Aquaculture Europe 2017 – an excellent opportunity for cooperation in improving research and production

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INTRODUCTION

After 18 months of intensive preparations, Dubrovnik hosted the Aquaculture Europe 2017 conference from 17-20 October 2017. The conference was organized by European Aquaculture Society, with the cooperation and support of the Croatian Government, Croatian Chamber of Economy, Dubrovnik-Neretva County, City of Dubrovnik, universities, research institutions, and Croatian producers. The decision to organize this unique event in Croatia reflects the international reputation of Croatia's aquaculture sector. Such an event would not be possible without the dedicated efforts, energy and commitment of the organizing committees, programme co-chairs, session chairs and students who spared no effort to give their best.

Aquaculture Europe 2017 (AE2017) was a great success, with nearly 1700 participants from 62 countries. Interest of the aquaculture industry was also high. The trade event was very well attended, with 107 exhibitors displaying the latest products and services. All trade show booths were sold and space was created to accommodate additional stands.

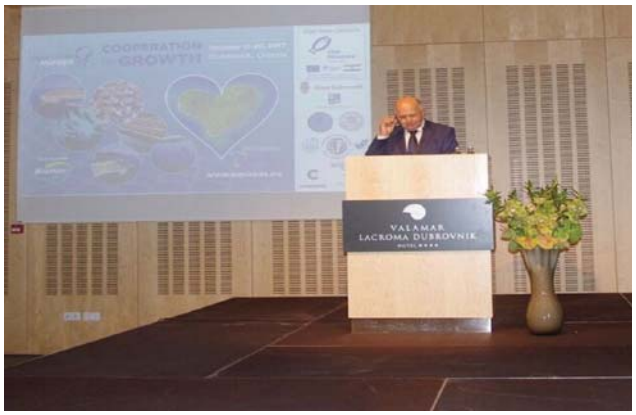

Fig 1. Aquaculture Europe 2017 – Opening ceremony orcherstrated by Congress Chair Dr. Ivan Katavić (photo: Snježana Zrnčić)

The event began with the opening speech by Congress Chair Dr. Ivan Katavić who orchestrated the opening ceremony (Fig. 1). This was followed by the welcome addresses from Croatian Agriculture Minister Tomislav Tolušić, Dubrovnik-Neretva County Prefect Nikola Dobroslavić, Vice-president of the Croatian Chamber of Economy Ivan Skorić, and EAS President Bjorn Myrseth.

Fig 2. Aquaculture Europe 2017 - Welcome address by Croatian Agriculture Minister, Tomislav Tolušić (photo: Snježana Zrnčić)

The Agriculture Minister thanked the organizers for bringing the latest achievements in aquaculture to Croatia, and for stimulating links between science and industry (Fig. 2). He found the conference to be an important venue for the discussion of the key scientific and technological issues for aquaculture development, stating that Croatia will keep in touch with international institutions and bodies to further improve Croatia's aquaculture industry.

Bjorn Myrseth expressed his concern over the slow growth of the European aquaculture industry in recent years. Furthermore, he stressed that fish farming requires the support of a long value chain, from administration, to

producers and consumers.
The theme of the event was Cooperation for Growth, founded on the belief that cooperation between operators in the sector can contribute to growth in the aquaculture industry (Fig. 3). This can be achieved by improving breeding programs, governance, policy and planning, health control and fish welfare, feed resources, environmental and zootechnical performances, promotion, product quality and marketing, training and knowledge management, including open access publications.
An impressive lineup of distinguished speakers outlined the most challenging and advanced topics in aquaculture development, and quality and safety of the fish food sector. Several Forums were held to address unique topics such as European flat oyster and Bluefin tuna issues, and Mediterranean aquaculture perspectives. A Student Forum was held as a programme for Young Generation Members.

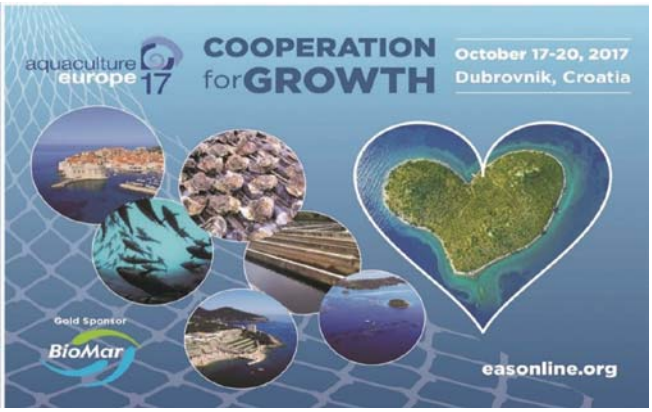

Fig 3. Aquaculture Europe 2017 – a promoslide (source: EAS)

Plenaries

The first day started with the plenary on ***Status of Fish Nutrition,*** likely the most controversial environmental issue in the forecasted future expansion of global aquaculture. Namely, the majority of poorly managed low trophic pelagic species are estimated to be around target levels or fully exploited. Therefore, the future of aquaculture based on fishmeal (FM) and fish oil (FO) as the main feed components is not promising.
On the other side, the efficient digestion of new plant-based ingredients may be limited by fish digestion physiology and capacity. With the increasing substitution of fishmeal with plant based matter, the feed components in aquaculture are increasing the risk of mycotoxin contamination, which also presents a potential risk to human health.
This replacement with plant-based ingredients may also affect the nutritional value of aquaculture products. Michael Crawford from Imperial College, London in his plenary speech titled "Is substitution compromising our omega 3 (DHA) position?" outlined the essentiality of a long-chain omega 3 and especially docosahexaenoic acid (DHA) − rich diet for brain development and maintenance (Fig. 4).

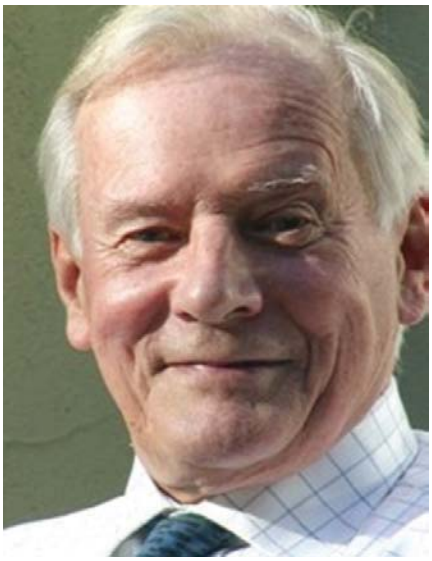

Fig 4. Prof. Michael A Crawford, PhD, Imperial College, London (source: EAS)

His recent research points out the importance of the health and nutrition of the mother to the intelligence of the newborn child even in the months preceding conception. His evidence has been supported several times by joint FAO-WHO expert consultations.
Crawford concluded that marine-derived HUFA and trace elements are also key for addressing mental illness, which is increasing at an alarming rate. Such a continued impact of escalating mental illness is a further reason for the urgency of developing marine food resources, while capture fisheries is stagnating with no real perspective to increase fish supply. "As we look to replace more and more fish meal and fish oil (for sustainability requirements) and replace them with terrestrial plants, the DHA content of farmed fish may also decline".
Looking ahead, he forecasted that a new industrial revolution will take place in the aquatic environment, in the form of "ocean agriculture". While vascular diseases were a 20th century problem, it is believed that mental illness will prevail in the 21st century. Seafood has no alternative to the health of a mother, her child, and especially the elderly, due to the extended life expectancy.
The plenary session on the second day was a real perspective

of the future of Eastern Atlantic and Mediterranean Bluefin Tuna (BFT) aquaculture. This was followed by a special session and workshop dealing with the most challenging BFT farming issues. Fernando de la Gándara, an expert on bluefin tuna (*Thunnus thynnus*) aquaculture and farming research from the Spanish Institute of Oceanography presented "Large scale RTD facility to take tuna farming forward" (Fig. 5). He provided excellent insight into a large-scale, land-based facility in Mazzaron Murcia, dedicated to overcoming the bottlenecks in the controlled reproduction and larval rearing of Atlantic bluefin tuna.

Fig 5. Fernando de la Gándara, PhD, Spanish Institute of Oceanography, Director of the Murcia Oceanographic Center, Mazzaron, Murcia (source: EAS)

Atlantic bluefin tuna is an emblematic species that has fed Mediterranean human populations for centuries. Over the past two decades, its wild stocks have been severely overfished, with high quota limits leading to consequent reduction of the production. A 15-year recovery plan for overfished BFT stocks in the East Atlantic including the Mediterranean was adopted at the historical International Commission for the Conservation of Bluefin Tuna conference (ICCAT) that took place in 2006, also in Dubrovnik. The ICCAT advised that an overall reduction in fishing effort and mortality was needed to reverse current trends that would otherwise lead towards BFT extinction. Thanks to science-based decisions, sacrifices of the entire sector and the good management that followed, recovery of the stock was recorded in less than 10 years time, and this success story has been communicated around the globe. In the meantime, progress in BFT fisheries based aquaculture has been made from fattening (short-term breeding) towards the real farming practices in Croatia (duration 1 – 3 years).

In order to protect BFT and to satisfy high market demand, it is essential to increase bluefin tuna production coming from sustainable aquaculture, where the entire biological life cycle is managed. Now, when the egg supply from caged breeders is no longer a limiting factor, this inaugurated, large, land-based facility devoted to research on controlled juvenile production is the next step needed towards achieving sustainable BFT aquaculture.

The facility presented is a model of how research centres of excellence can enhance cooperation to generate new knowledge of performance that can be transferred directly to operators, and to provide the technical basis needed to take the sector forward. Such large-scale facilities that are closer to production conditions may also provide a clear perspective of closing the biological cycle of other highly valuable fish species in captivity, and thus enabling diversification of the current aquaculture production.

"Gene editing. A game changer for aquaculture?" was the final plenary held on the third day by Anna Wargelius, a molecular biologist working on aquaculture genetics at the Institute of Marine Research in Bergen, Germany (Fig. 6). Anna and her group are currently exploring the function of wild beneficial genetic variation using the CRISPR technique, with the long-term overall aim to develop more sustainable solutions for salmon farming.

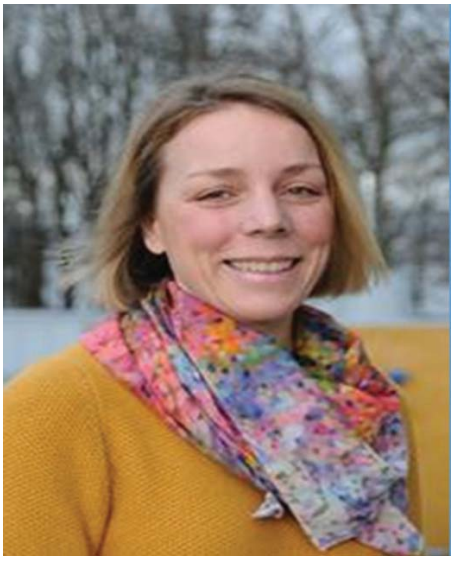

Fig 6. Anna Wargelius, PhD, Institute of Marine Research, Bergen, Germany (source: EAS)

Gene editing has been hailed as a 'major breakthrough' in both plant science and human medicine, with its 'pros and cons' widely published in the scientific and general press. However, what are the uses of gene editing in plant science and agriculture and how have these benefited the production of food crops? What is the potential for aquaculture and what are the main lines of work being researched? What are the quality/nutritional/market benefits and issues of this biotechnology for aquaculture?

The plenary tackled the level of public acceptance and ethical considerations of such a biotechnology that must be considered. It is expected that some public perceptions may exist for aquaculture products created using genome editing technologies. Should science be used to create new forms of life, be it microorganism, plant, terrestrial animal, fish, or human itself? Is everything that is technologically achievable good for the Earth and humans? This brings us to a crucial question: what are the ethical issues that we must consider as we assess if and how best to adopt this as a potential game changer for aquaculture? No doubt, if profit maximization is given greater priority over human health and environmental protection, it can be considered unethical with questionable morality.

Some highlights from parallel sessions

The three plenary sessions paved the way for 31 parallel sessions of oral presentations. This was accompanied by some 300 poster presentations, all derived from a record submission of 752 abstracts. Following are some of the highlights addressed by the presenters and the debates that followed, including some reports submitted with a personal selection of priorities.

Breeding programmes continue to deliver parental stocks with greater growth performances, health and quality. European aquaculture is still in need of diversification of both aquaculture production by species and food product. The successful reproduction obtained with greater amberjack, Atlantic halibut, wreckfish and mullet were highlighted. Remaining research areas of top importance are nutrition, grow out and husbandry, fish health, and consumer attitude towards new fishery products.

Applications of Recirculation Aquaculture System (RAS) were presented and discussed with particular reference to diverse species (sea bream, salmon, perch, and sea urchin) and advances in RAS water treatments in ozonation, carbon sources for denitrification, moving bed bioreactors, etc. Lack of knowledge on environmental requirements may have an impact on performance, health and fish welfare. Therefore, continued research efforts to benefit RAS production is needed in the future.

The organic aquaculture session provided a broad overview of the state of the art, key problems and challenges concerning producers. It started with carp and salmon farming in the 1990s, and is still considered one of most dynamic food production sectors. Regarding production of organic fish, there was a debate about regulations, different organic standards and certifications, knowledge needs to facilitate different fish species and production systems, environmental aspects, animal health and welfare, veterinary treatments, and consumer awareness and confidence. What concerns organic aquaculture producers most are the specific rules for sourcing feed ingredients covering the essential nutrients for the entire organic production cycle, from brood stock, over fry to on-growing phase.

Aquaponics, where fish and vegetable crops share the same waters, could be a suitable breeding system for many fish species. This system has become popular around the globe, and it is expected that EU policy will create real opportunities for aquaponics.

Mollusc aquaculture has focused on mussels and oysters, with less reporting on other species, excluding abalone and octopus. Major bottlenecks in production sector are space availability, food safety issues, and diseases.

Blue Fin Tuna, a special session, looked at the evolution of tuna farming in the Adriatic and Mediterranean as it moves from fattening to farming. The morning session presented the latest scientific findings concerning breeding, larval rearing, nutrition and health, while the afternoon session brought together a panel of tuna experts to look forward and to work together. This special session on BFT and the discussion that followed were very informative in addressing the status of the industry, bottlenecks, next steps and the importance of integrated research and collaborations. It is believed that based on these experiences, we will be able to do more for fast-growing oceanic fish-like tuna, yellowtail, cobia and mahi-mahi planned for AQUA 2018 in Montpellier next year.

The main issues covered by the ***Governance, Planning and Policy*** session were related to spatial planning of aquaculture, interactions with the environment as a whole, site selection techniques and higher mathematical and modelling analysis of aquaculture hydrography.
Finding space for aquaculture is likely the most essential factor determining the economic, social and environmental viability of an aquaculture project. The culturing site must provide optimum water quality for fish by mitigating

potential conflicts among users, and taking into account the interest of all stakeholders. The secret to success lies in an integrated approach that will optimize zoning for aquaculture, improve public acceptance of the aquaculture product, and contribute to both the global economy and rural development. In other words, without proper spatial planning, site selection and carrying capacity, there can be no successful commercial aquaculture sector, regardless of the level of advancement in other research disciplines (husbandry, feeds, veterinary medicine, etc.).

In addition to site selection, issues related to ***Interaction with the environment and social acceptability,*** which were high priority research subjects in the 1980s, are still popular, indicating that many lessons were not learned by industry and changes were not made in their corporate responsibilities.

Several presentations dealing with ***Integrated Multitrophic Aquaculture*** **(IMTA)** presented the efficiency and environmental performance in marine and freshwater systems. Although IMTA in Europe is still in the developmental stage, much research has already been carried out. The functional role of filter-feeders, deposit feeders, and extractive species (aquatic plants) in the IMTA system were demonstrated in several contributions. The potential value of such a system should be evaluated further, focusing on its ecological efficiency, environmental acceptability, product-diversified profitability, and societal responsibility. The final discussion that followed was very constructive and may help to promote cooperation in the future.

Legislation and regulations are still not harmonized in the EU today, creating unclear, vague and non-codified conditions. Moreover, they usually create extra production costs for producers, which is not always reflected in the market price of products.

Stakeholder participation and awareness processes are still vastly neglected. At the same time, research on the subject of socio-economics is still approaching the issue superficially, through surveys and tabular presentation of results, despite the development of specific analytical tools (statistical methods, etc.) that could advance our knowledge and allow for an improvement of analysis of both qualitative and quantitative data. Gradually, though, multi-criteria methods are increasingly used for this purpose.

Two separate sessions related to the health of aquatic animals were held: ***Health control – epidemiology, emerging diseases and diagnostics,*** and ***Health control – prevention and treatment.*** In the first session, presentations covered various groups of aquaculture species, *Salmonidae*, *Percidae*, *Acipenseridae*, in addition to Mediterranean fish species and molluscs affected by viral, bacterial and parasitic pathogens and toxic agents. Furthermore, several presentations reported general topics such as the economic impact of disease, disease management and new approaches to disease monitoring and epidemic forecasting. As new diseases are continuously emerging, immense efforts should be invested into developing diagnostic techniques, monitoring programmes, biosecurity implementation and risk assessment. Another session discussed new approaches to disease prevention by boosting the innate immunity using new ingredients or probiotic bacteria in feed, or through the implementation of vaccination programmes. The approach to combat economically serious diseases was also evaluated, though prevention should be more developed and highlighted as an important means of protecting the health and welfare of aquaculture animals.

EAS Thematic groups

Three EAS Thematic Groups organised events at AE2017 in Dubrovnik. **The European Percid Fish Culture Group** held a workshop entitled "New skillsets in Percid Fish Culture". The workshop discussed the latest achievements in skills and competencies required for successful percid fish culture. The Thematic Group brought together all those with an interest in the culture of pike-perch, perch and other species of the family *Percidae* for human consumption, stocking and conservation.

A whole day Industry Forum entitled "A stable supply of robust native oyster juveniles – identification and prioritisation of gaps and challenges", organised by the EAS **Thematic Group on Flat Oysters (*Ostrea edulis*),** brought together scientists and producers to address some of the principal bottlenecks and husbandry issues that are limiting the potential to bring back this native European species, so highly prized by connoisseurs and consumers. This was a forum for knowledge exchange and the sharing of best practices attended by scientists and flat oyster producers from across Europe. In the final part of the meeting, attendants were invited to prioritize the main challenges.

Finally, **European Eel Breeding and Hatchery Technology** held a workshop entitled "New Beginnings - The Way Forward for Eel Breeding and Larval Culture". The objective of this thematic group was to bring together researchers engaged in ongoing eel aquaculture projects

to facilitate cooperation and knowledge exchange in stocking, conservation, and larval culture technology.

A Student Workshop organised by the EAS Student Group called "A scientist, a producer and a student walk into a bar". The workshop aims to assist students of all levels to understand their possible next steps within the Aquaculture sector and how to prepare for them.

The ongoing **Horizon 2020 initiative COLUMBUS** presented an innovative new technique to better understand how to optimise the use of knowledge derived from research. Through a process of identification of Knowledge Outputs (KOs), it is developing transfer pathways to facilitate each step of the process to increase the Technology Readiness Level (TRL), to assist and support researchers in bringing their knowledge to market. This session introduced new techniques and presented several aquaculture case studies currently in the process. The presence of COLUMBUS partners at the AE2017 COLUMBUS Stand and transfer experts during the rest of the AE2017 event allowed interested scientists to look further into the transfer pathway and receive advice on pursuign their ideas.

Mediterranean Cooperation Industry Forum

This special AE2017 Industry Forum entitled "Cooperation in Mediterranean Aquaculture: A Croatian Perspective" discussed why aquaculture in the Mediterranean has not progressed significantly in recent years and addressed several of the issues inhibiting growth. The Forum brought together scientists from different aspects of Mediterranean aquaculture with industrial actors, including marine aquaculture professionals, farm managers, veterinarians, technologists, quality managers, representatives of the feed industry, representatives of vaccine and drug producers, as well as governmental bodies responsible for aquaculture.

Following an overview of the main issues facing Croatia's aquaculture sector, the first session of the Industry Forum was dedicated to the presentation of two ongoing H2020 research projects, MEDAid and PerformFISH. The project coordinators presented the main goals, and the approaches used to tackle the biological, technical and operational weaknesses of the Mediterranean aquaculture industry, aiming to improve industry performance, and foster sustainable growth through innovations.

The second session of the Industry Forum debated the main outcomes ensuing from ongoing EU and Mediterranean projects, and how to translate knowledge into benefits for the Mediterranean industry. The technical topics related to nutrition, health, welfare, breeding, product diversification, marketing promotion and quality of two most important marine species, European sea bass (*Dicentrarchus labrax*) and Gilthead sea bream (*Sparus aurata*) were discussed, and the main challenges prioritised.

Nutrition, feed and rapid changes in feed ingredients with all the consequences resulting from the replacement of fishmeal with plant-based protein sources that influence FCR, the underestimated presence of mycotoxins in feed, and the deficiency of certain micro ingredients were discussed.

Fish Health is still a bottleneck of the successful cultivation with an insufficiently organized common approach to disease prevention and control. Very few substances for infectious diseases are available and authorized on the market.

Welfare issues regulated by national and EU rules and the use of international standards and best practices are not precisely determined, mainly at transportation and slaughter. The panel debated how aquaculture operators should apply animal welfare principles.

Breeding selection programmes to reduce production costs and improve performance are relatively new in Mediterranean aquaculture. Part of the reason for the late implementation of such programmes is due to the structure of the industry, with a large number of small producers who cannot afford expensive breeding programmes.

Environmental management *has been recognized as an extremely important issue* in successful rearing. Some environmental properties are beyond production technology, though management should be harmonized and prepared to adjust zootechnical procedures to environmental conditions, such as changes in temperature, oxygen consumption, etc.

Product diversification, quality and marketing promotion *due to the current fragmented approach are still poorly developed compared to some other aquaculture species*, such as the salmon industry, catfish industry in the USA, or pangasius industry in Vietnam. The panel debated how to improve the image of Mediterranean aquaculture production systems (i.e. caging), and how to avoid the unwanted perception of the Mediterranean cultivated fish. New marketing strategies to drive consumer confidence and consumption matters more or less in all the above topics!

We look forward to further discussing all these issues at next aquaculture events, AQUA 2018 co-organised by the European Aquaculture Society (EAS) and the World Aquaculture Society (WAS) in Montpellier, France, and AE 2019 that will take place in Berlin, Germany.

Fig 7. Aquaculture Europe 2017 – First Steering/Programme Committee Meeting, held 12 May 2017 at the Valamar Argosy Hoel in Dubrovnik (photo: EAS)

Fig 8. Traditional music and dance – Lindjo (photo: Snježana Zrnčić)