Performance of the sea bass and sea bream sector in the Mediterranean

Minutes of a Workshop held within Aquaculture Europe 2014
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Organised by the European Aquaculture Society and the European Aquaculture Technology & Innovation Platform

Minutes prepared by the EATiP Secretariat
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Performance of the sea bass and sea bream sector in the Mediterranean

Minutes of a workshop organised by EATiP and EAS
Thursday, October 16th – San Sebastián (Spain)

More than 220 individual participants attended this workshop, which was organised within the EAS Aquaculture 2014 event.

Participants were welcomed by Kjell Maroni (EAS President) and Courtney Hough (EATiP General Secretary) who jointly chaired the meeting.

I. Introduction and overview of the key issues

Presented by Gustavo Larrazábal – Tinamenor Group & Chairman of the EATiP
(Picture courtesy of misPeces [www.mispeces.com])

The principal key performance indicators of Mediterranean aquaculture - growth, mortality and feed efficiency - have not progressed significantly in the sea bass and sea bream on-growing sector over the last 12 to 15 years. Actually, they may have got worse! Each individual company of the Mediterranean fish farming sector is very aware that there has been little to no improvement in its technical performance during this period and that this issue has become increasingly decisive for its sustainable development.

Collectively, the Mediterranean aquaculture producers’ representatives believe this to be the most imperative challenge to be resolved, exceeding the importance all other aquaculture issues and topics raised. Technical viability, including biological and operational aspects, is intrinsically linked to economic and marketing performance and, hence, to the growth and sustainability of the sector.

Why was this problem not flagged up before? A valid question – answered by:

- A lack of sectorial communication. *Individual companies may have thought the problem was only theirs and did not want to talk about it with others.*
- The financial crisis and the economic situation in many Mediterranean countries. *The whole industry has been in survival mode instead of being in a profitability mode, leading to being distracted from obtaining technical improvements.*
- The complexity of a sector functioning in many countries, many cultures, many languages...*but concentrated in one market.*

I hope that the scientific experts now recognise this issue, which was not the case before; nonetheless, we are aware that there are many unknown factors that influence performance and that I will describe later on.
What do we need?
The Mediterranean farmers, during meetings within the FEAP, have put forward the following issues:

- A lack of research into the nutritional requirements of the principal Mediterranean fish species reared
- Continuous, rapid changes in the feed ingredients used, for all life stages, by manufacturers and a lack of consultation on this fact with the producers, combined with a possible lack of depth in the relevant research achieved to date.
- The quality of juveniles, including broodstock selection and conditioning, affecting growth performance, susceptibility to disease, infection and survival.
- The lack of access to appropriate sites for following procedures, which means that new stocks for fish are not placed in the best environment for farming.

Nonetheless, the need for such technical improvements must also be accompanied by sincerity between players in aquaculture, opening up our communication channels, recognising and admitting the problems, followed by taking actions to resolve them. Pragmatic and practical solutions are needed urgently. My final comment is ‘let’s work well together’.

II. Strategy for the production and marketing of salmon and a comparison with the sea bass and sea bream industry

*Presented by Bjorn Myrseth – Vitamar AS & President-elect EAS*

(Picture courtesy of misPeces [www.mispeces.com](http://www.mispeces.com))

A comprehensive review of the production and marketing of salmon in Norway was presented by Bjorn Myrseth, who provided a comparison of these aspects with the position of the seabass and seabream sector in the Mediterranean (full presentation on [www.eatip.eu](http://www.eatip.eu)).

After noting basic biological differences between the species, it was pointed out that the feed conversion ratios for sea bass (FCR 2.0) and sea bream (FCR 2.3) were considerably higher than for salmon (FCR 1.2).1

In addition, genetic improvement work on salmon started in the 1970s, with considerable developments in the period 1993-2002. He noted that diseases were a bigger problem for salmon but that vaccination had significantly reduced the need for therapeutic treatments.

He reported on the investments made in research, with more than €100 million spent each year in recent times. Some 40% of this comes from industry, partially financed by a 0.35% levy on the export value of salmon. Large feed and production companies also invest in research.

Changes include bigger sites (up to 12,000 tonnes), bigger cages (from 12 metre diameter to 50 M and also much deeper). Needs bigger working boats, new material handling conditions (nets, moorings…). With increased mechanisation, lower production costs. Similar but slower developments have been seen for seabass and seabream.

In looking at prices/volumes, both sectors show price volatility, but more peaks and troughs in the seabream/seabass sector. Commercially, he noted that, between 2002 and 2012, growth had been 140% for seabass and seabream while Norway had grown 254%.

In a similar vein, it was reported that 90% of seabass and seabream are sold in domestic or local markets vs. 20% for salmon and that Norwegian salmon is now present in 160 markets worldwide – much higher export market penetration.

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1 FCR data provided by Bjorn Myrseth and FEAP
It was noted that in Portugal-Italy-Greece-Spain, salmon had achieved 15% growth (2010-2012) vs. seabass/seabream achieved 8% in these markets. He also noted the importance of Brazil-Russia-India-China markets – salmon having reached a total of 300,000 tonnes, vs 6,000 tons for seabass/seabream (mainly in Russia). Put simply, salmon has become a global commodity.

It was put forward that this position of salmon is due to a combination of factors:

- Boneless fillets – portion sizes
- Product diversification – smoked, sushi, attractive products
- Generic marketing actions

Whole fish represents only 5-10% of the salmon market vs. >90% for seabass and seabream. On the other hand, the yield for fillet is 63% for salmon vs. 45% for seabass/seabream.

Generic marketing actions are also important – €27 million were spent in 2013 = €0.02-0.03/kg of salmon exported from Norway; completely financed from the levy paid by salmon farmers.

In terms of productivity, the tonnes/employee has gone from 30 (1985) to 400 in 2011, with an associate production cost of NOK 20 vs NOK 68 in 1985.

Estimates indicate current production costs to be €3.3/kg for salmon and €5.10 for seabass and seabream. Extrapolated to fillets, this equates to €5.23 for salmon and €11.46 for seabass and seabream.

**A. Conclusions**

*Why has salmon been so successful?*

- High meat yield – a good fish to farm
- Well known species, image of a ‘luxury’ product

*What can be improved for seabass/seabream?*

- More R&D to reduce costs (control maturation, better FCR, disease prevention...)
  - Paid for by contributions from farmers? (e.g. a levy on feed?)
- Market development
  - More promotion, product development needed (paid by farmers?)
  - Better information needed cf. Kontali salmon report
- Bigger sites, site rotation/fallowing, year class separation
  - Better environmental management
III. Challenges – Identification and Prioritisation

Following these initial positions, panel presentations and debates followed (CVs of panel members are in Annex 1).

A. Panel 1 – Genetics, Epigenetics and Breeding

Potential impact of insufficient GENETICS, EPIGENETICS and BREEDING on the loss of performance, including brood stock selection and breeding programmes, brood stock conditioning, nutritional programming and larvae/juvenile origins and management.

1. Key points from panellists:

- **Antonio Coli, Selonda:** Last 10 years, an improvement of 7-10% in performance has been seen (from a selection programme).
- **Carlos Mazorra, Tinamenor:** Need to optimise feeding, maturation... Sector needs a structure to be able to proceed with the more risky (long-term) work on breeding envisaged. Knowledge exists but not enough critical knowledge; new technologies and approaches to breeding technology need to be implemented.
- **Marc Vandeputte, INRA:** Recommended identifying the best phenotypes so as to obtain improvement. Lots of new tools but you need good data to know how they perform (e.g. with new feeds...)
- **Anna Sonesson, NOFIMA:** Breeding activities are getting more technical and complex in the genomic era. Genomic information is in breeding used to increase selection accuracies. Quantitative genetics knowledge is needed in companies to ask the right questions, develop methods and implement new results. Breeding activities is today part of integrated companies, or set at specialised breeding companies.
- **Leonidas Papaharisis, Nireus:** Felt that there are too many individual breeding programmes – perhaps not effective enough. Funding an issue for marker-assisted selection.

Panel 1: Antonio Coli, Anna Sonesson, Carlos Mazorra, Leonidas Papaharisis, Marc Vandeputte
2. **Points raised in discussion**

Following the salmon example, Sonesson advised working with specialized breeding companies

- In Norway there are 2 specialised companies: AquaGen (owned by a big foreign company active in poultry breeding) and SalmoBreed (also for sale) – while Marine Harvest has its own programme
  - Both Selonda & Nireus (public Greek companies) have their own programmes for selection on growth patterns
- In France, all breeding programmes are private – SYSAAF is the French association of poultry and aquaculture breeders, which brings support to breeders and shares general expertise – this is a nice example of joint forces. When you buy juveniles, you have documentation on the genetic lines of stocks.
  - A similar initiative should exist for the whole Mediterranean
- Clear need for reproductive control so as to establish breeding programmes.
- Problem of management appreciation - that only sees the (very) long term investment without seeing the huge benefits
  - Investment of a minimum of 6 years before results are seen
  - No clear examples (of success) in the Mediterranean
  - Need a higher awareness of the need for (shared) data so as to obtain a solution
- Some participants claimed that it will be impossible to have the different Mediterranean companies working together in a joint breeding programme because all work in different manners and apply different criteria; sharing data is not liked
- It was reported that a growth rate increase of 30-40% can be obtained within 2-3 generations BUT environmental parameters also influence performance.
- Maturation and sex ratios are difficult traits to work with.

Still, working together will be a must for aquaculture to be competitive with other sectors – the chicken and swine sectors have established very successful breeding programmes!

- A producer/farmer commented that a lot of money is already spent on R&D but the results are too scientific and not of (evident) practical use – needs EU coordination taking into account the requirements of the farmers.
- Question:’ is it possible to create a ‘reference fish’ ?’ so as to benchmark the different breeding programmes (for salmon, ‘wild salmon’ is used)
- No or poor availability of high quality genomics resources (e.g. reference genomes, and high-density SNP chips) in both these species, although they are valuable for increasing knowledge on fish biology, gene mapping and selection accuracies. Work has largely been done without finding. Concerted action is needed!

3. **Panel Wish List**

- **Public investment to improve breeding programmes – lack of funding is a big issue**
- **Joint work – between industry/research**
- **Industry should make a Vision/Strategy to take the activity forward**
  - Funding the right structures for achievements
  - Exchange knowledge/technology
  - Common solutions for common problems
  - Service to the sector
- **Give more focus to genetics and its contributions**
4. Conclusions

1. There is no quick fix on genetic improvement.
2. Genetic improvement of breeding is big business that cannot be handled by individual companies (cf. the poultry industry, only 4 big companies are working with genetics for breeding)
   a. This appears as a position for commodity products like salmon, but is not the same for sea bass and sea bream. In the poultry sector there are some very successful but small breeding companies for minor species and specialised lines. But it is clear that selective breeding requires high levels of technical investment and dedication, which cannot be done just as a side activity to hatchery production.
   b. Specialisation is needed (but already exists to some extent), and should be supported and backed up by research programmes bringing together research and industry.
3. Need for joint forces to put in the hands of bigger entities – act as a service to the sector
4. Coordination on EU level requested (cf. Vision document EATiP) – check if next calls follow the guidelines set by this Vision document
5. Industry has to take the initiative – via European Investment Bank? Joint investment in a new breeding company?
   a. Request to FEAP to investigate (through Mediterranean Aquaculture Commission)

B. Panel 2 – Feeds, Nutrition and Ingredient Substitution

Potential impact of FEEDS/NUTRITION/INGREDIENT SUBSTITUTION on the loss of performance, including the evolution of Economic FCR; nutritional requirements and performance parameters to assess ingredient substitution.

1. Key points from panellists:
   - **Niels Alsted, Biomar**: The fish we rear are carnivorous animals. Sustainability factors and perception issues are important. Need to improve the quality of fish meal. No quota decision in Peru raised fishmeal price by 22% in one day. 3 big feed companies spend €30 million/year on research – but farmers need to learn to feed better.
   - **Ramon Fontanillas, Skretting**: How to reduce uncertainty/variations? Fish eat and need nutrients, not just different raw materials. Nutrients + vitamins + micro-ingredients
   - **Marco Gilmozzi, Cosasrl**: The sea bass and sea bream that we rear now are weaker animals than before.
   - **Alessandro Moretti, Inve**: We are not monitoring the quality of fry/juveniles well enough: More certification, after better consultation, is needed.
   - **Sachi Kaushik, INRA**: Noted progress and the work done in Aquamax, Arraina and other EU-funded projects.
   - **Torbjørn Åsgård, NOFIMA**: Quality criteria for feeds are needed. Need to have established references and benchmarks. Price movements & availability means that the choice of ingredients is a moving target. Need to establish quality criteria that correspond to the target potential of both ingredients and (compound) feed and define how to achieve this. Feed technical quality has changed a lot due to changes in ingredients used and feed logistics but is this optimal for the fish?
Points raised in discussion

- More cooperation between research & industry needed, accompanied by more business-oriented research that is not seen in the Mediterranean at the moment
- Investigate nutrients more than raw materials; benchmarking is also an issue – reference points are needed for stable ingredients but ‘quality’ criteria for nutrient formulation are not always evident.
- Issue of scarcity of fish meal and fish oil – the aquaculture industry cannot rely on these sources – in salmon feeds, there is already a drastic decrease in fish meal inclusion – Ω3 content is an issue – clear need for alternatives!
- More flexibility is needed in the choice of raw materials – the inclusion of PAPs and GMO is only an issue of perception – not safety!
- Fishmeal producers should also work on product development, e.g. question of taking out the essential nutrients, must listen to the needs of the aquaculture sector!
- Observations from Mr. Gilmozzi: feeds have changed a lot the last 10 years, fish are weaker now (little resistance to aeromonas) and fat inclusion is very high in the liver (necrosis) and pancreas affected, even in the fry of only a few grams weight – he suspects this could be due to the lower quality of fish oil used, lots of soya, small larvae are fed too early on pellets...
- Niels Alsted suggests 4 main working areas to solve the sustainability issue of fishmeal/fish oil – alternative raw materials:
  - Take better care of the by-products of the fishing industry for potential use
  - Algae production? – phototrophic might not be very cost efficient
  - Heterotrophic production of algae is a better route – however, obtaining the Ω3-equivalent from fish oil is a huge requirement and remains too expensive
  - GMO route? (e.g. genes from algae incorporated into plants) – a possibility but is it acceptable to public opinion?
  - There has to be a commitment by the farmers that they indeed want to use these alternatives at a higher cost → it is only with this commitment that the investments needed can be made.
- Alternative approaches:
  - Harvesting copepods from the ocean?
  - Use fish oil only for larval diets and finishing feeds
  - Genetically triggering good use of plant oils by the fish
- Question: why does the energy go to fat and not protein?
- There was a comment on the lack of presence of retailers in the panel as they determine everything, they set the rules on what is allowed or not. However, it was also noted that it seems very difficult to get retailers to participate; they do not want to tell or give individual opinions in public, but it was felt that such opinions may be based on (wrong) perceptions
- Is there a lack of research in seabass/seabream? More being done that thought originally but noted that feed costs for pig/poultry=80% of all costs. Other costs may therefore not be optimised?
- Discussion on feed quality–feed prices; it was pointed out that ‘you get what you pay for’ – farmers only want the lowest price but should be more realistic.
- Where to get the replacement of fishmeal and fish oil?
  - Discards? Only if unfit for human consumption
  - Heterotrophic fermentation? 20,000 tonnes equivalent production could be 2-3 times current price
  - GMO route? Possible but general GM acceptance issue comes up
  - Commitment to acceptance needed to get the investment
- Question: what should the industry do? What are feed companies working on?
  - Note: Reported that the FCR is worse for seabass than seabream
  - Efficiency vs. cost e.g. better software to manage automatic feeding
- Feed companies want to invest in more research but this has a high cost. If they don’t get rewarded, the research may not be done
  - benchmarking against a reference diet can really help to build trust and is a cost-efficient way to improve –
  - lack of capacity of the facilities to do benchmarking is a big problem!
2. **Panel Wish List**

- **Oil is the crucial point**
  - Need to know best levels of ingredient use
  - (Control of) rancidity is also a big issue to face
  - Some sources are not good enough to use

- **Need to focus on quality**
  - Rules/Certification need to be discussed

- **More open cooperation is needed between players**
  - Agreement on issues can lead to positive actions

- **A solid base for benchmarking is required where quality is rewarded**
  - Suppliers have to be engaged in the challenges
  - Quality control on feeds essential for benchmarking
  - EPA must be used, even if it is more costly
  - Feeds that provide top performance are essential

- **Pellets should be sized/structured to go with the stomach size/capacity**

3. **Conclusions**

1. Information exchange needs to go on – quality is certainly the way forward.
2. Discussion with retailers about (wrong?) rules is also a must – limitations on feed formulation have a negative effect on quality and therefore performance.
3. More open communication platform between all stakeholders needed to address specific problems.
4. Problem not limited to seabass/seabream – same questions asked for salmon 20-30 years ago: takes a long time to get research into practice!
5. Solid base for high-value feed (and performance) benchmarking needed – not selling on price only, sell on quality base.
   - Link to genetic optimisation
   - Need to optimise tools for the process
6. Engage raw material suppliers to feed/farming problems so as to develop new products.
   - Tailoring the use of (available) ingredients is important
   - Managing feed to dietary needs gives the best result
7. Nutrition has to be science and practice! The offer for good feeds exists.
8. Commitment by all players to use (more expensive) sources of Ω3 fatty acids?
9. The identified problem(s) in the Mediterranean need(s) a quick solution, causal factors? Can we study this in more depth?
10. Further discussion will be held at Aquaculture in Motion, organised by FEAP, where also consumer organizations and retailers will be invited

C. Panel 3 – Health, Diseases and Veterinary Treatments

Potential impact of FISH HEALTH/DISEASES AVAILABILITY OF VETERINARY TREATMENTS on the loss of performance, including industry priorities for the most important diseases to resolve, key parasite challenges, preventative veterinary measures (including fallowing) and availability of veterinary treatments.

1. Key points from panellists

- **Patrick Smith, Tethys Aquaculture Ltd**: Vaccines are essential (as opposed to antibiotic use) but there is still a long way to go. Consistent prioritisation exercises need so as to identify emerging diseases, product gaps and research needs.

- **Francesc Padros, SDPP-UAB**: Moving from diseases that kill fish to managing chronic problems. Establishing good health avoids losing money; the sector cannot support losses of >5-7% so mortality is a big problem. Nurseries are not well prepared and there is an important issue in applying the ‘basics’ in the early life stages.

- **Panos Christofilogiannis, AQUARK**: seabass and seabream rearing in adolescent phase cf. salmon. Sees parasites as the main new challenge although nodavirus is the main ‘killer’ in the Mediterranean.

- **Claudia Maira, Pharmaq**: Intensive rearing is a challenge – optimal production is a combination of factors.

- **Øystein Patursson, Fiskaaling**: remembers ISA (Infectious Salmon Anaemia) in the Faeroe Islands. Basic measures of year class separation and fallowing, making each fjord a management zone, has meant virtually no diseases but big difference between short-lived diseases and parasites; sealice is the big problem.

The Norwegian model of cooperation (administrators, private sector, research) has allowed solutions to complex problems and issues to be found.

- Legislation must be clear – produce in the right way (productivity-healthy animals – good sites)
- Record-keeping essential – disease notification, origin if fish
- Good sanitary status reduces the risk of disease
- Vaccination must be mandatory – linked to the production cycles

In the Mediterranean, cooperation is needed – especially between farmers – to have measures to combat diseases.
2. Points raised in discussion

- Question: What is the problem with parasites in the Med? In Norway, it is a resistance problem.
  - Answer: Too many different strategies to tackle disease, lead to production losses and slow growth; treatments tend to be individual reactions vs. coordinated.

- On the issue of individual site management/fallowing, it was indicated that the responsible authorities are not yet ready to understand the technical and social aspects of site management.
  - The Food and Veterinary Office of DG SANCO is undergoing a mission, including Mediterranean countries, so as to assess public and private measures on health and sanitary measures in Europe. Mission report anticipated end 2015.

- Spatial planning is good but should not concentrate farms in one area
- Feed is a black box but goes closely together with health; fish cannot fight disease if their liver is in a bad state.
- In a discussion on mortality, it was said that for salmon – from start to end – mortality rate is 10-15%; but sector does not know the reasons for all fish mortalities in cages
  - Panel view for seabass/seabream mortality is not under 15% and could be up to 40% in certain cases
- Absence of nurseries in Mediterranean – could reduce losses drastically by implementing nursery phases and separation of generations is needed. The future is to culture fish in nurseries up until 7-8 g to introduce them in the cage farms after vaccination.
  - Structural and management issue
  - Need to stock healthy vaccinated fish in the sea cages
- Technology for vaccinating 5-7g fish with machines is now available. Until recently this was only possible for fish >25g weight (salmon technology). Needs to be combined with defined best management practises
- The cost of up-front licensing procedures was highlighted (e.g. for recombinant DNA vaccines)
  - Legislation needs to be freer
  - The current effort is devoted to vaccines against Nodavirus and other upcoming bacterial pathogens. Vaccines for parasites, fungi and amoeba are not yet available, even for salmon, so it will take years and forward steps in technology so as to become available in the Mediterranean.
  - Licensing cost for a sea lice treatment was reported to be >€2 million – simpler registration procedure would be welcomed

- Intestinal parasites identified as giving significant growth losses; what can be done?
  - Not sure what is being done wrong so as to resolve the problem
  - Sector needs treatments that work
- BMPs for disease management would be one of the best things to prepare
  - Preventive measures are needed
  - Difficulties noted for treating fish in cages – can be dependent on the weather

Additional comments from participants:

- In Spain, estimate 8-10 years to be able to have sites for falling and separating year classes; problem is the autonomous Regions and having to deal separately with each one.
- For a farm that has to supply fish of the same size to the market – mixing stocks became the practice
- Nursery site needs – need to change thinking – how to use the sites best!
3. Panel Wish List

- **Reduce the risk of diseases through better site management**
  - Cooperation-communication essential to go faster
- **Vaccines development must be pushed**
  - Vaccine technology needed in the Mediterranean
- **Create a real-time network for monitoring and information on fish health**
- **Create a levy on production for marketing and health (how to create?)**
- **Need a new operating model for aquaculture in the Mediterranean**
  - So as to get the best results from genetics, nutrition etc.
- **Promote cooperation between industry and the administration**
  - Define better what you are targeting

4. Conclusions

1. Assuring fish health remains a top priority
   a. Monitoring systems need improvement
2. Vaccines provide a solid option for health improvement measures
3. Legislation needs to be more flexible to allow licensing of novel technology vaccines at national licensing levels, avoiding expensive and inflexible centralised and decentralised procedures.
4. Legislation to allow or impose year class separation should be promoted
   a. Site rotation and fallowing after year class harvest should be imposed
   b. 3 sites for 2 growing licenses needed
5. Improved governance and control, through public and private cooperation and management (site and stock) measures, is needed
How to improve? Together?

IV. Presentation on direction needed for the sector

A. Production Performance – Benchmarking – Farm-scale Research - Priorities

Javier Ojeda, APROMAR (Spain)

1. Summary

The comments provided by experts in the room earlier today have gone through a plethora of issues that could affect the performance of seabass/seabream production. They can be prioritised and possible overlapping issues analysed, but not much more can be added.

Handicaps the seabass/seabream production industry suffers today:

1. Complexity: Many countries, many cultures, many languages...
2. Economic situation: In survival mode most of the time instead on profitability mode.
3. Lack of sectorial internal communication.

Potential order of importance:

Complexity → Little/no sectorial communication → Economic situation.

This is a simplification - with many exceptions - but they are the core of the problem and also of its solution.

- We are in a scenario in which sectorial cooperation (national & transnational) is VERY complicated and almost inexistent today.
- So, this time, we (the producers) cannot blame others. It is our problem and it is us who have to solve it, or at least trigger the search of a solution, with help from researchers, suppliers, suppliers of suppliers, NGOs and Governments. We have heard of success stories elsewhere so this can work!

Industry situation in the Mediterranean is basically chaotic

From a highly fragmented industry, we have gone to a fairly consolidated one, but the behaviours are the same throughout. **Collaboration and cooperation is not happening.** Not only on working on production performance, but also on easier (communication/cooperation) issues:

- Commercialisation issues: Information on fish sold (sales/prices)
- Juvenile stocking levels (planning production)
- Fish health notifications
- Environmental issues

There are many topics that would best be addressed together – but this is not happening and we have heard that it is essential.
The basic principles defended by APROMAR are:

1. That information sharing allows for better decision-making of the individual companies and gives long-term benefits.
2. That our real competitors are other fish and even other terrestrial animal (chicken, pork...) producers.
3. That each company should analyse in which issues they can be better by themselves and accept the need to share improvements with other seabass/seabream producers on the rest of challenges.

But collaboration between companies requires building trust, between companies and in the system. And this is not happening. In Spain? a partial 'yes', but we are probably an exception. Collaboration (wherever possible) needs to be accepted and decided by the top strategy makers of the companies (a top-down issue).

This communication & trust should be extended (depending on the issue) other stakeholders (feed manufacturers, for example, as Ramon Fontanillas mentioned).

How to implement common actions?

Some collective measures (on fallowing, fish health rules, etc) can be implemented on a compulsory basis through hard laws (Norway - Norwegian Seafood Council) but also of voluntary basis through Codes of Practice (soft laws) (e.g. Scotland) for example.

As Bjorn Myrseth mentioned, individual salmon-producing companies have experienced and today enjoy the advantages of collective actions (promotion, public relations, external analysts, market intelligence...) but this does not exist for seabass and seabream.

I ask you on which precise topics can collaboration between companies be worth doing to improve performance?

Suggestions for ‘easy-to-accept’ collaboration objectives:

1. Facing our clients (supermarkets) together to accept the new feed ingredients (GMOs, PAPs, haemoglobin proteins, ...), limitations that are based on perceptions.
2. Explaining consumers on the requisite evolution of aquaculture production.
3. Addressing EU/FAO/National policymakers to set guidelines on, for example, fallowing.
4. Promote/fund a holistic transnational project/programme to face this performance challenge?

How can this collaboration be materialised?

The type of organisation/structure will obviously depend on the issues for which such collaboration is agreed, but:

- Associations/FEAP?
- Producer Organisations?
- External companies (such as Kontali)?
- Governmental organisations? Probably not...
- A new platform?

And with which stakeholders?

- We have heard about the need to involve other stakeholders (raw material suppliers, clients, consumers, NGOs) – but assuring their involvement and commitment also needs to be assessed.
Benchmarking – means Production benchmarking

- Measuring improvements requires that one knows the starting reference point.
  - Today, in our sector, we still have no good estimate of FCR, juveniles per kg of fish,…
  - Basic knowledge that we need
- We need benchmarking in the farms.
- We need to set top performance figures.
- Requires scientifically-designed data collection.
  - Is there any benchmarking being done today?
    - Note: the EC FindIT project, coordinated by FEAP, has this as one of its main targets

Research

- Transnational cooperation in research is already possible and effective around the EU.
  - But, why has the research investment within the EU not solved these problems already?
- Is the scale of research a significant factor in this aspect? i.e. Tank-scale vs Farm scale (offshore)
- The money is there – in the Framework Programmes and elsewhere

V. Additional Comments from participants

1. Topics covered
   - Genetic selection is a long-term process – but must be followed
   - Licences for vaccines – an evident need
   - Fallowing? Not enough sites – competition for use – unless production levels are lowered
   - Probiotics should be investigated

2. Issue of scale – individually, not able to pay – has to be the establishment of collective efforts – but not sure if cooperation is a recommendation

3. Implementation of risk management strategies could be important
   - Assurance of fish stocks against ‘disasters’
   - Stabilisation actions against price volatility
   - Resolving financial risks – need long-terms provisions vs. short term actions

4. Reducing financial losses is imperative – Greek mariculture has lost >€200 million!
   - Cooperation is essential
     - On marketing - producer organisations seem to be the best tool
     - Data sharing
       - Benchmarking on prices/volumes & marketing performance
       - Benchmarking on production performance and KPIs

5. Structures exist already – e.g. EATiP and (some) national multi-stakeholder platforms
   - Use/support these for improvement and support actions

6. Mobilising finance is a core issue – particularly where cooperation has been weak
   - Leverage is necessary to open doors and get actions on the road

7. Transnational research exists but this represents more cooperation between researchers rather than companies
   - Hope that attaining the EATiP VISION/SRIA is followed up
   - Public funding tends to be long term
   - Need to find balance and place for realisation of the SRIA
   - Bottom-up exercise for RTD requirements needed vs. top-down
VI. General conclusions

A. Overall position

1) More attention needs to be given by both the EU and relevant Member States to the urgent priority of improving technical performance of the Mediterranean fish farming sector, specifically on sea bass and sea bream. The absence of improvement over time is marked.
- Individual focused projects or a more holistic, integrated programme are required to address this, on both a short and longer term basis.
- The EATiP Board is committed to monitoring progress and compliance of project funding with the EATiP Vision and Strategic Research and Innovation Agenda.
- Industry and Research should review together the EATiP Vision and Strategic Research and Innovation Agenda with a specific view for adoption or adaptation to Mediterranean fish farming and its priorities.

2) Sectorial cooperation and collaboration is almost inexistent in the Mediterranean but this is an issue that has to be resolved by the production sector itself.
- Establishing trust and improving communication are key to establishing viable cooperation through a participative process.
- Options include use of the pan-European Federation, the development of an association of Producer Organisations or a specific Mediterranean structure.

3) The profession needs access to large-scale experimental facilities for a range of research and testing purposes, backed up by scientific substantiation, so as to reflect true farm conditions for validation purposes.

4) Financing from the industry is needed to put many of the actions discussed into place, be they research, monitoring or testing. It is urgent to agree on a financing model to enable their realisation, which should be discussed with the European Commission and other funding sources, including Member States and the European Investment Bank.
- Options could include a levy on production or feed use
- Such a funding mechanism could also be applied for marketing purposes

B. Practical Measures

5) Improved site management measures require a new legislative approach, both from EU and Member State positions
- Year class separation of fish stocked in cage sites is essential
- Site rotation and falling after year class harvest should be imposed
- 3 sites for 2 growing licenses needed, leaving one for falling purposes

6) Establishment and definition of the nutrient requirements of sea bass and sea bream are needed for each life stage/age.
- Research to provide the best quality feed is needed
  - For each species
  - For each stage of development

7) The profession needs healthier fish throughout their lifetime, so as to reduce mortalities and improve related Key Performance indicators.
- Better governance for monitoring and management systems
- Vaccine developments for existing and emerging health issues are a priority

8) Benchmarking and reference points are needed in many aspects of aquaculture operation and development
- Scientifically designed and supported measures are needed
- Sectorial cooperation must improve to allow this approach to be successful
C. Developments & Investments proposed

9) Breeding programmes – for improved stock performance – appear to be too big a task for individual companies, although the benefits are clearly recognised
   ♦ An industry-led and supported genetic improvement programme is needed
   ♦ Investment (in a breeding/genetics entity) and operations that required to implement a programme for the Mediterranean needs identification for further development

10) Investment in (an) industry-led experimental pilot marine farm(s) for scaled-up testing requires consideration so as to improve efficiency and competitiveness measures of research and innovation; ideally, one centre for the Mediterranean industry.
   ♦ Allowing testing of feeds, treatments, processes
   ♦ Examining biosecurity, zootechnology, genetics and husbandry
   ♦ Verified through scientific validity
VII. Survey results

A. General Prioritisation of the research areas discussed:

The results presented are the consolidated ranking scores, by theme, of 39 completed questionnaires provided by workshop participants to the organisers. The questionnaires were completed by

- 13 Research/Academic
- 20 Corporate, production or service companies
- 3 Associations, NGOs
- 3 Unknown

Compilation of the data was made by Alistair Lane (Executive Director of the EAS)

For each theme presented and discussed, participants were asked to identify the 3 top issues of importance where research and/or actions are needed to obtain improvement and development.

Scores are ranked on this basis, noting that similar topics have been merged.

1. Genetics, Epigenetics and Breeding
   1. Regional cooperative approach, with specialised structures 18%
   2. Breeding for growth 16%
   3. Breeding for disease resistance 13%
   4. Good, reliable strains 12%
   5. Maturation control 6%
   6. Application of knowledge 6%

2. Feed, Nutrition and Ingredient Substitution
   1. Need for FCR/quality benchmarking 15%
   2. Long term health benefits of FMFO substitution 14%
   3. Effectiveness of feed sources 12%
   4. Feeding management 10%
   5. Palatability & digestability 10%

3. Fish Diseases and Welfare
   1. Development & availability of vaccines 20%
   2. Monitoring, shared information & transfer of knowledge 15%
   3. Health management 11%
   4. Availability of antiparasitics 11%
   5. Fallowing/site rotation 7%
   6. Prophylatic treatments 7%

[Overall Priorities chart]

Overall Priorities

- Genetics & Breeding 32%
- Nutrition 31%
- Disease-Welfare 37%
4. **Other issues of importance**

Participants were also invited to share their views on other issues that should be considered, for improvement of performance and/or development.

1. Better marketing and new markets 13%
2. Cooperation between companies 13%
3. Better quality fish for consumer image 12%
4. Husbandry improvement 10%
5. Communication throughout the value chain 8%
6. A single (Mediterranean) reporting & data centre 7%
VIII. EAS/EATiP Panellists short CVs

A. Keynote presentations

**Gustavo Larrazábal.** President and Managing Director of the Tinamenor Group, he joined the company 23 years ago. The flagship of the Group, Tinamenor, S.L. was founded in 1973 and was the pioneer Spanish company in marine fish farming. Today, this is one of the most representative groups of the Spanish aquaculture, and holds six companies, operating from hatchery breeding to table-fish production and commercialisation. Member of the Board of Directors of APROMAR (Spanish Marine Fish Farmers Association). Vice-President of FEAP. Chairman of EATiP – European Aquaculture Technology and Innovation Platform.

**Bjørn Myrseth** has had an exceptional career, being active on many fronts since he graduated with a Master’s Degree from the University of Bergen in 1971. Almost immediately, he became a founder of Stolt Sea Farm, which was specialized in the production of salmon smolts first in Norway, then in Scotland, USA and Canada. Later, market-size Atlantic salmon was produced and Bjørn Myrseth was the key driver of the company’s involvement in sturgeon farming in California. He then looked to diversify his interests and, through Marine Farms AS where he was CEO, made investments in Greece, UK and Chile. Marine Farms was listed on the Oslo Stock Exchange in 2006, having operations in the UK (salmon), Belize (cobia), Vietnam (cobia) and in Spain (seabass and seabream).

He has been a long-time supporter of cooperation and openness in developing aquaculture and, already in 1976, was a co-founder of the European Mariculture Society – the precursor of the European Aquaculture Society (EAS). While active in founding regional and national aquaculture associations in Norway, he was elected President of EAS in 1992 and is the current President-elect (2014-2016).

A. Panel 1: Genetics - Epigenetics - breeding

**Antonio Coli** is an aquaculture professional that holds a BSc, an MSc in Aquaculture from Stirling University and an MBA from ALBA Greece. He is specialized in aquaculture of marine species. At the beginning of his career he worked as researcher, while soon after he started working in the field of hatcheries of marine species. He worked at the beginning in managerial positions and then as manager in several hatcheries in Greece, Turkey, and Norway. For the last 12 years he worked in Selonda S.A., as hatchery manager the first years and for the last 5 years he is responsible for the operation and the production of all the 5 hatcheries of the Selonda group and the logistics and transportation dpt. of the fry sector. His main area of interest is the management of aquaculture production business.

**Carlos Mazorra de Quero** – R&D Manager Tinamenor. Dr. Mazorra has experience on scientific project management, both within the RTD and Industry environments. After a grant period at the Microgravity Department of the European Space Agency, he was recruited in the UK’s Technology Foresight Programme and carried out his Phd at the Institute of Aquaculture of the University of Stirling. Following a number of years as Research Supervisor in the Marine Aquaculture Department of the Seafish Industry Authority in the UK, he joined the team of Tinamenor, S.L. in 2004 as Manager of Innovation. Now responsible for the R&D+i Department, he leads the contribution of the company in several R&D+i programs both nationally and internationally.

**Leonidas Papaharisis** is an Ichthyologist with advanced studies in Quality Management and has an MPhil in Fisheries Economics from the Business School of University of Portsmouth (UK). He has been working in the aquaculture industry since 1996. Since 2003 he has been working in NIREUS SA as QA/QC Manager, and since 2009 he took over also the Research & Development department of the company. He is responsible as head of the R & D team for the design, approval, monitoring and evaluation of all the R & D projects like breeding selection program, testing and development of new fish feed, new veterinary products, new aquatic organisms presenting an interest for the company and added value products.
Anna Kristina Sonesson is a senior scientist at Nofima, Norway, in Breeding & Genetics. Her specialities are inclusion of genomic data in breeding, management of inbreeding and gene mapping, for all aquaculture species. She is the leader of the EU FP7-project FISHBOOST which will boost the aquaculture production of six European finfish species through selective breeding- 26 partners from 9 countries. Other posts: Ass. Editor Animal Genetics, Board Member Aquaculture program of Norwegian Research Council

Marc Vandeputte is an animal geneticist at INRA, The National French Institute for Agronomic Research, where he coordinates the Aquaculture sector. He has been working towards establishing efficient selective breeding programmes in fish since 1996, initially on rainbow trout and carp, and then in sea bass with Ifremer in Palavas, since 2005. He has participated in many EU and national projects on fish breeding, and is part of the EU FP7 Fishboost project led by Nofima, which aims at bringing selective breeding programs to the next level for the main 6 EU fish species. He currently coordinates the FP7 AQUAEXCEL project on European Aquaculture research infrastructures.

B. Panel 2: Feeds – Nutrition – Ingredient Substitution

Niels Alsted is the Executive Vice President of the BioMar Group and is responsible for raw material sourcing, Niels has been working for BioMar for 25 years and has been a driving force behind the BioMar Group’s international expansion making them one of the world’s leading fish feed producers. From the beginning, Niels participated in setting new standards in fish farming; he was one of the persons behind the first environmentally declared fish feed in the world (Ecolife) which has make Danish Aquaculture an internationally competitive and environmentally friendly industry. He is member of the Board of Directors of Damolin A/S and GUDP (Green Development and Demonstration Programme) under the Danish Ministry of Food, Agriculture and Fisheries. He is a dedicated speaker and he participates in numerous cross-industrial and international forums where he e.g. plays an important role in ensuring a sustainable development of aquaculture, among others in dialogue with WWF and other NGOs.

Torbjørn Åsgård is a senior advisor/ scientist in nutrition and feed technology with Nofima AS in Norway. He holds degrees in Agriculture at the Norwegian University of Life Sciences (NMBU), 1979 and 1984 and became Professor in animal nutrition at the same school in 1992. He has 35.5 years of experience with aquaculture industry related R & D projects (in Europe and Latin America), 22 years as research scientist (Akvaforsk) and 13.5 years as Research Director (Akvaforsk before 2008 and Nofima from 2008 - 2014) and 3 years in 20 % position as Professor at Norwegian University of Life Sciences (NMBU). His main areas of interest are in Nutrition, Nutritional physiology, Ingredient processing, Evaluation of feed ingredients, Feed formulation, Feed technology, Feeding, Resource efficiency, Optimization of production and Sustainability.

Ramon Fontanillas is a veterinarian and holds a PhD in Animal nutrition by the Veterinary School of the Autonomous University of Barcelona (UAB) in 1996. After that he worked in several feed additives companies in France and Spain. Since 2004 he joined the Skretting Aquaculture Research Center (Skretting ARC), in Norway, where he works as Senior Researcher at the Nutrition Department. His main areas of interest are the study of the nutrition requirements and raw material use in Mediterranean species.

Marco Gilmozzi is the Managing Director of the COSA fish farm in Orbetello, Italy. He is also Vice-President of the COOPAM – the Regional Aquaculture Fish Farmers Cooperative Group and Vice-President of the Italian Fish Farmers’ Association (API) and also of the FEAP. He sits on the Board of Directors of the GAC Gruppi d’ Azione Costiera for the Tuscany Region.
Dr Sadasivam (Sachi) Kaushik, was until end of September, Director of Research in INRA, France. Has been involved in Fish Nutrition research since more than three decades. He is currently coordinating an EU FP7 project “ARRAINA” dedicated towards the development of sustainable alternative aquaculture feeds tailored to the nutritional requirements of European farmed fish species, over their respective full life cycles, with reduced levels of fish meal (FM) and fish oil (FO) and to assess the long term physiological consequences by applying targeted predictive tools applicable to multiple species of European farmed fish. He is closely involved with the aquaculture industry and is the current President-elect of the European Aquaculture Society.

Alessandro Moretti studied Marine Biology and started his career as junior hatchery assistant in SIRAP (Venice), the first Mediterranean Industrial marine hatchery. From 1985, partner and co owner of STM working for the design and management of private marine hatchery (main projects Italy, Greece, Spain, Portugal, Turkey, Tunisia, Algeria, Egypt) and as marine aquaculture specialist for local and international institutions among which: Alimenta, GENERALI, ENEA, FAO, EU Commission (STM Projects), World Bank (STM Project). From 1995 has been co owner and technical manager in MRS (marine hatchery for Sea Bass and Sea bream). From 2001 has been employed by INVE Aquaculture where today he is working as Product Manager for Fish Hatchery Nutrition and and Health Portfolio. Specific expertise: Marine fish farm design; Fish hatchery design, management and scientific co-ordination; Product Management and Fish Nutrition.

C. Panel 3: Health – Diseases – Veterinary Treatments

AQUARK is a leading consultancy firm in health and nutrition management in Mediterranean mariculture. AQUARK was established in 2004 by Dr. Panos Christofilogiannis who is a veterinarian, fish Biologist (MSc), fish Pathologist (MSc, PhD) with long experience in the aquaculture sector. AQUARK has an established network of collaborating fish veterinarians, fish biologists experienced on fish health management, vaccination field trials and strategies as well as experts on fish physiology and fish feed benchmarking and bioavailability. AQUARK also supports sector initiatives consulting for FGM / FEAP and act as coordinator of the HELLENIC AQUACULTURE TECHNOLOGY and INNOVATION PLATFORM.

Claudia Maira has veterinary degrees from Universidad de Chile and Norwegian School of Veterinary Science and has been involved in aquaculture since 1990. She works at PHARMAQ AS, Norway as a clinical scientist and is responsible for laboratory / field studies intended for product development and documentation in several markets including Norway, Chile, Central America and the Mediterranean. Previous experience includes field fish veterinarian in Norway and as a veterinary officer at The Norwegian Medicines Agency.

Francesc Padrós (DVM, PhDVM). Specialist in fish pathology and fish health management. Technical director of the Fish Diseases Diagnostic Service and Associate Professor at the Veterinary School of the Universitat Autonoma de Barcelona. At present, secretary of the SEA (Sociedad Española de Acuicultura). More than 20 years of experience in aquaculture industry & administration support on Fish Health issues and with a wide experience in Mediterranean Aquaculture species.

Øystein Patursson is the Head of research at Fiskaaling – the Aquaculture Research Station of the Faroes. Øystein has a PhD in ocean engineering and BSc in petroleum engineering and has worked with industry related research for the last 10 years. His main interests are: improved fish farming equipment for the highly exposed sites used in the Fareose salmon farming industry and environmental issues related to Faroese aquaculture, e.g. providing improved knowledge on the hydrodynamic transport between sites and how this knowledge can be used by the industry.

Patrick Smith, Managing Director of Tethys Aquaculture Ltd., founded Aquaculture Vaccines Ltd (AVL) – the first company to develop and commercialise vaccines for fish. AVL becomes a major sponsor of research into fish vaccines. AVL acquired by Schering Plough Inc (now MSD Animal Health) and takes position of Global Director of Aquatic Health Research and New Business Development. Currently, Vice-President of EAFP, Vice –Chairman of BTA and Board Member of EATIP and holds many scientific advisory positions.

D. Benchmarking

Javier Ojeda holds a BSc in General Biology (Universidad of Madrid), and a Master of Science in Oceanography (University of South Carolina, US). Since 1989, he has been involved in aquaculture production. In 2003, he was appointed general secretary for APROMAR, Spain’s marine aquaculture farmer’s association. A position from which he serves not only at a national level but also participates in international activities with the European Commission, the European Parliament, the Federation of European Aquaculture Producers, FAO, IUCN and other relevant organisations.