Marine Data to Support Aquaculture in the North Atlantic

A virtual workshop by EATiP, Copernicus Marine and EMODnet

October 20-21, 2020

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Executive summary

The online event "Marine Data to Support Aquaculture in the North Atlantic" was organised by the European Commission's general directorates for Maritime Affairs and Fisheries (DG MARE) and Defence, Industry and Space (DG DEFIS), the European Aquaculture Technology and Innovation Platform (EATiP), the European Commission's programmes of Copernicus Marine (Copernicus Marine Environment Monitoring Service – CMEMS[1]) and European Marine Observation and Data Network (EMODnet)[2]. More than 60 participants attended the event, with a background equally deriving from the aquaculture industry and the policy/coastal managers sector (37% each), with another 24% of attendees working on aquaculture research and 2% of participants from other areas, including data providers and consultancy agencies.

A series of presentations and discussions was hosted, and the first two main topics that they provided focus on were the identification of the specific data needs of the aquaculture sector in the region of the North Atlantic, and the input potential of the European Commission's Copernicus Marine and EMODnet services of marine monitoring and marine data initiatives. These are the two main long-term European services providing open and free access to harmonised and standardised marine environmental data (in situ and satellite), and in addition to this the national authorities are providing their own data services for coastal waters as well.

The third main topic was the set-up of an industry initiated, collaborative platform at a European level to encourage the aquaculture sector to share data that are necessary for the management of datasets to support various aquaculture activities. These, among others, can be (a) the application process for aquaculture licenses, (b) the development of the aquaculture sector with an ecosystem management approach and (c) the implementation of evidence-based management and governance in marine aquaculture. This platform would be focused at the aquaculture sector but its data and best practice examples would also benefit other stakeholders, including marine and agriculture organisations.

In relation to this, one key question discussed was the identification of an organisation or group that will provide this platform, and their needs for funding, knowledge and skills. Regarding the platform providers, EMODnet and Copernicus could combine European Commission data with sector-specific information and national initiatives and platforms. As far as funding is concerned, it was suggested that funding opportunities for the collaborative platform could be coordinated at European level, by EATiP and supported through EC funds, following of course the appropriate process of proposal selection. Payment for actual use of the services can be expected from the industry if a clear added value is shown. This might be possible for large businesses whereas smaller enterprises might benefit through existing clusters, national networks or consortia. It was however agreed by most participants that access to the platform should be free to encourage its use, with more labour-intensive services, for example forecasts, possibly on a paid basis. This is feasible, since the data services that the EC makes available are open and free of charge.

Participants also agreed the platform should be user-driven and shared ideas about potential new data products that it could provide. It should incorporate existing data and platforms, with the example of the public online platform of BarentsWatch in Norway, which is organised and funded

[1] https://marine.coperni cus.eu/
[2] https://emodnet.eu/en

by the government and the industry. The aim of a sector-related data platform will be to build upon and improve services already in place, without duplicating existing information.

Another discussed issue was data ownership, with frequent changes of contact authorities making it difficult to know and verify it. It was noted that EMODnet and Copernicus Marine data include metadata that provide further information (e.g. the data's format and type or parameter), as well as the originator and provenance. In response to this, there was a comment by the representative of the Scottish Association for Marine Science (SAMS) that in some countries there is difficulty in finding who the contact person is for Copernicus and EMODnet, there is no clear reference to the party which collects the data and how to obtain it, and there are often added complications for obtaining raw data. It was however noted that the creation of a dedicated platform could help to deal with these issues.

It was agreed that the information provided by a future platform should be in English, despite this being a language barrier for some local aquaculture communities. To overcome some technical barriers of the use of digital systems that may exist, it was recommended that scientific experts and information technology specialists could be employed to help provide a suitable simple user interface and provide training when necessary.

The platform could also help to show the public that the industry is complying with strict environmental regulations, something that could be highlighted with a workshop showing the benefits of the platform and its applications. In this way, it would also serve to improve the sometimes-negative perception of aquaculture in society.

One of the most significant challenges to overcome with a potential platform, as agreed by the participants and explored by the European Commission, is the reluctance of industry to share data. Reasons include commercial concerns of data being available to competitors, a lack of trust or, especially for small businesses or fish farms, the time-consuming and labour-intensive administration and data upload processes involved. This is happening in spite of some rare good examples of data coordination, collection and sharing such as ongoing private and public efforts in Norway together with the existence of the aforementioned public platform of BarentsWatch.

A solution to this challenge is ensuring proper communication between the different stakeholders in order to encourage them to offer more data, with the advantage of more and higher quality data eventually being available to them in return. In this context, it was agreed that there should be a well-coordinated effort to highlight and highlight the benefits of sharing information within a single platform, with the suggestion to commission a case study on ways of data sharing and its advantages.

One of the other problems addressed, that a future platform could solve is the aquaculture industry's requirement for sector-specific tools that from its perspective the European open data services cannot currently provide, in spite of their continuous effort to increase the spatial resolution and quality of their data. In response to this, it was mentioned that (a) EMODnet is already focusing on developing new data products that can be tailored and used by the industry with a system of fully centralised data access, and that (b) Copernicus has data visualisation tools such as MyOcean that are easily accessible to citizens, students, large businesses and start-ups without the need for expert knowledge or guidance, which is also provided as dedicated training workshops for the aquaculture industry. The participants highlighted the need to make the use of these two data services easier, with further guidance towards their potential use with respect to

the specific properties of each particular sea basin or smaller area, and to include the currently missing biological data, beyond the existing data on biology and biodiversity already available through EMODnet Biology. This was also recognised by the Copernicus representatives as a field that needs specific focus.

With the consideration of the above discussions, the Commission is looking into the identification of the requirement for sector-specific tools, and their development and finance needs through the facilitation of an industry-driven European collaborative platform with the involvement of key stakeholders. This could be done in the context of the stimulation of sustainable activity in the sector, but without interfering with the market. Finding a good balance between the two would be necessary. It was also noted that the Commission itself would not be responsible for developing or operating this platform. Instead, it will make the data available, through EMODnet and Copernicus, as it already does and aim in supporting better quality and improvement of spatial and temporal resolution. Any other aquaculture data initiatives will be in the hands of local governments, regional authorities and industry.

The workshop ended with a call for participants to share case studies, data and concrete examples of how open source data and data products can be used. Welcoming the meeting as a success, the organisers announced the plans to hold a complementary workshop in 2021 on marine data that will support aquaculture in the Mediterranean region.

Introduction

This year's workshop followed one held on September 24th-25th 2019 in Athens on 'First Marine Data for Aquaculture', organised by EATiP and Mercator Marine Systems. It examined the overall needs for data from the aquaculture community, with shown examples of various use cases. A knowledge gap was identified on the awareness of existing data services, and a particular need for user-friendly, high quality, well-documented and interoperable data. It was concluded by the EATiP representatives that in order to provide better services for the aquaculture industry, a link must be made between available farm, ocean and coastal data, with the provision of integrated data sets from both Copernicus and EMODnet.

During the course of the current workshop there were three main discussions held: (a) on the implementation of useful tools to support evidence-based management for aquaculture with an ecosystem approach, (b) on the ways that a collaborative platform can help achieve this goal with the incorporation of the industry and the two data services of Copernicus and EMODnet, and (c) how it should be governed, funded and used.

Copernicus Marine was presented as a user-driven service implemented by Mercator Ocean International that offers a portal for marine data. More than 25,000 people from 3,700 organisations and 166 countries use it. It features worldwide physicochemical data from 1995 onwards, which come from satellite and in-situ monitoring and ocean models.

EMODnet was also presented as a long-term EU-funded initiative bringing together more than 150 organisations that serves as a gateway to in situ marine data, spanning seven thematic areas of bathymetry, biology, chemistry, geology, human activities, physics and seabed habitats, with data originating from the wider European area and beyond. EMODnet data and data products were shown to be used by a variety of stakeholder communities, and as an essential tool to increase productivity and stimulate innovation in the aquaculture sector, with its data sets nowadays being used by an increasingly global user base with international collaborations.

It focuses on *in situ* data from seven thematic areas: bathymetry, biology, chemistry, geology, human activities, physics and seabed habitats. Examples of EMODnet thematic data sets and products were given, including for example EMODnet Chemistry that provides integrated marine chemical environmental datasets to assess ecosystem status according to the Marine Strategy Framework Directive. The network's data ingestion portal is also important as a public service to assist data providers to share data.

As also emphasized by its representatives during the workshop, one of its main concepts is the particular value found in its free provision of data that are usable by the industry, policy makers and any other user that needs it. The use of FAIR (findable, accessible, interoperable and reusable) data is key to this.

Monitoring requirements of aquaculture in North Atlantic – national differences

The differences in data requirements between European countries and in the availability of training sessions were discussed, also, regarding how they make a "one-size fits all" solution impossible from the considered platform. In order to illustrate this, the range of varying monitoring activities and requirements in sea-based farms of the North-Atlantic region was mentioned with examples from Belgium, Denmark, France, Iceland, Ireland, Norway and the UK/Scotland.

In Belgium, aquaculture is the responsibility of the Operational Directorate of Nature from the Royal Belgian Institute of Natural Sciences. While several new ideas have been proposed for aquaculture, no commercial aquaculture activities have been set up. However, a series of pilot projects have been started to determine proper legislation and required data acquisition to monitor the environmental impact.

Norway and Denmark are more advanced in this sector. The Norwegian Directorate of Fisheries enforces regulations on sea-based aquaculture licences, and companies are responsible for carrying out environmental surveys to obtain and operate such a licence. According to the NS 9410 salmon-farming standard, samples need to be taken from sediments under and around the farms. Sea bottom parameters measured and reported under and around the sites include pH, total nitrogen, salinity, temperature and oxygen with various sampling points per farm according to its size. Other parameters include ocean currents, particle scattering, biological parameters and a biodiversity analysis. Automated monitoring tools such as Remote Operated Vehicles (ROVs) are often used to perform high-resolution surveys of the seabed to control the risk of damage to vulnerable ecosystems.

Denmark has similar monitoring requirements for new environmental approvals, but with further restrictions on the amount of feed that can be used. Denmark also has requirements for filming of the seabed. Independent of the country of operation, marine farms operating under the Aquaculture Stewardship Council (ASC) certificate need to analyse additional elements in sediment samples.

In Iceland, aquaculture is growing rapidly, and authorities are catching up with laws and regulations. The required parameters and information vary according to the type of farms, for example land- or sea-based. For sea-based farms, compulsory data include output of juveniles, inventories for each cage, production volume, feed consumption and diseases. Farmers submit reports monthly or bi-annually if they operate under 20 tons. The Icelandic Food and Veterinary Authority (Matvaelastofnun – also called MAST) collects data from aquaculture operators and is working on a computer system to collect and publish all necessary figures, but without any available to share at this point.

In Ireland, regulatory controls are applied by the Irish Licensing Authority, Department of Agriculture, Food and the Marine. Local environmental impact assessments are carried out with officially available statements. Salmon farming is controlled by eight different protocols. In addition to environmental monitoring, Ireland's aquaculture farms need to deliver controls of fish health status, sea lice abundance and mortalities. Fish health authorisation needs to be obtained from the Marine Institute. Monitoring for harmful algal blooms is carried out by this institute, but plankton

samples are provided by industry. Finally, aquaculture scientists and policy makers are using Copernicus, EMODnet and national body data.

In Scotland, environmental regulation of aquaculture is carried out by the Scottish Environmental Protection Agency (SEPA). Companies need to provide plans on the structure of a site and its management details such as the feeding methods, the nutrient content of feeds etc. Firms are also required to give data for specific sites on chemical water quality parameters for copper, zinc, total nitrogen, total phosphorus and total organic carbon (TOC). Marine Scotland and the Fish Health Inspectorate (FHI) regulate the presence of sea lice on salmon. Farmers need to report weekly to FHI when the sea lice threshold is breached, and must notify FHI of unexplained mortalities. The Scottish Salmon Producers' Organisation reports the monthly average sea lice numbers and mortality percentage for each farm, one month in arrears.

In France, IFREMER (L'Institut Français de Recherche pour l'Exploitation de la Mer/French marine research institute) manages environmental monitoring of water parameters including chlorophyll-A concentration, turbidity, phytoplankton diversity and toxic species as well as oyster reproduction, growth and mortality. Data on water quality, phytoplankton and harmful algae, oyster reproduction and oyster mortality and growth is available on public repositories. In addition, different programmes are available to visualise data online such as oyster mortality rates and larvae abundance. The results of the French oyster sites are archived in the Quadrige information database, are made available to the French ministry, aquaculture industry, and water quality managers. Follow-ups are carried out on a bi-monthly basis and put online a few days later. The data is also used to model growth and egg-laying capacity under different climate scenarios. It was noted however by the representative of the European Mollusc Producers Association that the authorities are not obliged to share their data, and that the establishment of the discussed platform would help with their evaluation of the data precision and the establishment of the link between territorial and coastal activities, which is essential for tidal aquaculture such as of shellfish.

In addition to the above differences in regulations, the situation is also different across Europe regarding the frequency of data collection and its resolution, the involved parameters, methodologies etc. For example in some regions there are less data collected, and they are more model-based and thus less reliable. In other cases, they are available from one industry provider and not from another. A suggested solution to this problem was data provision from third parties, and possibly the aforementioned uniform platform. As noted by the representative of FAO, free access to this platform across Europe would also help countries without their own access to information to benefit from predictions of climate-change forecasts and their impact.

The aquaculture sector's data support and its issues

The industry's digital transformation was discussed by the participants, with the highlighted need to enable a better, more specific and streamlined use of the provided data in one single platform. The representatives of EMODnet commented that it is really a question of the explanation of the types of available data to its potential users – especially fish farmers - and helping them become familiar with various ways of their use. According to the participants, it would be necessary to include showcasing these data services with specific examples. From the side of Copernicus it was informed that in the context of better data organisation and distribution there is work scheduled to start in June 2021 on coastal models of higher resolution, after collecting the data requirements from the aquaculture sector to ensure the optimal collaboration with member states.

The objectivity of the data was also an important issue that was discussed, with the example of the aforementioned BarentsWatch data platform in Norway. BarentsWatch's representative underlined the crucial input from government data as an information source that is independent, objective and responsible for setting and controlling the criteria. It is complemented by fish farmers who in Norway are legally obliged to take samples and provide information, with the example of weekly temperature data. The impartiality and objectivity would be guaranteed by the suggested platform being run on a European level, as long as the cooperation of regional and national groups could be sought.

One other discussed problem was data availability: data are not provided in all countries. The crucial datasets are often not open access, and fish farm data are not shared between the different stakeholders. It is therefore difficult for industry to share data across different systems. Better data sharing protocols would support this process, incorporating government sources and other third parties such as companies and private organisations. However, that new policies and national regulations would be needed to establish these rules, and the industry would need to be given incentives to provide / share its own data.

The issues of (a) the necessary data categories as a list of country-specific user requirements, (b) the data scale level not being clearly defined and (c) its resolution not being high enough to meet the aquaculture industry's needs were also particularly highlighted. The example of Copernicus was mentioned, with discrepancies between what CMEMS provides (a 1.5 km resolution) and what is needed for an aquaculture company (100 metres). The representative of Marine Institute Ireland commented that while aquaculture typically takes place in coastal or shallow waters, the available open data are not of a sufficiently good resolution for those areas, particularly in a depth of 25 to 50 metres. Regarding the aquaculture activities that are far from the coastline and in more exposed ocean areas, it was commented by the representative of the Norwegian Seafood Federation that the further away from the shore the desired area is, the more the amount of available data and their resolution are decreasing. In this particular case, EMODnet / Copernicus services would really be able to add value to the current national models.

Sharing data tools and models

The identification of data tools and models and their existing use in the aquaculture sector was also discussed. For example in Norway the data on diseases are widely shared, but it was commented by the representative of the BarentsWatch Norwegian online platform that Norway was not keen to share aquaculture data on sensitive issues that could raise concerns among the public. The representative of the Scottish Salmon Company also expressed scepticism about data sharing as something difficult without a proven application and mentioned that commercial sensitivity is a pretty big obstacle for the Scottish industry to overcome. Efforts should be made to make data more transparent, possibly with the suggestion of tiered data sharing.

In general, it was discussed that aquaculture companies would be more inclined to share data if this could help them to comply with regulations and to communicate the transparency of their practices. Moreover, in the cases where they are obliged to provide data for themselves, they could also provide it to EMODnet or Copernicus. The added benefit from this would be the increase of the precision level of regional forecasting models. However, one interesting point was a noted difference between northern European countries, like Norway and Scotland, being more open to the practice of data sharing than southern.

Regarding data models, it would be essential to find a way to combine local and international sources and incorporate them in the platform for certain geographical areas, particularly in relation to European Space Agency (ESA) requirements. The model use is also explored by ”Blue-Cloud”, a European H2020 project that aims to pilot innovative services for marine research and the blue economy, building on existing marine data infrastructures including EMODnet and Copernicus Marine. It was commented by the BarentsWatch and FAO representatives that its data are useful for national planning, but not for local farms as they require more detailed and up-to-date information.

Setting up a collaborative platform and its goals

The future development of a collaborative platform can be a tool to increase predictability in aquaculture with the optimisation of production sites, allowing for better planning, reducing risk and allowing the sector to grow in a sustainable way. It could help the compliance with regulations and decisions regarding climate change and benchmarking. It could also fit in well with general policy initiatives such as the United Nations' SDGs (sustainable development goals) and the European Union's European Green Deal to tackle climate and environmental-related challenges.

The challenge will be to harmonise data from Copernicus, EMODnet, coastal authorities and from farms. As noted above, stimulating the collaboration, exchange of information and experience across different countries and advice from other marine industry sectors can help to overcome this obstacle.

At present, data sets are not sufficiently used by governments or other end users when regulating sea-based aquaculture production. That could be a crucial goal for the platform to achieve. The example of data usage for sea lice regulations was mentioned: as widely known they are an important problem in salmon fish farms, so it could be useful if biodiversity data were made available to investigate the problem from that perspective. Nevertheless, as mentioned from the EMODnet representatives, since the aquaculture sector is not a heavy user and provider of biodiversity data, it would be difficult to incorporate its data into EMODnet's biology platform. The additional example of aquaculture farm biomass data also not being able to be entered into this biology platform was mentioned. As a result, new data categories will have to be introduced into it.

One other challenge related to this is to design a systematic and user-friendly way for data entry, as information from aquaculture producers is currently mainly shared through PDF files which is not ideal, as they are difficult to amend. As noted by the representative of the aquaculture company of Lerøy Seafood, adding a new interface could be cumbersome and integrating data into existing systems is the way to go, especially since local industry workers often do not have the time to engage with data and only really discuss it with software suppliers. Therefore, keeping the same interfaces and focusing on these suppliers would increase the use of Copernicus or EMODnet services.

The need to prioritise the most important data and to provide training workshops for their use through the platform was widely acknowledged. The knowledge for this could be built on recent similar events such as EMODnet's Open Sea Lab I and II "hackathons". As noted by the representative of DG MARE, this would also help to overcome technical barriers as some industry workers are reluctant to engage with data that do not seem relevant to them. The challenge would then be to work alongside industry to make those data accessible and meaningful.

As far as the types of included data, it would be good to convince industry to provide more information than the bare minimum - for example more than just temperature - to enhance the quality of data around the coast. Farms have also started to register algae and report these data, therefore it would be ideal for all this information to be put in a format that allows farmers to see what biomass is available around the farms. The example of the aforementioned Norwegian public online platform of BarentsWatch was discussed: It is more geared towards veterinary-type data, while also incorporating other information such as environmental and meteorological. However,

the specific aquaculture user requirements must be precisely identified before determining the models and degree of resolution. For that purpose, it was suggested that semi-structured interviews should be used instead of surveys.

Conclusions

It was widely agreed that all data should be open access, as this provides greater value than having the industry ask for the necessary information from individual national data centres. Moreover, in Europe, Copernicus Marine and EMODnet offer long-term data services to support data sharing, ingestion, standardisation and harmonisation. The issue of data provision was identified as a sensitive one: in practice there are many country differences as northern European countries are more keen to share data than southern, often due to government restraints.

The challenge to get aquaculture firms to provide and share data was a recurrent theme of the workshop. Their value and contribution towards the desired high resolution and accuracy was particularly stressed, as well as the fact that data sharing would improve the overall quality of information offered to the whole sector. Nevertheless, industry partners need to be convinced that it is in their best interest to share that data. As a beneficial example, this will increase the visibility of their activities, show their products are of high quality and help to correct the often-negative public image of the aquaculture sector. This was noted as something that can hamper the industry's desire to send in data.

A suggestion to improve the situation was to have big organisations highlighting examples of how data can be used successfully in terms of trend identification, decision making and development support. The obstacles to overcome in this area are commercial concerns over data privacy, confidentiality issues, competition and also lack of time to submit data – particularly for small businesses. Monetary incentives might be a way forward to encourage an industrial player to invest in a data-sharing platform.

Encouraging the sector to submit data is a challenge, but the associated intentions have already been expressed such as the shellfish industry's key aim of data collection and sharing for 2030. As the next ten years will be very important for the aquaculture industry, DG MARE commented that to meet this challenge all actions will be streamlined through communications to stakeholders and official guidelines from the Horizon 2020 research programme, as well as via investment projects and other funding tools.

Other bottlenecks include how to get end users engaged with the data, and the provision of more user-friendly data. Training and workshops would help, along with more mainstreaming of the databases available. Another idea was to have an official list of user requirements, although such lists would have to be different according to the regulation needs of each country.

The development of a collaborative platform was proposed as a way to bring data together in one place in a standardised, streamlined and harmonised way, and solving the problem of data ownership information. It should be end-user driven, with many participants saying it should be run at a European level but making use of existing platforms at a local and regional level. Regarding its funding it was suggested it should come from the European Commission, perhaps while offering paid access to some more labour-intensive services. The European Commission representatives were very clear that funding can provided through the standard instruments of financial support, but the proposal should come from the industry and should stand evaluation, as all proposals.

Participants agreed a balance is needed between having as much data as possible and the quality of country and metadata. It is important to improve data resolution in certain areas to discover the

geographical areas of greatest need. The Copernicus Marine service representative commented that the improvement of their data is an ongoing process with the provision of more and higher resolution ones as soon as they become available, and with the intention of organising dedicated training workshops for the aquaculture industry.

The representatives of EMODnet welcomed the recommendations on the data needs and requirements from the industry, as well as the ideas for future data and the involved products. They were identified as points that the EMOD network will take up in further discussions, and the open invitation was extended for industry to collaborate on producing joint use cases of data and data products offered by EMODnet and Copernicus Marine.

Other sources of information

(1) CMEMS - Copernicus Marine Service: https://marine.copernicus.eu/

(2) EMODnet - European Marine Observation and Data network: https://www.emodnet.eu/en

(3) EATIP – European Aquaculture Technology and Innovation Platform

(4) Quadrige: https://www.gbif.org/fr/dataset/aeeff4d1-a1e0-454e-ae87-2748138279d3

(5) EuroSea project: https://eurosea.eu/

(6) ForCoast project: https://forcoast.eu/

(7) Blue-Cloud project: https://www.blue-cloud.org/

(8) European Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

(9) European Atlas of the Seas: https://ec.europa.eu/maritimeaffairs/atlas_en