)		
Start	End		Title	Presenter	Details
8.00	9.00		Registration		Pick up badges
9.00	9.30		Welcome-Logistics	Alicia Estevez & CC Mylonas	
9.30	9.50		Welcome	Dr Sergi Tudela Casanovas	Director of Fisheries, Cataluna
9.50	10.10	1	Induced spawning of paired meagre with male rotation	Duncan, Neil	IRTA
10.10	10.30	2	Wreckfish reproduction status in Spain	Alvarez, Blanca	IEO
10.30	10.50	3	Some approaches to improve the nutrition and husbandry of DIVERSIFY´s target species. A U La Laguna collaborative contribution	Rodriquez, Covadonga	ULL
10.50	11.30		Coffee		
11.30	11.50	4	Effect of background color and photophase on performance of larval greater amberjack and expression of genes related to the GH/IGF axis	Tsalafouta, Aleka	HCMR
11.50	12.10	5	Prospects for probiotics with Atlantic halibut larve	Berg, Øivind	IMR
12.10	12.30	6	The effect of algal turbidity on larval performance and the ontogeny of digestive tract functionality in grey mullet	Koven, Bill	IOLR
12.30	12.50	7	Wreckfish ontogeny of the major organs related to feeding and digestion	Papadakis, Ioannis	HCMR
12.50	13.10	8	COLUMBUS Project – Knowledge Transfer for Blue Growth: Aquaculture knowledge outputs and case studie	Christofilogiannis, Panos	AQUARK (Invited)
13.10	13.30	9	Physical prototypes of new producs from the selected DIVERSIFY species	Bou, Ricard and Robles, Rocio	IRTA/CTAQUA
13.30	15.00		Lunch		
15.00	15.20	10	Epigenetics in aquaculture	Piferrer, Francesc	ICM (Invited)
15.20	15.40	11	How can CFeed copepods help bring new marine species to the table	Remman, Tore	C-Feed (Invited)
15.40	16.00	12	Results on mullet grow out in farm conditions: a multi-partner trial	Robles, Rocio	CTAQUA
16.00	16.20	13	Parasitic infections in greater amberjack in Greece	Katharios, Pantelis	HCMR
16.20	16.40	14	Construction of a genetic linkage map in meagre and identification of genetic markers related to growth for use in marker-assisted breeding programs through QTL mapping	Tsigenopoulos, Costas	HCMR
16.40	17.00	15	Consumer sensory perceptions of the selected new products from DIVERSIFY species	Guerrero, Lluis	IRTA
17.00	17.30		Coffee		
17.30	17.50	16	What do we know about the immune system of meagre and amberjack?	Milne, Douglas	UNIABD
17.50	18.10	17	Behavioral analysis of intra-cohort cannibalism in young pikeperch	Colchen, Tatiana	UL
18.10	18.30	18	Wreckfish larval rearing trials	Vilar, Antonio	MC2
18.30	18.50	19	Feeding pattern for greater amberjack: effects on growth, feed utilization and welfare	Montero, Daniel	FCPCT
20.00			Dinner at Ayre Rosellon Hotel (consortium dinner)		

Table 2. Agenda of DAY 2 of the Annual Coordination Meeting 2017, which took place on the 16-19 January 2017, at the Palau Macaya, Barcelona, Spain.

DIVERSIFY					
7FP-KBBE-2013-603121					
Meeting Agenda			2017 Annual Coordination Meeting	Barcelona 17-19 January 2017	Palau Macaya
DAY 2		18-Ιαν	Wednesday (Open Day presentations)		
Start	End		Title	Presenter	Details
8.00	9.00		Registration		Pick up badges
9.00	9.20	1	Protocol for the strip spawning of meagre females and in vitro fertilization	Ramos, Sandra	IRTA
9.20	9.40	2	Spawning kinetics of greater amberjack in response to multiple GnRHa injections or implants	Fakriadis, Ioannis	HCMR
9.40	10.00	3	Effects of phosphoglycerides and HUFA levels on ontogenetic development and performance of pikeperch larvae	Lund, Ivar	DTU
10.00	10.20	4	Sensory characterization of DIVERSIFY species	Grigorakis, Kriton	HCMR
10.20	10.40	5	Influence of dietary combinations of vitamin e, c and k in the development of systemic granulomatosis in meagre	Montero, Daniel	FCPCT
10.40	11.00	6	Systemic granulomatosis in meagre	Katharios, Pantelis	HCMR
11.00	11.30			Coffee	
11.30	11.50	7	Meagre behaviour and response to feeding training stimuli	Papadakis, Ioannis	HCMR
11.50	12.10	8	The effect of cage depth in the performance of meagre	Tsalafouta, Aleka	HCMR
12.10	12.30	9	Experimental consumer test of the new products from DIVERSIFY	Krystallis, Thanassis	HRH/AU
12.30	12.50	10	Spermatogenesis and sperm characteristics in captive greater amberjack	Zupa, Rosa & Fauvel, Christian	UNIBA/IFREMER
12.50	13.10	11	Why I have come to hate meagre and why amberjack is a jinxed species: 25 years of feelings & experiences from health diagnostics	Padros, Sito	Uni Autonoma Barcelona (invited guest)
13.10	15.00			Lunch	
15.00	15.20	12	Launching the new DIVERSIFY products: business models, market tests and market diffusion	Nijssen, Ed and vd Borgh, Michel	TU/e
15.20	15.40	13	Comparison of programmed and auto-demand type feeding in tanks	Duncan, Neil	IRTA
15.40	16.00	14	Multifactorial nutrition experiment in pikeperch	Kestemont, Patrick	FUNDP
16.00	16.20	15	Maturation and spawning induction of grey mullet	Rosenfeld, Hanna	IOLR
16.20	16.40	16	Atlantic halibut larval nutrition and drivers of asymmetric pigmentation and eye migration in flounders	Hamre, Kristin	NIFES
16.40	17.30			Coffee	
17.30	17.50	17	Induction of gonadal maturation in teleosts by recombinant gonadotropins	Gimenes, Ignacio	Rara Avis Biotech (invited guest)
17.50	18.10	18	Nodavirus in Atlantic halibut and possible vaccine strategies	Patel, Sonal	IMR
18.10	18.30		Dissemination activities, articles and uploading on ECAS system - Rocio Robles		
18.30	18.50		Dissemination activities, articles and uploading on ECAS system - Rocio Robles		

DAY 1 and 2 – Task-specific presentations of implemented work and invited guests

The morning session started with a welcoming presentation (**Fig. 1**) by the Project Coordinator (PC), Dr. C.C. Mylonas, presenting the Agenda for the meeting, welcoming the invited guests from outside the consortium and explaining the intentions of the consortium (as presented in the DOW, WP1 Project Management) for including other scientists and stakeholders in these ACMs. Also, Dr Sergi Tudela,

Director of Fisheries for the Catalonia government offered a welcoming. Dr. Tudela underlined the importance of DIVERSIFY for Spain and Catalonia, as the need for species diversification in the Mediterranean aquaculture has been recognized here as well.

The invited guests included Dr. Francesc Piferrer (Institute of Marine Sciences, CSIC, Barcelona, Spain), Dr. Francesc Padros (Autonomic University of Barcelona, Spain), Dr. Ignacio Gimenes (Rara Avis Biotech), Torre Remman (C-Feed S.A.), Dr Panos Christofilogiannis (AQUARK, S.A.), Mr Nigel Balmforth (5N Publishing), Mrs Rhiannon White (International Aqua Feed Magazine) and Mr. Javier Villa from a commercial aquaculture company (Andromeda SA from Greece/Spain).

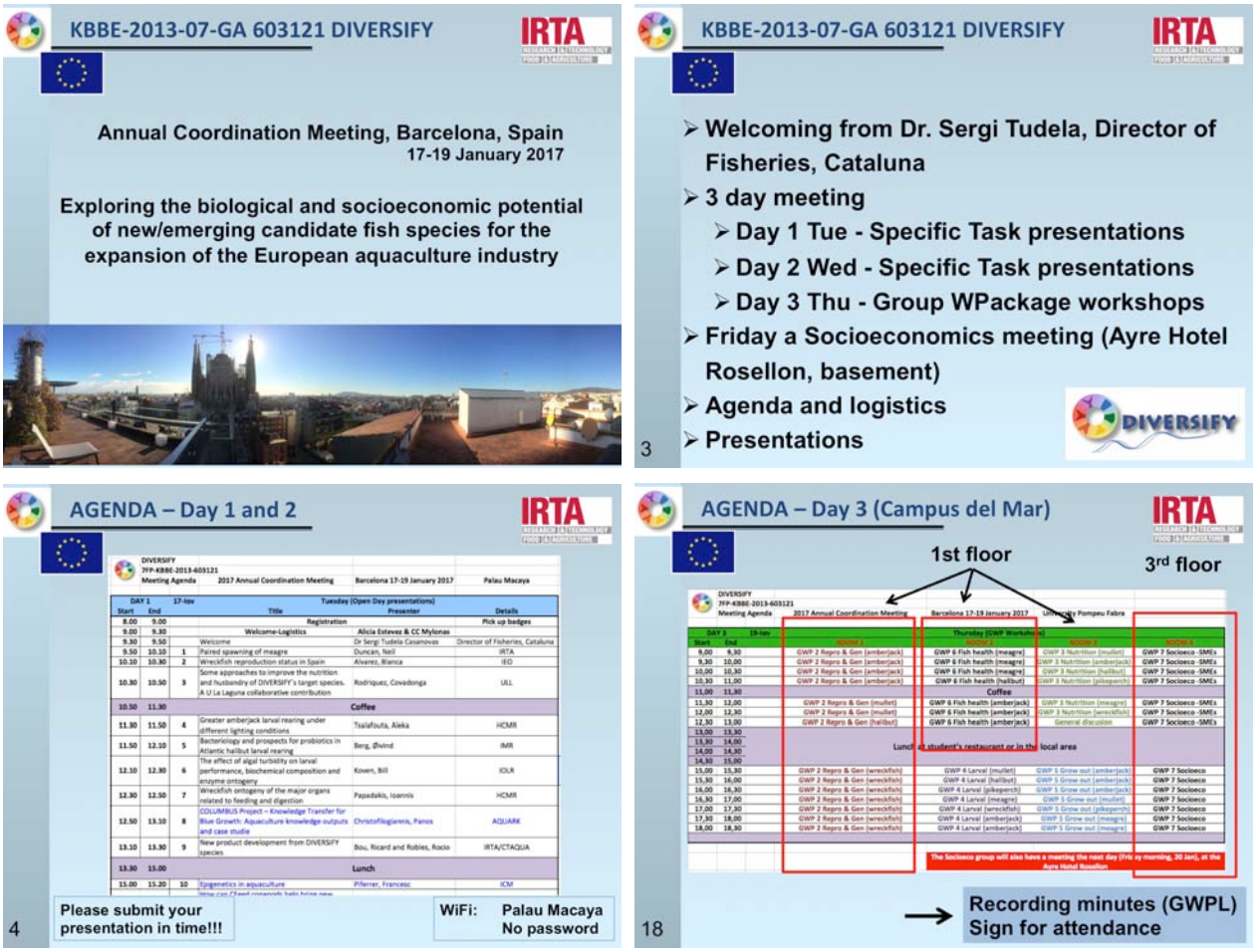

Figure 1. The opening slides for the Annual Coordination Meeting 2017, held by P3. IRTA in Barcelona, Spain, explaining the Agenda of the meeting (upper right slide) and the slides explaining the organization of the DAY 1 & 2 presentations (lower left slide) and the DAY 3 GWP workshop with the four parallel sessions (lower right slide).

The extended format of task-specific presentations for DAY 1 & 2 allowed a large number of the RTD partners to present their work –which in many cases was done in collaboration with the SMEs and Large companies participating in the project, as well as work to be presented from all Scientific Disciplines. In total, 18 RTD partners presented their work, representing collaboration with the two large companies and six SMEs from the DIVERSIFY consortium (**Fig. 2**).

Figure 2. The opening slides from some of the task-specific presentations of some of the RTD partners of the consortium during DAY 1 & 2.

The presentations from the invited guests, which followed the presentations from consortium GWP leaders and Partners, demonstrated both the interest of other organizations to participate in our ACMs and the interactions DIVERSIFY is trying to encourage with relevant researchers. Of great interest were the presentations of Dr. Francesc Piferrer (reproductive endocrinologist) on the recent knowledge of the epigenetic modification of gene expression in aquaculture, and the effects early rearing may have on sex differentiation. Also of specific interest to the DIVERSIFY consortium where the presentations of Dr Francesc Padros (fish pathologist) on his extensive experience with meagre and greater amberjack diagnostics, and of Dr Ignacio Gimenes (reproductive medicine physician) on the production of recombinant gonadotropins and their use in inducing gametogenesis in captive fishes exhibiting reproductive dysfunctions in captivity. Also, of great interest to the larval rearing scientists in the consortium was the presentation of Mr Torre Remman from C-Feed S.A., a commercial company specialing in the production of marine copepods for use as live food items for marine fish larvae. The participation of commercial aquaculture companies is also a clear indication of the relevance of DIVERSIFY to the EU industry, and the interest of their technical management to be updated with the current developments in the project. The connection with these companies also provides a means for DIVERSIFY to obtain relevant feedback from the sector, as well as having the potential to try some of the developed methodologies before the completion of the project and the release of the results. Some of these companies, such as Andromeda SA who attended the meeting for the third year, continue to provide access to their facilities and fish stocks, and collaborate with DIVERSIFY as non-partners at no cost to the project. This ensures that expensive infrastructures and resources from outside the consortium are available to DIVERSIFY at no extra charge.

Figure 3. The opening slides from some of the presentations of some of the invited speakers on DAY 1 & 2.

Dissemination

At the end of Day 2, there was a presentation by the WP 31 Dissemination leader, Dr Rocio Robles. The presentation begun with a brief reiteration of the WP's many objectives, emphasizing the need for all Partners to participate actively in the preparation of dissemination materials and activities (**Fig. 4**). Then there was a presentation of the various dissemination activities carried out in the last 2 years (2014-2015), which included the publication of four semester Newsletters that are uploaded at the website of the project and three species-focused articles published at the quarterly magazine of the European Aquaculture Society (for greater amberjack, meagre and pikeperch). A special "DIVERSIFY" session was held at the annual conference of the European Aquaculture Society (Deliverable 31.10). The Special Session was titled "New/emerging finfish species (EU Diversify project)" and was organized in the order of the species' work in the DOW. The session opened with a summary presentation for DIVERSIFY, given by the PC of the project -see *Deliverable 31.9 Annual presentation of DIVERSIFY (Y2) at a relevant conference.* Following each of the six Species Leaders summary presentations, presentations were also given by DIVERSIFY researchers on specific Tasks of the DOW. The Special Session lasted for the whole day (10:30 to 17:00) and an estimated of 30-120 persons were present at the different presentations in the designated room. The Species Leaders' presentations have been uploaded on the DIVERSIFY website.

Figure 4. Photos from the presentation of WP31 leader Rocio Robles on Day 2.

As regards the DIVERSIFY website, the partners were informed that the website of the project (www.diversifyfish.eu) is being modified in order to make it easier for the visitors to find recent findings of the project, as well as the scientific articles that are now being produced and published (**Fig. 5**). In order to facilitate the production of short reports on implemented work and acquired results to be uploaded in our site, the Dissemination leader prepared in 2014 a format file to be used by all scientists to prepare dissemination materials, in a way that would be easy for the partners to fill. The format file is available in the INTRA page of the DIVERSIFY website. Unfortunately, not many such reports have been produced so far, and more effort must be dedicated to encourage DIVERSIFY scientists to start preparing these short dissemination material from their activities.

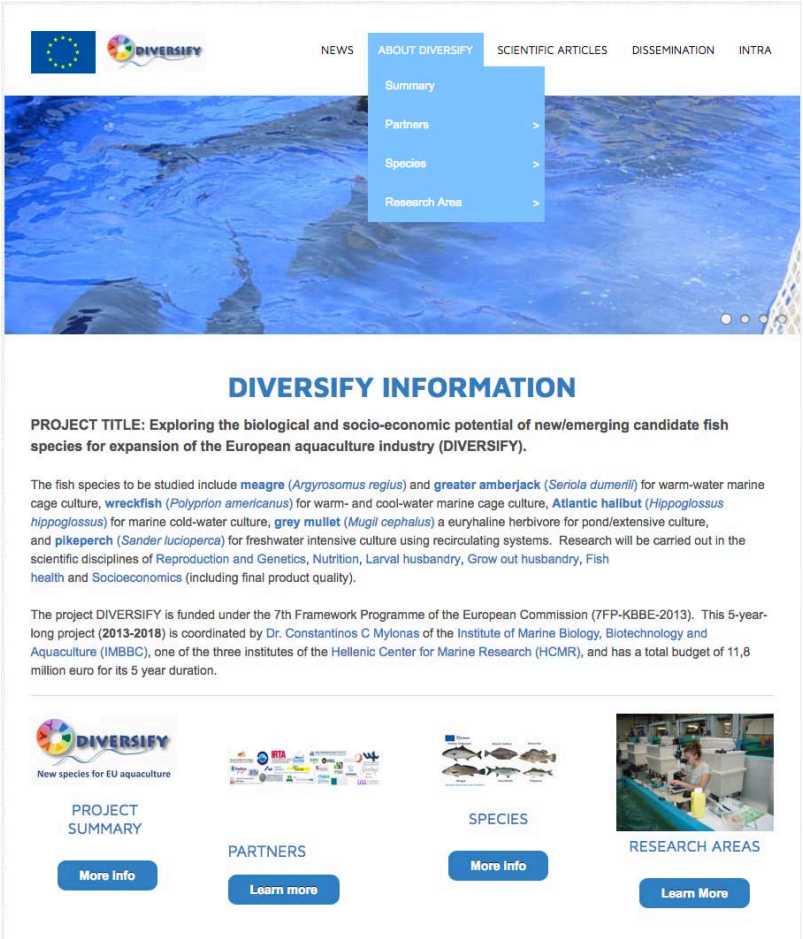

Figure 5. The new version of the project's website, modified to give more emphasis on recent activities and news, as well as the easy dissemination of the scientific articles that are now being produced at a fast pace.

The Dissemination WP leader then discussed again the issue of uploading dissemination activities ion the ECAS portal, as well as preparing the work done in DIVERSIFY for submission to scientific magazines (**Fig. 6**). Already 9 articles have been published and a number of manuscripts have been submitted for publication and many more researchers expressed their intention to start submitting their work. The contractual requirements of the DIVERSIFY are 2 articles per GWP per year, which makes for a total of 60 articles. Currently a total of 10 articles have been published from the areas of Reproduction and Genetics, Nutrition, Larval rearing, Fish health and Socioeconomics. As mentioned earlier, a change was done on the project's website, by moving the "Scientific Publications" page to the main menu bar (**Fig. 7**), so that visitors will have a more rapid and direct access to the scientific work of the Consortium.

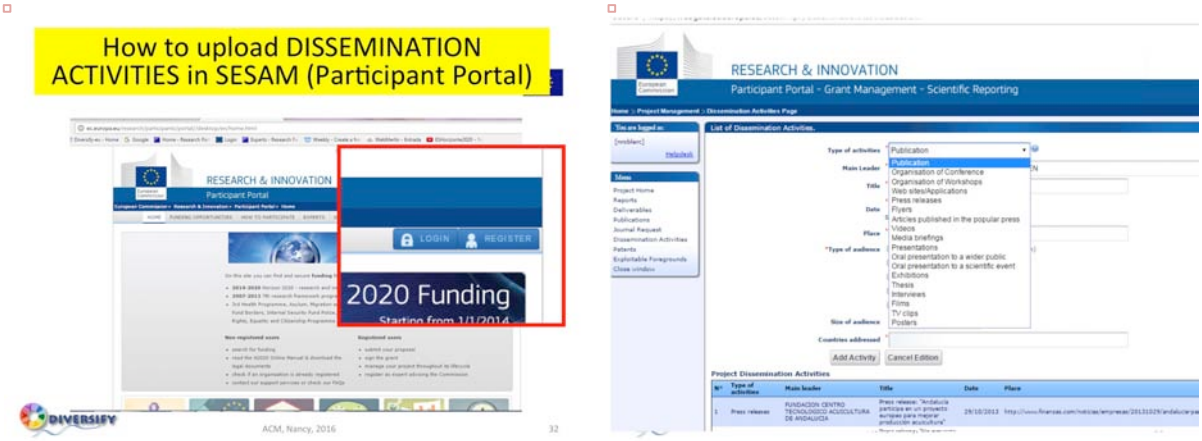

Figure 6. Representative slides from the discussion on uploading dissemination activities on the ECAS portal and about the preparation of scientific publications.

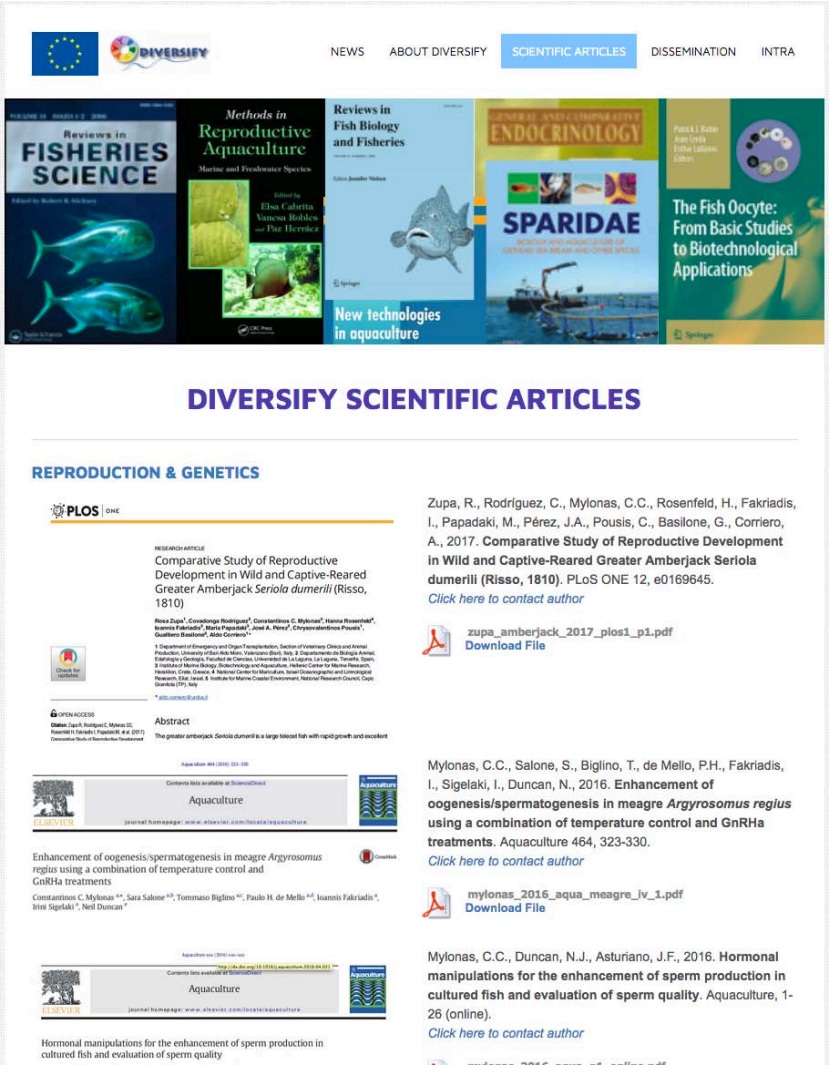

Figure 7. The new version of the project's website, modified to give more emphasis on the scientific articles that are now being produced at a fast pace.

In agreement with the intentions of the consortium to be as open as possible and to disseminate the results as promptly as possible, all the presentations of the ACM 2017 were uploaded on the website of the project within 2 weeks after the end of the meeting (end of January 2017), to be available to all interested stakeholders. In addition, it was agreed that all GWP leaders will submit a paragraph with the major highlights of the work implemented so far in their Scientific Disciplines, in order to prepare a 1-2 page flyer, which will then be translated to various languages by our Professional Association partners and disseminated to their members (*e.g.* in Greece, Spain, Hungary and Germany).

The next ACM is planned for 23-26 January 2018 in Tenerife, Spain. In the DOW, it was proposed that one of these meetings would be held in Norway, and would be organized by P7. IMR. However, due to the fact the time coincides with the mid of winter in this partner it was proposed by the PC, after communication with P8. IEO and P15. ULL to hold the next meeting in Tenerife, Canary Islands, Spain. This was received with enthusiasm by the Partners, therefore the next meeting will be hosted by the latter partners.

DAY 3 – Group Work Package workshops

During Day 3 of the meeting, six Workshop Sessions were organized according to Scientific Disciplines with the objective of (a) reviewing and evaluating the work carried out and (b) planning the work to be implemented in the various scientific WPs during the fourth year (2017) of the project (**Table 3**).

Table 3. Agenda of DAY 3 of the Annual Coordination Meeting 2017, which took place on the 17-19 January, at the Campus del Mar of the University Pompeu Fabra, Barcelona, Spain.

DIVERSIFY					
7FP-KBBE-2013-603121					
Meeting Agenda		2017 Annual Coordination Meeting	Barcelona 17-19 January 2017	University Pompeu Fabra	
DAY 3	19-Ιαν		Thursday (GWP Workshops)		
Start	End	ROOM 1	ROOM 2	ROOM 3	ROOM 4
9,00	9,30	GWP 2 Repro & Gen (amberjack)	GWP 6 Fish health (meagre)	GWP 3 Nutrition (mullet)	GWP 7 Socioeco -SMEs
9,30	10,00	GWP 2 Repro & Gen (amberjack)	GWP 6 Fish health (meagre)	GWP 3 Nutrition (amberjack)	GWP 7 Socioeco -SMEs
10,00	10,30	GWP 2 Repro & Gen (amberjack)	GWP 6 Fish health (meagre)	GWP 3 Nutrition (halibut)	GWP 7 Socioeco -SMEs
10,30	11,00	GWP 2 Repro & Gen (amberjack)	GWP 6 Fish health (halibut)	GWP 3 Nutrition (pikeperch)	GWP 7 Socioeco -SMEs
11,00	11,30		Coffee		
11,30	12,00	GWP 2 Repro & Gen (mullet)	GWP 6 Fish health (amberjack)	GWP 3 Nutrition (meagre)	GWP 7 Socioeco -SMEs
12,00	12,30	GWP 2 Repro & Gen (mullet)	GWP 6 Fish health (amberjack)	GWP 3 Nutrition (wreckfish)	GWP 7 Socioeco -SMEs
12,30	13,00	GWP 2 Repro & Gen (halibut)	GWP 6 Fish health (amberjack)	General discusion	GWP 7 Socioeco -SMEs
13,00	13,30	Lunch at student's restaurant or in the local area			
13,30	14,00				
14,00	14,30				
14,30	15,00				
15,00	15,30	GWP 2 Repro & Gen (wreckfish)	GWP 4 Larval (mullet)	GWP 5 Grow out (amberjack)	GWP 7 Socioeco
15,30	16,00	GWP 2 Repro & Gen (wreckfish)	GWP 4 Larval (halibut)	GWP 5 Grow out (amberjack)	GWP 7 Socioeco
16,00	16,30	GWP 2 Repro & Gen (wreckfish)	GWP 4 Larval (pikeperch)	GWP 5 Grow out (amberjack)	GWP 7 Socioeco
16,30	17,00	GWP 2 Repro & Gen (wreckfish)	GWP 4 Larval (meagre)	GWP 5 Grow out (mullet)	GWP 7 Socioeco
17,00	17,30	GWP 2 Repro & Gen (wreckfish)	GWP 4 Larval (wreckfish)	GWP 5 Grow out (pikeperch)	GWP 7 Socioeco
17,30	18,00	GWP 2 Repro & Gen (wreckfish)	GWP 4 Larval (amberjack)	GWP 5 Grow out (meagre)	GWP 7 Socioeco
18,00	18,30	GWP 2 Repro & Gen (wreckfish)	GWP 4 Larval (amberjack)	GWP 5 Grow out (meagre)	GWP 7 Socioeco
			The Socioeco group will also have a meeting the next day (Friday morning, 20 Jan), at the Ayre Hotel Rosellon		

The workshops of DAY 3 were running in parallel (4 Scientific Disciplines at a given time) in an attempt to minimize the potential time conflict for most Beneficiaries. The duration of each session was decided by the GWP leader based on the number of WP included in the Scientific Discipline, as well as the amount of work that needed to be presented and discussed, and the workload expected for the upcoming year. Therefore, GWP Reproduction & Genetics and GWP Socioeconomics requested full-day Workshops, so a room was dedicated to their work. In addition, the Workshops were organized in a way that the WPs dealing with the

same species were planned at different times during the Workshops, to allow all scientists attending all the WPs of the same species. This was also achieved, to a degree, by the participation to the ACM 2016 of more than one scientist from some of the beneficiaries that are involved in many GWPs. For example, P3. IRTA was represented by eight researchers and P1. HCMR by nine researchers. Unfortunately, P2. FCPCT that has the third largest budget in the project was represented only by a single scientist (Dr Daniel Montero, the GWP leader for Nutrition), while the PI of the organization was not present at this ACM also.

The minutes prepared by the GWP leader of each scientific discipline from the different GWP workshops (**Fig. 8**) were provided to the EU Scientific Officer (Dr. Marta Iglesias), together with the minutes of the whole meeting, which are presented below.

Figure 8. Photos from the DAY 3 Workshops in the various scientific discipline GWP.

Main outcomes from the various Scientific Disciplines

GWP Reproduction & Genetics

Great success has been achieved in the control of reproduction of **greater amberjack**. Spontaneous natural spawns have be obtained in tanks in the Canary Islands (Spain), while in the Mediterranean Sea stocks the

use of gonadotropin-releasing hormone agonist (GnRHa) implants has resulted in the production of large numbers of good quality eggs (**Fig. 9**). In the 2016 reproductive season, >50 kg eggs have been produced from three stocks maintained in sea cages in Greece, and have resulted in the production of ~150,000 juveniles by the HCMR larval rearing department. These juveniles have been then supplied to five commercial rearing sites in Greece, for the first ever, large scale commercial grow out trial of this species in the Mediterranean region.

With regards to work with **Atlantic halibut**, experiments have demonstrated that F1 fish could be induced with GnRHa implants to spawn earlier and produce higher fecundities compared to controls. This work will be scaled up and validated with more breeders from commercial facilities in the coming years.

Figure 9. Greater amberjack breeders maintained in sea cages in Greece for reproduction purposes (left). Greater amberjack breeders given GnRHa implants to induce spawning during the reproductive season (right). (photos by HCMR).

Work with **wreckfish** provided interesting results, with both spontaneous natural and GnRHa-induced spawning in tanks and stripped gametes for *in vitro* fertilization (**Fig. 10**). Although a small number of fertilized eggs have been obtained so far, larviculture period had reached 27 days providing important results with regard to critical larviculture parameters. Although the success is far from what has been obtained in greater amberjack, this is the first time that a substantial amount of eggs of this deep-sea species have been available, for the implementation of larval rearing experiments.

Figure 10. Sampling **wreckfish** (gonadal biopsy) to evaluate reproductive stage of development (photos by Aquarium A Coruna).

Work with **grey mullet** resulted in the increase in the percentage of fish maturing and synchronized gonadal development with treatments of recombinant follicle stimulating hormone (Fsh) and metoclopramide. Spawning was then successfully induced in most females, with GnRHa and metoclopramide, resulting in the production of millions of eggs and larvae. However, common problems that still need to be addressed are the observed failed ovulation in many females (~42%) and the high variation in fertilization (0-90%).

For the **meagre and pikeperch**, in order to provide tools for genetic improvement, captive broodstocks were genetically characterized, demonstrating that they have sufficient variation to be used for breeding programs, and strategies were suggested on how the stocks could be improved. Work with **meagre** also demonstrated that single male and female spawning was possible to produce known families for a breeding program.

GWP Nutrition

The results obtained so far have improved weaning diets for **meagre**, demonstrating the importance of raising the essential highly unsaturated fatty acid (HUFA) levels up to 3% and vitamins E and C over 1500 and 1800 mg kg^{-1}. **Greater amberjack** enrichment products were also improved by defining the adequate levels of docosahexaenoic acid (DHA, 1-2%), in order to prevent bone malformations and promote maximum growth and survival. Moreover, an optimum method for the effective enrichment of rotifers for **greater amberjack** was developed, and specific diets for broodstock of **greater amberjack** and **wreckfish** were formulated based both on bibliographical and analytical studies. Studies to develop optimum weaning-diets also started for **pikeperch**, focusing on the determination of the requirements for essential fatty acids. The trials for producing on-grown *Artemia* for **Atlantic halibut** have been completed, but have not produced any improvement in juvenile production so far.

GWP Larval husbandry

Work on **meagre** showed that larvae can be weaned to artificial diets as early as 10 days post hatching (dph) without compromising nutritional condition and skeletal deformities. However, growth and survival should be considered. Cannibalism could be controlled by increasing the feeding frequency, removing dominant individuals, regular grading and by keeping the larvae in the dark when food is unavailable or in short supply.

In **greater amberjack**, the larval rearing parameters to be used in the semi-intensive mesocosm method and the intensive method were established, and large numbers of juveniles have been produced (**Fig. 11**) and sent for grow out to selected sea cage sites. Results until now showed that intensive rearing conditions favor amylase, alkaline protease and pepsin activities in 30 days post hatching (dph) larvae, while in earlier stages (12 dph) amylase activity was also higher, in contrast to alkaline protease and lipase activities.

Figure 11. Greater amberjack juveniles produced by the HCMR larval rearing department in 2016 (left), and sent to a number of commercial sea cage sites for on-growing trials (right) (photo by HCMR).

In **pikeperch**, the effects of selected environmental factors (*i.e.* light intensity, water renewal rate, water flow direction and tank cleaning timing), individually and in combination on larval rearing, were examined using a multifactorial design experimental system. In **Atlantic halibut**, a study is presently running to compare the efficacy of RAS and flow through (FT) for larval rearing. Larval mortality was shown to be higher in the RAS system during the first week after hatching. In **wreckfish**, the objective was to define optimum conditions for the larval rearing. Although, larval survival was poor, samples of larvae were taken out on days 0, 5 and 10 of life to obtain the fatty acid profile of wreckfish larvae and the first results show that the fatty acid profile has little variation in the first 10 days of life. Moreover, early embryonic and larval development has been documented (**Fig. 12**). Although the larval rearing still needs further development, these initial larval rearing efforts are very significant in providing information that will enable us to evaluate the potential of this deep-sea species, for commercial larval rearing.

Figure 12. Wreckfish larvae just prior to hatching (left), 1 dph (middle) and 13 dph (right) during the larval rearing trials at the Aquarium A Coruna, Spain (photos by Aquarium A Coruna).

Concerning **grey mullet** studies, results revealed that rotifer consumption and larval survival were dependent on algal turbidity in the rearing tanks, but independent of algal type added. Higher survival resulted in higher levels of smaller fish, which reduced average fish weight. Also, growth compensation was observed after grading at 29 dph.

GWP Grow out husbandry

The evaluation of feeding behavior of **meagre** demonstrated that juvenile fish were able to learn and remember specific stimuli related to feeding (**Fig. 13)**. Small fish of 50-100 g body weight responded very quickly to light stimuli (2 days after the start of the experiment), but responded very slowly to mechanical stimuli (air bubbles). Larger fish (200 g) responded very quickly to both stimuli. The study demonstrated that

both air bubbles and light can be used in an industrial setting, as they can be manufactured, implemented and managed easily with existing technologies in sea cages.

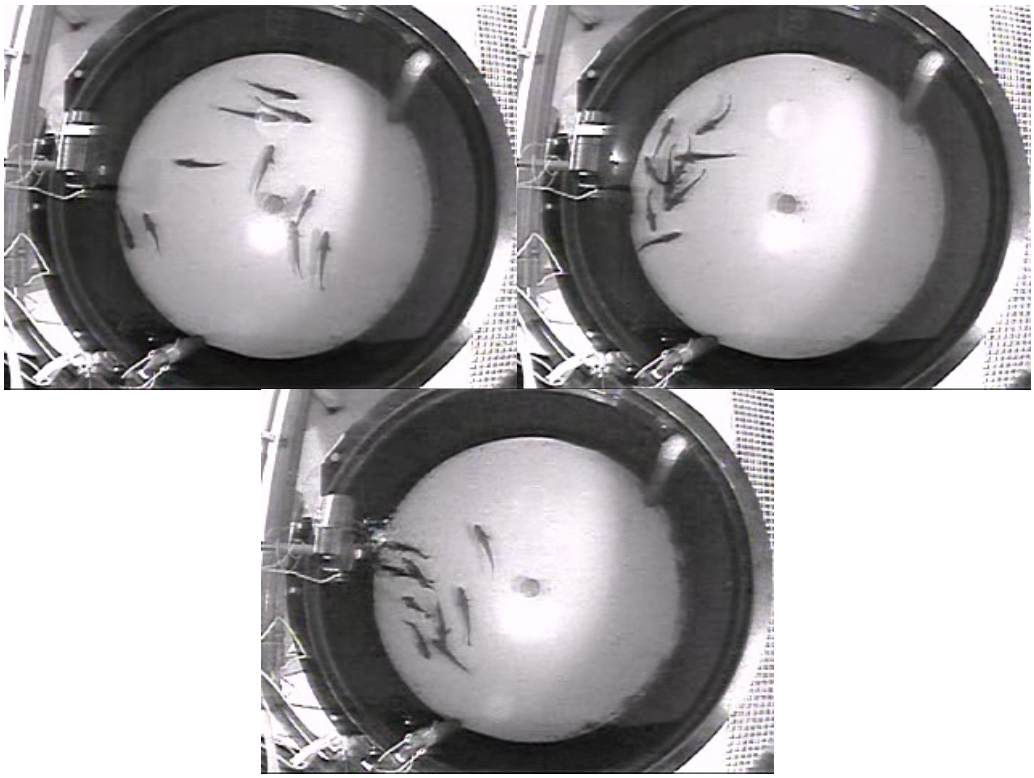

Figure 13. Feeding behavior experiments with **meagre** juveniles. The fish were usually distributed randomly throughout the tank (left), but when a light stimulus was given (center) they gathered around the light source and consumed immediately the feed that was provided from an electric feeder in the same area (right) (photos by HCMR).

For **pikeperch**, the husbandry studies focused on the on-growing requirements, emphasizing on the effects of (a) environmental parameters, (b) farm conditions, and (c) domestication level and geographical origin on growth, immune and physiological status. Finally in **grey mullet**, the first study that has been completed related to the definition of an optimal weaning diet. It was shown that fishmeal (FM) substitution did not affect any of the performance and condition parameters analyzed and that weaning wild **grey mullet** fry (which are zooplanktivorous) may be conducted using diets with a high level of FM substitution. In addition, a grow-out study was initiated in Spain and Greece, using wild-caught fry that are reared to harvest size under different environmental conditions and stocking densities, using a common DIVERSIFY formulated grow-out diet.

GWP Fish Health

In **meagre**, a first experiment has been made to characterize the ontogeny of the immune response in meagre, with samples collected at various times post-hatch. Samples of different tissues from juveniles have

been also provided for analysis of immune gene expression. First attempts to develop a challenge model have been performed with *Photobacterium damselae* subsp. *piscicida* in meagre and greater amberjack.

Efforts have been made to isolate pathogens from cultured **meagre** and **greater amberjack**, and several parasite and bacterial species have been isolated and identified (*Epitheliocystis* in **greater amberjack).** The monogenean parasite *Zeuxapta seriolae* (**Fig. 14**) was the most prevalent and important parasitic pathogen. Apart from *Zeuxapta seriolae*, it has been also identified the blood fluke *Paradeontacylix* sp. to be present in **greater amberjack** reared in Greece (**Fig. 14**). There is scarce information on the biology of this parasite and almost nothing is known about its life cycle. A passive collector device has been designed and tested as a method to detect and quantify the level of infestation of monogenean parasites in **greater amberjack** during rearing in tanks.

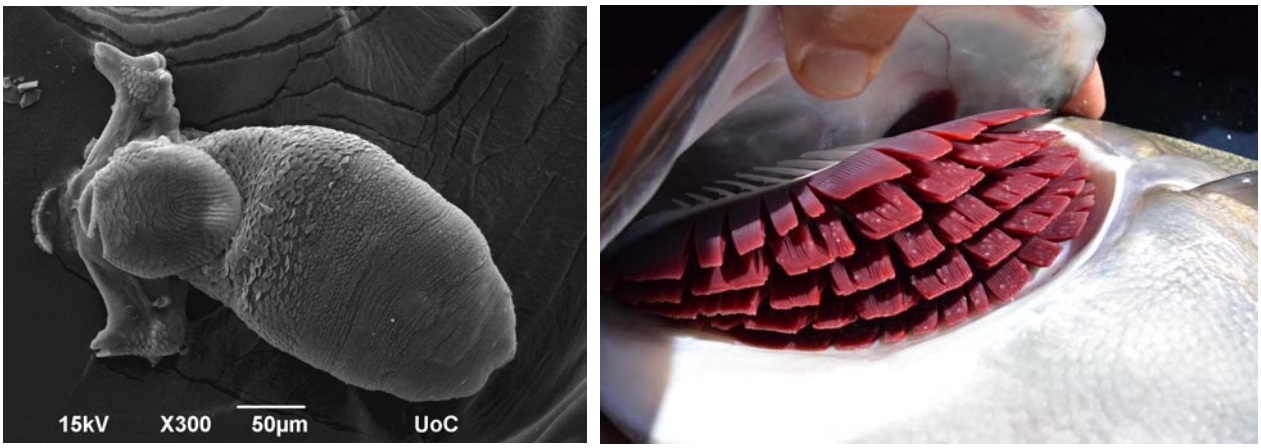

Figure 14. *Diplectanum sciaenae* from **meagre** broodstocks (left) and an infection of *Paradeontacylix* spp. on the gills of a greater amberjack broodstock from sea cages (right) (photos from HCMR).

With regard to **Atlantic halibut**, production of Viral Neural Necrosis (VNN) capsid protein has been progressing well, and successful expression in *E. coli*, tobacco plants and *Leishmania* has been achieved. However, bacterial cells do not glycosylate the expressed protein, as do higher eukaryotes. By expressing the capsid protein of nodavirus recombinantly in different systems, it should be possible to find out if post-translational modifications influence antigenicity, thereby affecting its ability to induce protection when used as an antigen in a vaccine.

GWP Socioeconomics

The macro-environmental context analysis performed, has indicated that most EU countries have a policy to increase fish consumption, and seafood consumption is increasing in most EU countries. This growth can only be realized at the expense of other protein sources, since the protein market has been stabilized in the last few years. The southern countries eat more fresh whole fish, while northern countries prefer processed fish. Consumer preferences concerning farmed fish seem to converge to convenience and fresh standardized products, such as fish fillets, portioned meals and processed foods. Industrial buyers in northern EU work closely with their trusted suppliers to develop new products, while the southern EU can be determined as seller markets, meaning that suppliers often initiate new product offerings. In approaching industrial buyers, farmers should be able to provide full information on their entire production process.

The consumer survey identified three consumer segments: (1) involved traditional consumers (29%): who know relatively more about fish and buy traditional fish products; (2) involved innovators (36%): who know relatively more about fish and who have a more open mind to buy new fish products and (3) ambiguous indifferent (35%): who know relatively less about fish and who are less open to buy new fish products. Based on the first findings, more than one third of the consumers in the five selected countries belong to the segment of 'Involved innovators' and could therefore potentially be open to buy new species.

A total of twelve products have been selected from a pool of 41 concepts for new value added product from DIVERSIFY species, based on their different degree of technological complexity and processing and taking into account the appropriateness for each of the species under study:

(1) Frozen fish fillets (meagre) with different recipes,

(2) Fish (meagre) burgers shaped as fish (**Figure 15**),

(3) Ready to eat meal - salad with fish (meagre) **(Figure 15)**,

(4) Fresh fish fillet (pikeperch) with different "healthy" seasoning and marinades,

(5) Ready-made fish (pikeperch) tartar with additional soy sauce,

(6) Fish (pikeperch) spreads/pâté,

(7) Thin smoked fillets (grey mullet) (**Figure 16**),

(8) Ready-made fish fillets (grey mullet) in olive oil (**Figure 16**),

(9) Fresh fish fillet (grey mullet) with different "healthy" seasoning and marinades,

(10) Frozen fish fillet (greater amberjack) that is seasoned or marinated,

(11) Ready-made fish (greater amberjack) tartar with additional soy sauce

(12) Fresh fish steak (greater amberjack) for grilling in the pan (**Figure 11**).

Intrinsic (sensory properties) and extrinsic characteristics (information provided) of the selected products/concepts were assessed by consumers in five countries (France, Germany, Italy, Spain and UK). Extrinsic properties were evaluated for the twelve developed new products meanwhile, for practical reasons, intrinsic attributes were only assessed for 6 of them ((2), (3), (6), (7), (8) and (12)). A complete report with the results of this evaluation can be consulted at www.diversifyfish.eu.

Figure 15. Fish (meagre) burgers shaped as fish and ready to eat meal - salad with meagre (photo from IRTA).

Figure 16. Thin smoked fillets (grey mullet) and ready- made fish fillet in olive oil (lefft). Fresh fish steak (greater amberjack) for grilling in the pan (right) (photo from CTAQUA).

Steering Committee meeting

There was no steering committed meeting at this ACM, since a number of issues were discussed via email during the previous months, in preparation of the 3rd Amendment to the DOW, which was submitted initially on 30 November 2016, and then resubmitted after a minor correction at the request of the Legal officer (Mrs Patricia Oprea),on 12 January 2017.

Special meeting of WP 30. Socioeconomics

A special workshop was also planned among some of the Socioeconomics partners during the morning of Friday 20 January 2017, in order to discuss the market testing proposed in the DoW. Present were Gemma Tacken (GWP-leader), Hellas Saltavarea, Kostas Larentzakis, Lluis Guerrero, Marija Banovic, Thanasis Krystallis, Ed Nijssen and Machiel Reinders. Based on the discussion, the indication was that it is not realistic to perform the test as stated in the text of the DoW. However we first must make sure if products can be delivered and when products can be delivered.

The group agreed on the following procedure:

- First check whether we can perform the market test in the original way as stated in the DoW: experimental design/ checklist for the SMEs with what we need for a real market test.
    - Ed already has this design (Taguchi-experiment)
    - We need an answer of the SMEs to have a go/ no go:
        - Availability of products
        - Availability of partners
        - Whether things can be settled in time
    - Decision should be made by the 1st of May.

Deviations:

The ACMs were planned in the DOW to consist of 2-days of open presentations and 1 for consortium activities. However, the previous ACM 2014 (Bari, Italy) and ACM 2016 (Nancy, France) contained only 1 open day and 2 days reserved for consortium activities. This was considered necessary because of the large number of Work Packages in the project, and the need for as much time as possible to be allocated to the discussion of obtained results and future planning of the work, as well as the preparation of the 1st and 2nd Periodic Reports (Mo 12 and Mo 36). However, as this time there was no periodic report due, until a year

later (January 2018), we returned to the originally planned format of having 2-days of open presentations and 1 for consortium activities and planning of upcoming activities. This decision was already taken after the previous ACM (2016) and was reported in ***Deliverable 1.6 Annual Coordination Meeting for Y3***. This format allowed all Partners to have a detailed view of the progress of the project after 3 years and will disseminate the information to a larger invited guest audience.

There were no other major deviations from the DOW at this time. Some delays in the uploading of the Deliverables have been discussed (and mentioned in the minutes of the GWP Workshops), but they are not considered major in kind. Also, there are a number of expected delays in some of the upcoming deliverables, but so far there is no expectation of any Deliverables not been completed within the lifespan of the project. These expected delays have been mentioned within the minutes of the specific GWP workshops reported in the previous pages.

A group photo of some of the participants of DIVERSIFY ACM 2017 at the beautiful staircase of Palau Macaya, Barcelona, Spain.

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