Workshop on Climate Change Adaptation

Feedback and information from participants

A presentation on the components and outcomes of the draft Guidance document guided the discussion. The participants were asked to provide information and feedback so as to complement and fill any gaps identified.

Additional Adaptation Measures

- Feed in relation to nutritional requirements of fish in a climate change scenario given that, for example, protein energy ratios are completely different higher temperatures. In addition, functional feeds as a barrier to pathogens in a climate change scenario.

Additional Good Practices

- When there are droughts or scarce water conditions to fill the ponds, alternate land plant production. Saxony example - use of one full pond instead of two half-empty ones for carp production.
- Combine the infrastructure measures with "system development" because, for example, in freshwater aquaculture a combination of technologies and management systems can be a good solution for climate adaptation addressing water scarcity.
- Link the document more strongly with environmental management. Better environmental management is a type of adaptation and fosters the sector's sustainability.

  Moderator Note: Links to the other Guidance documents, which are the guidance documents on access to space and environmental performance, are included. Where is deemed apt more links will be included.
- Monitor and forecast impact of pH and salinity, abiotic and biotic factors.
- Diversification in types of shellfish and algae as well as selective breeding for shellfish to be considered as adaptation measures and production opportunities.
- Identification of sites that will be more resilient in the face of climate change.
- Insurance and financial tools for emergency assistance in case of negative effects due to extreme climate occurrences.
- More extensive and comprehensive management of harmful algal blooms.

<u>Suggestions on Additional Good Practices examples</u>

- Examples applied in Greece:
  1. A tool that can measure the oxygen concentration in the water and chlorophyll using satellite imagery. It has been given to farmers to evaluate and plan to adapt and expand it based on feedback.
  2. A decision support software for site selection developed in an EU-funded project (AquaSafe), targeting farmers of sea bass, sea bream and meagre. It models the conditions close to shore and offshore, in terms of biological performance as well as

assessing the risk of heat waves and extreme weather effects etc and provides an idea of how a farm will perform in various environments. It evaluates the present conditions and provides forecasting of future scenarios. Many farmers produce all three species and the tool can help them to plan future production. The tool can be used in adaptation and farm management, as it can help farmers adapt their stocking periods and the cycling among species. This tool can be adapted for use in the rest of the Mediterranean.

3. Two innovative uses of sensors, one as a research project and one by a company (a cage producer that is the partner of a French start-up). They are using sensors to monitor oxygen and are able to forecast changes about 48 hours in advance.

- Examples applied in Ireland
  1. The use of AI to identify phytoplankton species for salmonid farmers, enabling the identification of species harmful to the fish and adaptation of husbandry practices in response.
  2. A spring-based system used on fish farming grids that dampens the effect of storm events and, in some cases, can be used to generate energy, and
  3. A company using blood testing of fish to identify welfare or disease early before the fish exhibit physical symptoms, enabling better management and intervention.

Moderator Note: Important to understand to what degree the practices mentioned are being tested and used and how the MS can get more information.

- Complimentary information on the Seastar project, (already included in the document) that used wearable sensors on fish to monitor their health remotely in real time and use the data for risk assessment and forecasting: The project has led to a pilot phase in the Gulf of Follonica (Tuscany, Italy), in collaboration with nine different fish producers, eight fish farms and one shellfish farm, in the main fish production region of Tuscany, Italy. The reference area is an allocated zone for aquaculture and will be nested with sensors. The sensor data will be validated with satellite data and with in situ data and made available to the producers.

- Examples from France (for molluscs)
  1. In the Mediterranean area, higher temperatures encourage algae growth which decreases the available oxygen with negative impact on production. In a joint project with companies, they are using sensors to identify areas with low oxygen and employing oxygen injection.
  2. To prevent microalgae blooms in the “clairs” (saline pond systems where oysters are held for several weeks prior being marketed) producers installed cooling equipment. It is very costly but very effective. As temperatures continue to rise with climate change, this will have to be continued.
  3. In the case of norovirus contamination they are testing, at the stage of depuration, how shellfish are adapting in a closed circulation system that can be cooled. It is still experimental, but if it is effective. The system is being validated in the Netherlands to confirm the technical and economic feasibility and the return on investment. The results will be disseminated.

This project has been noted as another excellent example of a crossover case between environmental issues, climate adaptation, health and infection.

- Technology that will assist in managing jellyfish blooms by noting rising temperatures. Mobile phone applications have been developed by several European and national projects. Users including individuals and professionals can take pictures with their cell phones, identify the species, and report the bloom. Professionals, including aquaculture farmers, can then respond accordingly. Reference the GoJelly project and similar ones in Malta, Spain and Israel. The projects concern larger jellyfish.

- Moving offshore to deeper waters to avoid warmer waters and coastal storms. An example in the UK of moving shellfish farming offshore. However, deep water aquaculture faces many challenges including mooring in deep waters in exposed areas, requiring navigation and avoiding collisions. Technology for remote monitoring will be essential at these distant locations and there is extensive technology available that can be used. Work is underway for upscaling and moving these offshore aquaculture systems from the pilot stage to a large-scale production stage.

  Moderator Note: This falls and within the location adaption measures (included in the document)**.**

- In terms of location planning and relocation, an assessment of the suitability of a site in view of climate change be included. Noted that, in the case of a pond, it cannot be relocated and thus the need for the suitability index for the farmers to know the future effects of climate change on their farm.

  Forecasting tools for location planning, relocation and suitability have been developed to assess the risk associated with the impact of climate change on three key viruses, both in the short-term (through mid-century) and long-term (to the end of the century). Specifically, the tools are risk maps that consider the geographic regions, the impact of temperature on both the viruses and the diseases they cause, and the effect of temperature on crop growth – for example, the number of days with temperatures favourable to disease development. The information in the risk maps is combined into a suitability map so that farmers can assess how their farms and businesses will perform in relation to these pathogens as the climate changes. There have been publications on this work.

  Moderator Note: This falls and within the location adaption measures (included in the document). Also, an example from Portugal on site suitability assessment for shellfish farming is also included in the document.

- An example from Norway relating to the adaptation measure on infrastructure adjustments. The use of sea-based closed and semi-closed systems gives some flexibility in dealing with changing environmental conditions.

- Suggestion for infrastructure adjustment and integration for shellfish and particularly for clams. An example for this necessity is that this past summer In Northern Italy, all the seed was eaten by blue crabs and more than 80% of the clam production was lost, meaning this area will have no clam production next year. Perhaps containment structures that can prevent the entrance of blue crabs in the coastal and transition area where the production is located may help to save some of the shellfish production.

- The rearing of multi-species to reduce risk and increase diversification. Some good examples of this in the AquaVitae project in France, Portugal and Norway.

- There must be a balance between environmental protection and the measures employed to attempt to regain control over climate change. RAS as closed, controlled systems whose effluent can be managed, are 'climate-proof'. Suggestion for inclusion of more positives on RAS and not refer only to the cost and energy intensity. As noted, many of these systems are beyond the research stage and climate change mandates that we investigate ways to attract financing and strengthen these systems that can benefit producers and also the environment.

- Efficiency is important but a focus strictly on the efficiency of aquaculture misses other targets of aquaculture, such as the complex socioeconomic and environmental benefits of pond aquaculture. Thereby, the request for more detail on adaptation measures where pond aquaculture is concerned (Chapter 3) as there is significant variability in how it is affected. For example, smaller streams with smaller catchments are more affected by extreme climate events, droughts, floods, etc than very large river-based paddock ponds in plains areas. Related detailed documents could be shared.

- Request for more content underlying that aquaculture is part of an ecosystem having in mind the involvement of coastal communities in production. Noted that nature based solutions [part of WP2- environmental performance] also target climate change and adaptation to it. Aquaculture could be part of Nature based solutions (NBS).

- Request to research if there are examples proving that Integrated multi-trophic aquaculture (IMTA) by itself is a system of aquaculture production that is not only environmentally friendly but could also provide solutions to climate change and, if so, to be included as another function of IMTA production systems.

- Two terminology issues and three content issues were posed:
  1. In Table 1, page 11, instead of the terms 'extractors' or 'inputters' or 'primary operators' which can be confusing, it would be better to use terms normally used and understood by the aquaculture sector.
  2. Noted that the EC has a specific definition of 'producer organisation' and that perhaps the document was referring to 'producer associations'. As this is an EC document, perhaps that should be changed if this is the case.
  3. RAS should definitely be promoted, given that energy intensive does not equate to impact on climate change.
  4. Very important to have insurance for the new climate conditions.
  5. On page 27 with respect to the introduction of non-native species, this is an option that many operators and MS are investigating. However, they face great difficulties even introducing locally absent species, species that were native but are no longer there. Noted the example of meagre in the Canary Islands in Spain, that it is not allowed to be farmed there.

- Example cited of diversification as adaptation measure: Farmed sturgeons (specifically *Acipenser baerii* and *Acipenser nudiventris*) when the water is too warm for trout. In relation to legality and the species directive, sturgeons are allowed to be farmed, even if they come from Siberia.

- Regarding financing and insurance, participants should consider the European Maritime Fisheries and Aquaculture Fund which, in some cases, provide funding up to 50-60% for measures or expenses related to climate change adaptation or mitigation, including food and water taxes or even insurance payments, which should encourage more farmers to take out insurance policies.

- Diversification and introducing non-native species, can be adaptation solutions but there is lack of the required information to make decisions about which species to introduce where. A study was just completed (onaquaculture in Norway). It considered about 50 different species of fish, algae, crustaceans, bivalves, etc. and will introduce the concept of aquaculture readiness level in the paper that will be published soon. The aquaculture readiness level is determined by defining what is known of the biology, technology and (growth) potential in different areas and under varying conditions for each species to determine whether it can be successfully cultured. It is emphasised that, overall, much of the needed information is still missing and attention should be payed to the proposal to culture large fish in the Mediterranean, for example amberjack, without having studied the thermal tolerance of amberjack at 33 or 35^0C as in fact it will not survive at these temperatures. Moreover, relevant such information is also missing for algal alien species.

  Moderator Note: Requested identification of opportunities which was relatively weak in the document, partially because many opportunities are at the same time associated with threats. For example, opportunities afforded by actions such as reducing the life cycle duration, the production cycle at certain times of the year, or adapting husbandry to plan the next programming cycle are often accompanied by threats such as new and emerging diseases and other limitations to production. In this respect, the so-called opportunities offered by climate change and adaptation measures are relatively weak.

  The more they review temperature-related advantages, the more they find complications and limits related to them. As previously stated, some areas that seem like opportunities may not be considered as such by industry. For example, in Norway they have proposed moving salmon production further north but there are relatively few sites available there. On the other hand, salmon farming in the south and southwest of Norway will likely not be feasible in 20 years. Perhaps they will be looking to introduce new species including non-fish species there and this will be supported by the assessment of different species to determine which sites become more feasible for the production of other species.

  Moderator Note: In summary, opportunities in diversification have been identified including some marketing aspects, production management aspects and some new trout strains. However, when it comes to good practice in selective breeding (based on the use of CODE EFABAR in the document) they had difficulty providing specific good practice regarding a breeding programme. As such, in consultation with several breeding companies and experts, they derived an overview on the major European species that concluded that none or few of the current strains in European aquaculture are resilient to dramatic, rapid, and impactful climate change adaptation.

- There is a need for capacity building among producers, many of whom running SMEs, and perhaps are lacking knowledge in climate change effects on their entity. This should be explained at national and regional/local level. The document is a very good starting point with a good overview of climate change effects, categorised according to production systems,

so producers can identify and understand what climate change could mean to them, but is suggested that more good practice examples are given.

- **Moderator Note:** Inquired if it is requested that the geographical dimension is given in the document i.e. what to be made and in what areas.

  The answer was affirmative

- Providing more information on the request it was stated that a matrix can be included linking good practices to certain areas that are most suited for. Noted that there are several studies that identify areas in the EU based on their vulnerability to climate change.

Validation of knowledge gaps and identification of research needs

In the document the research priorities were cited by reviewing the literature on European and national project areas as well as documents identifying both current and emerging priorities.

They are as follows:

Current	Emerging
Effects of CC and OA on pathogens and disease development, and on complex disease outcome.	Information on offshore environment/ecosystem and potential impacts of CC and OA on the sustainable growth of offshore aquaculture.
Development of vaccines for emerging new pathogenic bacteria and viruses.	The synergistic effects of CC and OA and the effect of fluctuating compared to continuous exposure to these impacts on settlement (shellfish), growth and survival of aquaculture species.
Development of models for forecasting the growth of aquaculture species at shifted temperature regimes.	The capacity of aquaculture species at individual and population level to adapt to CC and OA.
Fast development of in situ diagnostic tools for disease, but especially for welfare status.	
Effects of CC on the environmental impacts of aquaculture – e.g., assimilative capacity of receiving water bodies, including impacts at potential offshore sites.	
Understanding of the changing environmental factors under altered climate scenarios on the processes involved in the invasion, establishment and spread of a range of relevant non-native species.	

Input on additional research and knowledge:

- In the “Forecasting growth” research priority, suggestion for ‘shifted temperatures’ to be changed to ‘shifted temperatures and acidification regimes’. Reference to a tool developed in Japan from the JEC [Japan Environment Corporation] to assess acidification everywhere in the world, especially in Europe, and what the impact would be for two species, mussel and salmon. It identified the best places for farming to minimise the impact of acidification on these two species from 2030 to the end of the century.

- Identified the absence of models combining environmental parameters and disease, specifically the prediction of pathogen emergence and disease development in the context of climate change and generally of changes in environmental parameters.

- To address coastal aquaculture systems as biotic sensors – sentinels or early warning systems.

- Research priorities on non-native species to be expanded to include not only the impact the aquaculture sector has via the introduction of non-native species but also the risks to the industry posed by introductions of invasive species beyond its control. Also, the sector is increasingly impacted by native species acting invasively such as a proliferation of sea squirts on bottom mussel beds which makes harvesting and management very difficult. More research is needed on how to manage these situations.

  Moderator Note: The document refers to the issue of predators and highlighted examples of starfish predation as well as the impact of ballast water.

- Expand the first bullet point of current priorities to include antimicrobial resistance. The document references an increase in antibiotics use but this affects both antimicrobial resistance and consumer safety. Suggestion for more information on the effects of increased antibiotics use on pathogen and disease development in the context of increasing antimicrobial resistance in aquaculture.

- Add fish feed as a key topic in research priorities. Within adaptation, more resilience of the food and feed industry is required, including producing more feed locally, i.e., finding alternatives to importing from other continents or using by-products of fish. There has been attention on algae or small mussels or side streams from the marine sector like micro- or macro algae. RAS and closing the nutrient cycle and carbon cycle are discussed with respect to CO_2 and nutrients from aerobic digestion, from food side streams, or from biotech side streams. Given that emissions are generated, better resource management is required as well as new technologies together with regulations that support a circular economy to reach goals for nutrient and carbon balance.

  Algae based feed, for example, is very expensive and currently not an option farmers consider. Industrial symbiosis with more microalgae produced in large amounts and circularity of nutrients is a solution, and a viable one, because without circularity and recycling of nutrients in industrial symbiosis, costs cannot be reduced to make algae-based feed a viable option for farmers.

  A political effect of adaptation measures is that more food security for our systems is required.

- Continuing on feed: 1) the issue of alternative feed additives, which can make fish species more adaptable to climate change, should be included in addition to circularity. To include new types and sources of immunostimulants in research priorities. 2) In addition and in relation to this, microbiome investigations could be valuable.

Moderator Note: Already suggested to include as an additional adaptation measure, adaptations in feed during the life cycle or during part of the year according to temperature effects. It should be highlighted that the document concerns adaptation and not mitigation measures. As for circularity, the approach developed within the European Compound Feed Manufacturers' Federation (FEFAC) could be referenced.

- On supply chains and the market: 1) Concerning feed from a broader perspective, the resilience of supply chains is critical, as demonstrated by COVID-19 and the war. There is little information on supply chain adaptation, essentially what will change so the sector can address that proactively. 2) Consumer preference or acceptance is changing and this should be taken into account when, for example, products are harvested earlier or later, so at different size and weight. In particular, there is very little information about diversification of product size and how this might affect consumers or the market.

  Moderator Note: Several documents produced by the European Market Observatory for Fisheries and Aquaculture (EUMOFA), on the resilience of aquaculture with regard to COVID showed that seafood and aquaculture as part of it, were performing relatively well. The research need on the impact of these changes on products as a result of climate change adaptation and in extend the impacts on markets and consumers will be considered for mention. It can also be mentioned in terms of the "management of the production cycle" as an adaptation measure.

- Essential to know what is happening with the global food system in the context of climate change. There is a need for predictions about the impact of climate change on the 'special ratio of feed' in non-EU countries, the fish stocks providing fish feed and fish oil to the aquaculture sector, alternative raw materials and even the microalgae currently being investigated as feed given the fact that the European aquaculture sector is affected by these global markets.

- On the third item of current research priorities "development of models for forecasting the growth of aquaculture species at shifted temperature regimes" it should forecast not only growth but also health, and include pH/acidification in addition to temperature, particularly for shellfish for which this is the most important factor. 2) the sixth item of current research priorities, the phrase 'the establishment and spread of range of relevant non-native species' should also include 'and associated organisms' as most of the problems associated with introduction of non-native species are related to non-target organisms, that come with these alien species, particularly in the case of shellfish. 3) Forecasting how the environmental conditions and risks are changing should be included in in the third item.

  Moderator Note: The point in the emerging research priorities "*the synergistic effects of CC and OA and the effect of fluctuating compared to continuous exposure to these impacts on settlement (shellfish), growth and survival of aquaculture species"* is likely the most complicated one, as it includes climate change and ocean acidification (CC and OA) and their synergistic effects as well as the effect of fluctuating variables compared to continuous exposure. It is obvious now, that fluctuations are happening from one week to the next – not seasonal, or semi-continuous, or continuously increasing – and it is not only one variable that is fluctuating. It is a very complex emerging area of research where more knowledge is needed.

- 1) in addition to models for forecasting changing environmental conditions and risks, increasing the resolution of models is needed (for example 1x1 km^2 is needed instead of

10x10 km^2) . 2) Besides Suggestions for forecasting growth at different temperatures should also include heat consumption because temperature affects both. For example, one may have faster growth but lower capacity for digestion and energy use, leading to growth to energy ratios that are extreme. Hence forecasts of the effects of more measures beyond only temperature should also be included as well as of combinations of factors in forecasting growth. 3) In the sixth item "Understanding of the changing environmental factors under altered climate scenarios on the processes involved in the invasion, establishment and spread of a range of relevant non-native species" suggestion to add 'to understand the effect of various stressors on the physiology, immune system and health of species'.

- There is too much emphasis on pathology, as three out of the six priorities are about diseases and it would appear that climate change effects on aquaculture are strictly a matter of disease outbreaks. However, the sector must be more efficient, must decrease the impact of aquaculture in a new climate change scenario, and develop new models. 2) Regarding pathology, on point two, "the development of vaccines", should be broader. As mentioned by a participant, functional feeds can be used as an adaptive measure and there are now models to predict sea lice outbreaks (in Norway, for example). More information on tools that may prevent diseases can be provided and not only vaccines. 3) Regarding non-native species, it was asked whether this can be brought up in an environment favouring biodiversity-friendly approaches since, in the past, new species, non-native species and alien species were not considered biodiversity-friendly in terms of ecosystem protection and thus worthy of investment. Thereby, it is asked is the question whether the EC now thinks that investing in non-native species may be an opportunity to diversify aquaculture.
- Request that the document be more detailed and specific concerning the effects of CC on the environmental impacts of aquaculture – e.g., assimilative capacity of receiving water bodies, including impacts at potential offshore sites. It is likely that assimilative capacity will decrease, but how it changes in relation to climate change and how quickly it changes, and also the mechanisms of the aquaculture industry to adapt to this, should be investigated.

Moderator Note: The point in the emerging research priorities "*the synergistic effects of CC and OA and the effect of fluctuating compared to continuous exposure to these impacts on settlement (shellfish), growth and survival of aquaculture species"* is likely the most complicated one, as it includes climate change and ocean acidification (CC and OA) and their synergistic effects as well as the effect of fluctuating variables compared to continuous exposure. It is obvious now, that fluctuations are happening from one week to the next – not seasonal, or semi-continuous, or continuously increasing – and it is not only one variable fluctuating. It is a very complex emerging area of research where more knowledge is needed.

Industry measures recommendations

The industry measures identified in the document are as follows:

- Develop breeding programmes for all EU species focused on increasing tolerance to temperature changes and including the identification of genes related to thermal adaptation.
- Monitor fish health, performance, and behaviour (using real time / in situ tools):
    - Daily measurements of dissolved oxygen and temperature.
    - Improved understanding of fish growth rates.
    - Data records on mortalities.

    - Data records on disease related mortalities (>500 individuals).
- Develop and adopt more robust (and automated) infrastructure for:
    - Feeding
    - Movement of fish
    - Cleaning processes in line with increased biofouling.
- Increase and further develop the use of aerators and other oxygen supply techniques.
- Apply adequate biomass management (where possible) to compensate for seasonal temperature profiles.

Moderator Note: It is noted that oxygenation [bullet point four] has been already flagged by participants as the most important technique to be further developed but there are other techniques related to improving the water in terms of its suitability for promoting growth and feed consumption, etc. Also noted, is the wish of the industry to have real-time biomass estimation [bullet point five], a major priority for many years for the aquaculture sector.

Additional Industry measures proposed:

- The monitoring of shellfish health, performance, and behaviour is not on the list. Request that it be integrated in the second bullet point on monitoring of fish.

  Moderator Note: The word "fish" will be deleted so as to be clear that it includes and shellfish.

- Observation that algae was not covered.

  Moderator Note: Breeding programmes will cover algae.

- A major challenge is what to do with the data. The objective should be to develop programmes and systems that can take the data and provide farmers with simplified predicted outcomes.

- 1) Suggestion that the phrase "animal welfare" should be in the second bullet point as well, and that monitoring of animal welfare and environmental conditions could be integrated so that one monitors health, performance, behaviour and all the secondary effects of climate change in their production unit. 2) The third bullet point, [develop and adopt more robust (and automated) infrastructure], is missing infrastructure improvements to prevent escapes given the increasing frequency of storm events.

- Suggestion for an additional paragraph for freshwater aquaculture to include "climate adaptive sustainable intensification combined systems in fresh water".

- Regarding the first bullet point on industry measures, [develop breeding programmes for all EU species focused on increasing tolerance to temperature changes and including the identification of genes related to thermal adaptation], it would be better to be less specific and restrictive and phrase it in terms of increasing robustness in the context of climate change, noting that when selecting a certain focus or parameter such as growth rate, one inevitably affects other traits that may not be so desirable.

- Also regarding the first bullet point noted that there are two techniques of selection for shellfish. Mass selection will be accomplished naturally in three to five years because a minimum of 50% of production is done in natural sea environments. The second is selective family selection in hatcheries, which is related to bullet point 1.

- Regarding the second bullet point, [Monitor fish health, performance, and behaviour (using real time / in situ tools)], there was a recommendation by AAC requesting the Commission and MS to include shellfish as a bio-indicator of the quality of shellfish waters in respect to not only health and survival, performance and growth but also reproductive capacity, and to follow reproductive cycles again and again.
- Regarding the subsection in bullet 2 about data records on disease related mortalities, he noted that shellfish farmers in France developed a tool together with the MS authorities which invites every producer to register and provide mortality data.

Policy actions

Five policy actions are proposed in the document:

1. Allocate funds in support of breeding programmes to improve temperature sensitive traits.
2. Establish or upgrade monitoring programmes (with standardised format/content and easy access to pooled results for operators, on:
    - Site physio-chemical indicators of water quality (all sites)
    - Phytoplankton/zooplankton in ponds
    - Other appropriate environmental monitoring that provides the required data on climate change.
    - Husbandry indicators, including data on individual sizes; length of production cycles; stocking rates; winter biomass losses; mortality and disease outbreaks.
3. Integrate aquaculture spatial planning into the existing framework for Maritime spatial planning) and Inland Planning, including:
    - Identification of sites for potential relocation or reallocation of aquaculture activity by the further identification and establishment of AZAs where critical affecting parameters of climate change are less abrupt and hence allowing aquaculture production to adapt to changes more easily.
    - Adaption of legislation/licensing thresholds to finer scale and with a flexible framework for the designation of new farm sites.
    - Explore and promote co-location with other marine/maritime activities (for example aquaculture and wind farms).
4. Map and monitor relevant habitats; promote habitat conservation or restoration measures (e.g., LIFE projects).
5. Further develop national and/or European support to insurance for climate-related events.

Suggestions for additional policy actions:

- Need for programmes for all species to help both the governments to adapt regulations to the new conditions created by climate change and also the sector to ensure quality. She mentioned a platform, 'endemic seeds', with different mollusc larvae in different areas, and programmes to monitor the larvae and larval behaviour of the species of molluscs that rely on natural seed.
- Suggestion to allocate funds not only to breeding but to all the research gaps identified.
- Suggestion to delete item 4, as mapping and monitoring relevant habitats was not related to the guidance document.

- Suggestion for adding financing for climate adaptation and for aquaculture to be included in the taxonomy regulation.
- Note that public administrations, MS and regions should work harder to reduce administrative procedures and licensing procedures and that this point is already raised in the strategic guidelines. Moreover, all stakeholders must keep the spotlight on aquaculture, when it comes to climate adaptation, as it will be done for other economic sectors.
- Suggestion for mapping and monitoring of hotspots of climate change across Europe.
- Noted that the document does not address adaptation of organic aquaculture to climate change.
  Moderator Note: It was omitted as it could confuse the issue in two ways: focusing on differences in the production methods of a specific species using a certain technology, which could then lead to additional issues relating to standards, certification schemes, and a choice for a consumer position product like organic aquaculture, moving far beyond climate adaptation issues.
- Suggestion for a reference to a Common Aquaculture Policy integrating all policies, measures and regulations on the sector. The industry needs a common policy that is well-defined with binding measures. Noted that the Guidelines are not binding for the MS and their recommendations are not necessarily implemented.

Other comments on the Document

- Suggestion that the climate adaptation plans for aquaculture be part of the national climate adaptation plans, as also the document suggests. This inclusion is important, because the actions for aquaculture are interlinked with many other sectors and their actions, and all the stakeholders involved in the preparation of the aquaculture climate adaptation plans should also be involved in the preparation of the national adaptation plans.
- Stakeholder typology [Table 1, page 11] to be more specific and include economists, environmentalists and other experts for the understanding of market movements and climate change.

  In reference to Table 3 [Examples of indicators and outcome targets for the identification of adaptation measures (page 13) in the context of research needs and industry measures, noted that the document suggests that once indicators and outcome targets are identified, adaptation measures can be classified into categories. However, the measures must be supported by policy. There is a section on policy recommendations, but there are few good practices addressing this. It is difficult but important to better identify how policy and legislation can support climate change initiatives in relation to aquaculture, as without policy support at the national level or regional level, it will be very difficult to introduce new measures to help producers survive climate change effects. The document should make it clear to policymakers at all levels why it is essential to spend money on climate change adaptation for the aquaculture sector.