GENERAL FISHERIES COMMISSION
FOR THE MEDITERRANEAN

COMMISSION GÉNÉRALE DES PÊCHES
POUR LA MÉDITERRANÉE

Committee on Aquaculture (CAQ)

Working Group on the Black Sea (WGBS) and Working Group on Site Selection and Carrying Capacity (WGSC)

Report of Training Workshop on site selection, allocated zones for aquaculture (AZA) and site management for coastal marine aquaculture (WGSC-SHoCMed)

Trabzon, Turkey, 18–21 February 2013

SUMMARY

1. The Training Workshop (T/W) on site selection, allocated zones for aquaculture and site management for coastal marine aquaculture was held at the Central Fisheries Research Institute (CFRI), Trabzon, turkey, from 18–21 February 2013. The T/W was attended by experts from the Black Sea riparian countries Bulgaria, Romania, the Russian Federation, Turkey and Ukraine, as well as by lecture-experts from Spain, Greece, Italy and Turkey. The list of participants is provided in Appendix B to this report. The T/W was organized within the framework of the Working Group on Site Selection and Carrying Capacity (WGCS) SHoCMed project and THE Working Group on the Black Sea (WGBS). It was designed to support the development of sustainable marine and brackish aquaculture in the GFCM area, as a follow-up to the work plan agreed at the first meeting of the WGBS held in Constanta, Romania, from 16–18 January 2012. The T/W was organized in cooperation with the Trabzon Central Fisheries Research Institute (Turkey) and the research and other relevant institutions in the Black Sea countries involved on aquaculture activities.

2. The activities and outcomes of the T/W, as reflected in the report, can be briefly summarized in three main parts a following brief presentation of the aquaculture sector in the sub-region. The first part (*didactic-informative*) provided basic elements and concepts on integrated coastal zone management (ICZM) and Ecosystem Approach to Aquaculture (EAA); use of the Geographical Information System (GIS); available case studies on allocated zones for aquaculture (AZA); environmental monitoring programme for AZA; environmental impact assessment (EIA) and interaction of aquaculture and the other coastal activities; relevance of the allowable zone of effects (AZE) and carrying capacity; management and planning activities within AZA; and the use of sustainable indicators to monitor aquaculture. The second part (*participative*) included applied sessions with some practical exercises on site selection in order to stimulate the participation, the appraisal and the feedback from participants on the main

concepts related to AZA. Finally, during the third part participants discussed and synthesized the challenges posed by adopting AZA including main constraints for its implementation and opportunities for aquaculture development.

OPENING, ARRANGEMENT OF THE MEETING AND ADOPTION OF AGENDA

3. Mr Ilhan Aydın, Director of the Central Fisheries Research Institute (CFRI) welcomed participants and expressed his honour to organize this meeting of the Training Workshop in Trabzon, given the importance of the meeting not only for Turkey but also for the whole Black Sea area.

4. Mr Sabri Topbaş, Director of the Trabzon Provincial Food, Agriculture and Livestock Directorate, welcomed and addressed participants. He recalled the importance of aquaculture in the region and concluded expressing wishes for a fruitful work.

5. Mr Aydın provided some information about CFRI which was established in 1987 with the name of "Trabzon Fisheries Research Institute" and has undertaken applied research activities since 1988. Following ten years development, in 1998 the Institute had its status advanced by the Ministry to national level and its name was changed to “The Central Fisheries Research Institute”. Its task was to investigate every kind of aquaculture and seafood based research on behalf of the Turkish Ministry of Food, Agriculture and Livestock. The Institute now investigates fishery and aquaculture management, socio-economic matters, sea food technology and fish diseases with respect to the whole of Turkey, but with a special focus on the Black Sea, the Marmara Sea and on the inland waters of Turkey. Moreover, the Institute assists government in developing incentives for fishing and aquaculture and suggests limitations on fishing as a result of its investigations.

6. Mr Fabio Massa, FAO Aquaculture Officer of the GFCM Secretariat thanked the host institute and welcomed participants. He informed about the GFCM activities on AZA, on the objective and structure of T/W on site selection, allocated zones for aquaculture and site management for coastal marine aquaculture

7. Mr Simion Nicolaev, Director of the Romanian National Institute for Marine Research and Development, (Grigore Antipa) and WGBS Coordinator, delivered a presentation on the activities of the WGBS of the GFCM. He underlined the need to start a new phase of cooperation in the region for which an ad hoc working group for the Black Sea was established. During its first meeting in Constanta, from 16-18 January 2012, the current status of Black Sea Fisheries and Aquaculture developments was discussed, among others, and strengths, gaps and priority actions were identified. He informed that the main concerns had been the collapse of pelagic fisheries at the end of 1980s due, most likely, to the combined effect of the long term over-exploitation of fish stocks, increasing pollution and eutrophication. In addition population outbursts of alien planktonic species concomitantly with impacts from a changing climate were recorded. Mr Nicolaev added that despite the opportunities offered by marine aquaculture, this sector has remained underdeveloped in the Black Sea. In conclusion he expressed his trust and confidence in the T/W to identify key issues for prompt, concerted actions. He thanked all those

organizations involved in facilitating this event and praised them for the excellent collaboration it had engendered.

8. Ms Güzel Yücel-Gier, introduced herself as facilitator and rapporteur of the T/W and outlined the agenda on behalf of the organizers. The Agenda was adopted with minor changes and is provided in Appendix A to this report.

GENERAL OVERVIEW ON AQUACULTURE DEVELOPMENT IN THE BLACK SEA COUNTRIES

9. Participating experts presented the main activities and some progresses on aquaculture in their countries[1]:

Aquaculture development in Turkey (*by Deniz, H.,)*

10. Abstract: The main frame of aquaculture development in Turkey was presented. Endowed with rich aquatic resources including 26 million ha of water surface, 8 333 km coastline and 177 714 km of rivers, Turkey has great potential for aquaculture. In 2011 the total fisheries production amounted at 703 545 tonnes in which aquaculture contribution accounted for 27 percent in volume and 52 percent value respectively. In the past decade aquaculture has been the fastest growing food production sector worldwide as well as in Turkey, where there were 2 163 fish farms with total capacity of 404 634 tonnes per year in 2012. Although still considered a very young industry, Turkish aquaculture is steadily improving and currently Turkey owns 25 percent of the European seabass and seabream market share, whilst it is also becoming an important producer of trout. The latest developments in the aquaculture sector put Turkey in an important position both in the Mediterranean basin and among other European countries.

Mariculture in Bulgaria *(by Raykov, V.; Konsulova,T.; Bektchieva, I.; Petrov, K.)*

11. Abstract: The overview of marine aquaculture in the Bulgarian Black Sea was presented. The existing legislative base, national strategy, policy, management instruments in fisheries and aquaculture were also outlined. The Bulgarian operational programme for 2007-2013, based on and synchronized with the EU legislation, addressed the main challenges, standards, present situation and perspectives to ensure the sustainable development of the fisheries sector in Bulgaria. The biology, environmental effects of the mariculture and zones dedicated for these activities were presented and discussed. It was also outlined the general process for establishing aquaculture farms in Bulgaria and the stakeholders involved.

12. The challenges and future development of mariculture in Bulgaria are based on the existing production of black mussel (*Mytilus galloprovincialis*). Mussel culture appears as an emerging and promising industry in Bulgaria with both socio-economic and ecological implications, and at present the mussel production is mainly for the domestic market. Different mussel farming systems can be found along the coastal zone which also plays an important role as spawning and nursery fish areas. Bulgarian mussel farming has proved to be economically

[1] In multi-author presentations the presenter's name is underlined.

profitable while being environmentally sustainable thus adhering to the principles of sustainable development. Beside mussel culture, salmon and flounder breeding experiments also continue. Marine aquaculture is considered a promising opportunity for Bulgaria, and continuous efforts are made to foster its development.

Aquaculture opportunities, requirements and ecological drawbacks for the development of marine aquaculture on the Romanian littoral *(by Nicolaev, S.; Zaharia, T.; Nita, V.)*

13. Abstract: The fisheries sector in Romania includes aquaculture, marine and inland fisheries, processing and marketing activities. Capture fisheries along the Black Sea coastline remains limited compared to inland fisheries. The apparent fish consumption almost doubled in the past 10 years going from 2.6 kg to over 5 kg per capita, with more than 50 percent demand being supplied from imports. Marine aquaculture is still at its infancy and at present only two small companies producing turbot and molluscs are active. An extensive analysis of opportunities, requirements and constraints regarding the development of mariculture as well as its potential conflicts among the different users of maritime area was also highlighted.

Experience on mariculture of crustaceans in the Russian Federation *(by Kovatcheva, S.)*

14. Abstract: In recent years, the cultivation of crustaceans has been an important direction for aquaculture in East and Central Europe, particularly in the Russian Federation. This is important both for the preservation of species variety, maintenance of natural populations and for increasing the production of high value species such as the red king crab (*Paralithodes camtschaticus*), freshwater crawfish, (genus *Astacus* and *Pontastacus*), the giant freshwater prawn (*Macrobrachium rosenbergii*) and several other crustaceans. To further develop crustaceans' aquaculture, the Russian Federation is undertaking actions for the rehabilitation of natural stocks of valuable commercial species to ensure an optimized production and exploitation. Other important aspects to be addressed in future to foster crustaceans' aquaculture in the Russian Federation include: (i) aquaculture legislation; (ii) risk insurance systems for aquaculture; and (iii) other necessary measures to guarantee investments.

Aquaculture in Ukraine (*by Kulyk, P.; Demianenko, K.)*

15. Abstract: The country has more than 1 000 000 ha of water resources which could potentially be used for aquaculture including reservoirs (about 800 000 ha), ponds (123 000 ha), lakes (87 000 ha), and cooling reservoirs (14 000 ha). In Ukraine freshwater aquaculture dominates the production of farmed fish which include species of Ukrainian carps, silver and spotted silver carps and their hybrids, grass carp, sturgeon species, catfish, buffalo fish, haarder and some other species. Aquaculture is also important for restocking purposes in freshwater reservoirs and other basins, especially with herbivorous species such as silver and spotted silver carp. About 14 million fingerlings of these species are released annually and approximately 30 000 tonnes are caught in these environments from capture fisheries, whilst the average annual production from aquaculture in inland reservoirs amounts at 22 000 tonnes. Besides, artificial fish breeding of some species from the Black and Azov Seas is also performed: 500 000 fingerlings of sturgeon (Russian sturgeon and starred sturgeon), 1 million fingerlings of flatfish

(Azov turbot and Black Sea flounder), 5 million larvae and fingerlings of haarder (*Liza haematocheilus*) and 5 million larvae and fingerlings of pike perch are produced annually.

16. Recirculating aquaculture systems (RAS) are also used although they are not common due to associated high costs/low profitability involved (e.g. investment system set-up, supplemented feed to farm relative low value species), and the annual production does not exceed 300 tonnes. Feeding manufacturers are now interested on more valuable species such as sturgeon, salmon and catfish and have started investing in this direction.

17. Demand for fish and seafood is steadily growing in Ukraine: it is expected that by 2015 market capacity will grow by 33 percent (250 000 tonnes) whilst the foreseen demand for fish and seafood could be as high as 700 000 tonnes per year.

18. The national programme for fishery development 2012-2016 supports the development of marine aquaculture. It includes plans to establish in the Azov basin (Crimea and in Zaporozhe region), fish-breeding centres specialized in the reproduction of the Azov turbot. It also promotes shellfish farming of Mediterranean mussel, cage farming of flatfish, mullets and valuable semi-migrating fish. Other provisions envisage the release into natural reservoirs of more than 37 million fingerlings of valuable species, and also to increase volume of commercial fish breeding of valuable fish species to 80 000 tonnes.

INTRODUCTION TO THE AZA CONTEXT

Recent progress and knowledge in the GFCM area regarding the application of allocated zones for aquaculture (AZA) *(by Massa, F.)*

19. The GFCM Secretariat informed participants on the issues concerning the development of aquaculture in the GFCM area, particularly in relation to coastal zone management. As a result, increased attention has been paid by the GFCM to the concept of "allocated zones for aquaculture" (AZA) in light of their potential as a management tool for preventing conflicts with other coastal zones uses while enabling aquaculture planning. AZA have been identified as a necessity for activities related to the sustainable development of aquaculture in the Mediterranean and Black Sea. At its 36th session in 2012, the Commission adopted Resolution GFCM/36/2012/1 on Guidelines on allocated zones for aquaculture.

The principles of sustainability in the process of site selection and AZA *(by Avila Saragoza, P.,)*

20. Abstract: The concept and origin of sustainable development were presented. This took into consideration the different events worldwide outlined at the United Nations Conference on the Human Environment in Stockholm in June 1972, together with the Rio Conference and Barcelona Convention on Biodiversity. These events were milestones for the definition and identification of the pillars and principles of sustainability. The concept of Sustainable Development for Aquaculture in the Mediterranean was further explained against also the background work done by the IUCN as laid out in their three *Guides for Sustainable Development of Aquaculture in the Mediterranean*. Finally, the integration of the principles and

objectives of sustainable development were outlined in connection with the site selection and AZA processes.

Definition of AZA, space availability and site selection for marine aquaculture *(by Karakassis, I., WGSC Coordinator)*

21. Abstract: Participants were introduced to the needs for the development of marine aquaculture in the contexts of increasing human population and shortage of freshwater resources. These latter impose limitations on agriculture as well as on the overexploitation of marine biological resources through capture fisheries. The intense activities and competition of use along the coastal zones, expected to result in further conflicts among users in the near future, call for specific spatial planning tools. These would be necessary to ensure enough space in the sea for food production to meet the needs of increasing human population.

BASIC CONCEPTS, INTEGRATED COASTAL ZONE MANAGEMENT (ICZM) AND ECOSYSTEM APPROACH TO AQUACULTURE (EAA)

Basic concepts and general context of Allocated Zones for Aquaculture *(by Macias, J.C., key trainer)*

22. Abstract: The most important concepts and the overall context of the application of AZA were introduced. In this regard, the importance of sector planning as a basic tool for the development of strategies for locating and zoning aquaculture were particularly stressed. Crucial elements in the sector were identified and the different interests involved were also analysed. Moreover, as the central axis in establishing AZA areas, the importance of preliminary studies on suitable areas for subsequent implementation were highlighted. In this regard the different terminologies associated with these fields of action were outlined. Furthermore, relevant documents prepared by the European Commission and addressing the lack of space to develop aquaculture were presented. The key principles to consider when establishing AZA were discussed, most notably the Integrated Coastal Zone Management (ICZM) framework and the Ecosystem Approach to Aquaculture (EAA). Finally, Geographic Information System (GIS), Environmental Monitoring Programme, Environmental Impact Assessment (EIA) and the concept of Carrying Capacity were presented as appropriate tools in the process of establishing AZA.

Ecosystem Approach to Aquaculture (EAA) *(by Avila, P.)*

23. Abstract: The concept of an Ecosystem Approach to Aquaculture was explained from the experience and background of the FAO Fisheries and Aquaculture Resources Use and Conservation Division/Aquaculture Service (FIRA). The definition and principles of the EAA were presented according to FAO as well as the concept of EAA as a tool for sustainable development of aquaculture. The methodological process and steps to establish AZA were introduced. Identification of development needs, sectoral and legal framework information and definition of the study areas were considered and explained as first steps in the process. The selection of agents and stakeholders involved, as well as the parameters to study from the administrative and environmental point of view were outlined. Field work and data collection

methodology were explained. The use of GIS, criteria for data analysis and methodology for construction of preliminary charts for validation by stakeholders were introduced. Participatory approaches including consultations, workshops and panels of experts were highlighted as methods for consensus building. Methods for environmental data collection and analysis to identify areas suitable for aquaculture in terms of oceanographic and water quality conditions were also presented. Socio-economical aspects and type of aquaculture to be developed were introduced as the conclusive steps to be considered to establish AZA.

Guide and methodological process for the establishment of Allocated Zones for Aquaculture (AZA) *(by Macias, J.C.)*

24. Abstract: The lecture was based on the draft Guide developed within the SHoCMed project on the establishment of AZA in the Mediterranean. An introduction and background on the necessity of space and good water quality for the establishment of aquaculture was outlined, as well as the need for the establishment of AZA as a priority identified by the WGSC. The concept of AZA was defined and the principles for developing AZA presented. An introduction to ICZM showed the main principles and objectives described in the ICZM Protocol signed in Madrid in 2008 within the framework of the Barcelona System. Special attention was paid to the priority that the protocol gives to those activities that are directly dependant on the marine ecosystem such as aquaculture. Basic concepts and principles to be taken into consideration for site selection and AZA process were considered and linked with ICZM. Finally, the design of a management and monitoring plan as well as the integration of AZA in the legal framework were introduced.

GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN AQUACULTURE AND IN ALLOCATED ZONES FOR AQUACULTURE

Geographical Information System (GIS) in aquaculture and in AZA *(by Macias, J.C.)*

25. Abstract: An introduction to GIS and its application to aquaculture and specifically to the establishment of AZA was presented. The need for sites with appropriate environmental characteristics and good water quality; the social aspects of interactions with other human activities, conflicts over the use and appropriation of resources in both inland and along coastal zones were identified as constraints. These need to be considered in the monitoring of existing aquaculture facilities and in order to efficiently set up new facilities. Marine spatial planning is a tool that brings together multiple users of the ocean such as energy producers, other industries, government, conservation and recreation. All must be evaluated in order to make informed and coordinated decisions about how to use marine resources sustainably. The importance of tools such as GIS, remote sensing and mapping applications to address all geographical as well as spatial issues in marine aquaculture were highlighted, and examples of these latter could be found in Kapetsky and Aguilar-Manjarrez, 2007[2]; and Aguilar-Manjarrez et al, 2008[3]. The differences between aquaculture zoning and site selection were described. Zoning is a

[2] Kapetsky, J.M. and Aguilar-Manjarrez, J. 2007. Geographic information systems, remote sensing and mapping for the development and management of marine aquaculture. FAO Fisheries Technical Paper No. 458. Rome, FAO. 2007. 125 pp.

[3] Aguilar-Manjarrez, J., Kapetsky, J.M. and Soto, D. 2008. The potential of spatial planning tools to support the ecosystem approach to aquaculture. FAO/Rome. Expert Workshop. 19–21 November 2008, Rome, Italy. FAO Fisheries and Aquaculture Proceedings. No.17. Rome, FAO. 2010. 176p.

mechanism for more integrated planning of aquaculture development so as to avoid conflicts with fisheries and other sectors. Site selection is the process of choosing a certain space in the environment by examining, among others, environmental, technical, legal, administrative, social, economic and other aspects in order to set up an aquaculture project. GIS is a system of hardware, software and procedures to facilitate the collection, management, manipulation, analysis, modelling, representation and display of spatially referenced data (Johnston, 1998)[4]. With respect to specific consideration on GIS, the spatial scales (farm, water body and global), parameters, types of data, available tools and software, scale and resolution, database, methodology and functionalities were explained.

ESTABLISMENT OF AZA: OVERVIEW OF MEDITERRANEAN EXPERIENCE

1st Case Study: The Implementation of Allocated Zones for Aquaculture in Spain *(by Macias, J.C.)*

26. Abstract**:** Ten examples of existing AZA in Andalucía (South Spain), implemented by the Regional Government were presented. The examples showcased practical issues and adopted solutions along the process of establishing AZA. Both sea and terrestrial areas were examined from the point of view or administrative interferences and from environmental approach. Methods and tools employed in each case were presented and results and important conclusions were underlined.

2nd Case Study: The Implementation of Allocated Zones for Aquaculture in Turkey *(by Deniz, H.)*

27. Abstract: In Turkey marine aquaculture started in 1985 with European seabass and seabream farms located in closed and sheltered bays and by using traditional, small size wooden cages. At that time European seabass and seabream farms were already established in the Aegean and Mediterranean coasts. In 1988 when conflicts raised between mariculture and other sectors such as, among others, tourism and maritime navigation, the first marine aquaculture zones were established and existing farms were moved into these zones. To account for the very rapid development of marine aquaculture which followed whereby innovative culture technique, cage design and fish feed technology were employed, several studies were needed in order to establish proper zones for aquaculture.

28. After a new Environmental Law was enacted in Turkey, new aquaculture zones were determined with a consensus of all related institutions and in accordance with the current regulatory provisions as of 2008. Subsequently in 2009 the inshore marine farms were moved into the new allocated offshore aquaculture zones but conflicts over use of marine space continued due to lack of proper stakeholder participation during the establishment process. More consultative initiatives were successfully undertaken to overcome these problems, and recently the Turkish Government developed the National Marine Aquaculture Development Plan

[4] Johnston, C. 1998. Geographic Information Systems in Ecology. Chapter 8: Global Positioning Systems and GIS. Ed. Blackwell Science, London.

(NMADP) to minimize conflicts and to provide stable ground for the future growth of the aquaculture sector.

29. To lessen or prevent environmental impacts by the fish farms, some measures were introduced in agreement with stakeholders. New regulations are now in force and existing ones were amended to be aligned with EU regulations. Eventually parties realized that sectoral planning did not suffice to achieve sustainable management of the sector and decided to embrace the ICZM approach.

3rd Case Study: The Implementation of Allocated Zones for Aquaculture in Turkey (Black Sea) *(by Aydın, I.)*

30. Abstract: Currently in the Black Sea region cage systems is employed to farm trout and the European seabass. CFRI is responsible for five areas in the Black Sea with respect to the establishment of allocated zone for aquaculture (Table 1). The task of CFRI is to investigate aquaculture development under the direction of the Ministry of Food, Agriculture and Livestock of Turkey in accordance with Fisheries Law No. 1380 and subsequent amendment under article 14 of the Fisheries law No. 3288. One of the responsibilities of the CFRI is to give advice on developmental topics for the ministry as required.

31. Normally a private who wants to establish a fish farm must submit an application to the Provincial Directorate Food, Agriculture and Livestock (PDFAL) of competence. CFRI creates a research team for site selection according to written instructions from PDFAL. In general the team consists of two researchers form the Department Aquaculture, one researcher from Department of Fisheries and one researcher from the Department of the Environmental and of Resource Management. The team joins the investor in order to finalize the selection of site and studies are carried out to measure the following parameters: water depth, distance from the coast, dominant wind, temperature, oxygen, salinity, pH, turbidity, suspended solid, nitrite, nitrate, ammonia, phosphate, silicate, total phosphate, total nitrogen and chlorophyll-a.

Table 1: Marine aquaculture situation in the Turkish side of the Black Sea

Area	Cage system	Total capacity (tonnes)
Trabzon	9	14 650
Ordu	6	1 160
Rize	4	1 550
Samsun	10	11 932
Sinop	Application phase	-

PRACTICAL SESSION

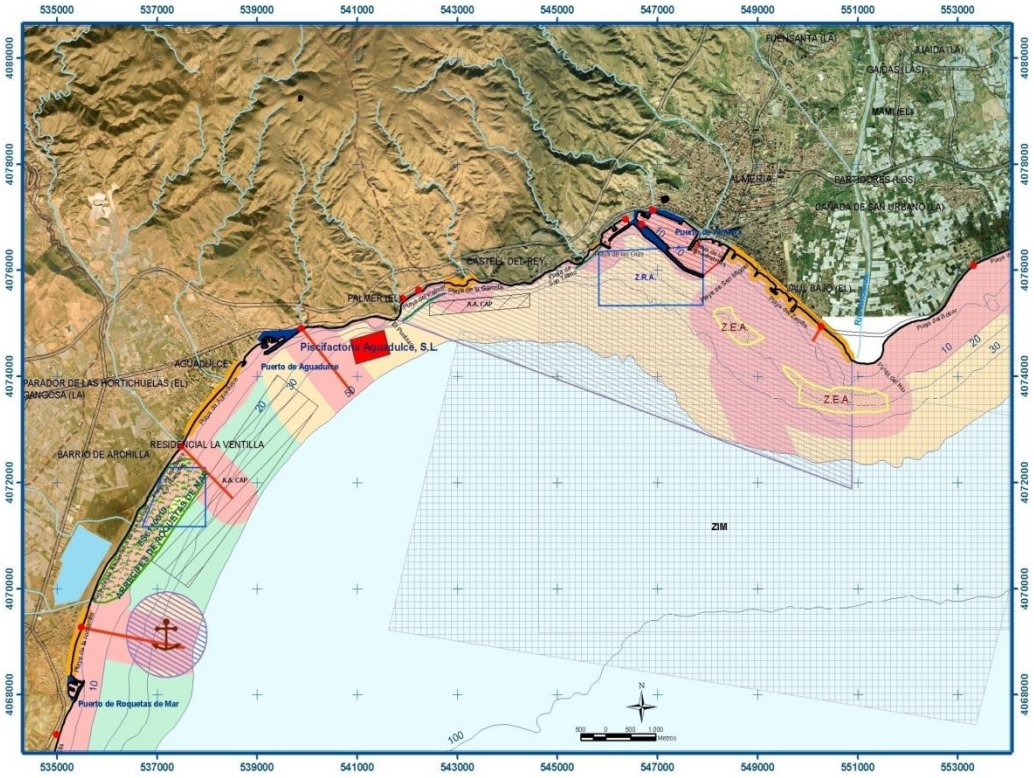
32. The practical session of the T/W addressed the lectures presented thus far through exercises which were organized in three main sections as follow:

1) Identification of main stakeholders to be involved in the site selection process;
2) Identification of key criteria for site selection; and

3) Identification of possible farm site in a map.

33. The results of the practical exercise are summarised hereafter.

1) Practical exercise on stakeholders' involvement for site selection



34. For the practical section the participants were split into two groups. Group A was to discuss matters connected with setting up AZAs within a Bay. Group B was to discuss matters connected with an open coastline. Firstly it was necessary to decide which stakeholder was likely to be involved and what their priorities would be. The following stakeholders were identified:

- Group A (formed mainly by participants from Turkey): tourism, maritime activities, fisheries, environmental groups, public local users and army;
- Group B (consisted mostly of participants from Romania and Bulgaria): central authorities responsible for the environment, fisheries and regional development. At national level, there would be committees for ICZM, authorities for water, navigation matters and for tourism. Moreover there would be representatives from the chambers of commerce, local government, local environment agencies, local veterinary agencies and the local fisheries sector. Fish farm producers, NGOs and scientists would also be involved.

2) Practical exercise on the identification of key criteria for site selection

35. Participants were asked to identify main issues to be considered as key criteria for site selection. Two groups of four participants each discussed the following dimensions:

- Environment
- Socio-economic
- Governance

The following issues were identified:

MAIN ISSUES FOR SITE SELECTION	
GROUP A	**GROUP B**
Water quality (temperature, depth, wind, current, etc.)	Currents
Distance from coastline	Waves
Pollutant	Temperature
Other activities (agriculture, etc.)	Salinity
Powerful sectors can effect aquaculture activities	Conflict of interests
Employment (workers supplier)	Employment
Marketing	Market
Economic profitability	Infrastructure
Which is the priority of the place	Legal network
Financial supports from government	Concession system
Other governmental activities (like army, oil platforms)	Economic instruments for stimulation
Development plans for the area	Regulation

3) Identification of possible farm sites in a map

36. This exercise was based on a real case in Camas Bruaich Bay, a small bay on the West coast of Scotland. The farming system is consists of a relatively small-scale salmon farm in cages of 4m x 4m x 4m, located in the bay with a width of about 500 m. The exercise was to analyse a satellite image of the area (from Google Earth ®) to decide where locate the cages. The exercise served to understand the importance of "adaptive measures" during AZA planning.

Camas Bruaich Bay, Scotland

The result of the exercise was as follows:

COMMENTS	
GROUP A	**GROUP B**
The farm will be place on the NW side of the bay.	**The farm will be placed on the NW side of the bay but due to environmental aspects it will not be placed.**

37. The participants were informed about this case, where fish cages were in operation for about a decade from 1980-1990. However, planning authorities decided that aquaculture development was not appropriate because interfering with the Falls of Lora landscape; consequently aquaculture activities was no longer allowed in this area.

RELEVANCE OF SUSTAINABLE INDICATORS FOR AZA

Indicators for the sustainable management of AZA *(by Avila, P.)*

38. Abstract: The methodology for the selection of indicators was presented based on the previous work developed by the WGSA in the framework of the InDAM project. Following a participatory approach and taking into consideration the three pillars of sustainability and of governance, indicators are selected according to an agreed definition of principles and criteria. Definition of indicators as a tool for communication, among others, was explained. The main attributes for the selection of good indicators were listed. The methodology associated with the

process was explained and the following steps were presented: (1) identification of common issues, (2) matters concerning the objectives of sustainability, (3) principles, criteria and indicators relevant to definition and description, (4) data collection and reference values, (5) PCI validation and consensus, (6) implementation and monitoring, (7) revision and adjustments, and (8) organizational framework concerning the working teams and experts to be involved in the process. A list of regional indicators was presented and some ideas about tools such as the Delphi method and the traffic light approach to use as a follow-up on the performance of indicators were also introduced.

Environmental indicators for aquaculture *(by Karakassis, I.)*

39. Abstract: The work on environmental indicators done by the GFCM working groups and the principles for the monitoring of environmental change at different spatial scales was presented. The Delphi exercise performed by WGSC-SHoCMed for the definition of Environmental Quality Standards (EQSs) for Mediterranean fish farming was discussed, as well as the use of EQSs as an indirect way to define the holding capacity for marine aquaculture. Finally an example from Greece where aquaculture production levels were adapted to the environmental characteristics of the marine environment was introduced.

AZE: Allowable Zone of Effects. Its role and importance in environmental monitoring of marine fish farms *(by Tomassetti, P., Marino, G.)*

40. Abstract: Spatial planning for aquaculture should carefully consider the environmental aspect because aquaculture, as others human activities acting on the coastal waters, can produce some environmental perturbations. Based on this assumption the AZE concept was introduced by recalling that the environmental sustainability of Mediterranean aquaculture depends on the reduction of local impact on both environmental conditions and biodiversity, and the preservation of the ecosystem service. AZE is defined as "the area of sea-bed or volume of the receiving water body in which competent authority allow the use of specific Environmental Quality Standard (EQS) for aquaculture, without irreversibly compromising the basic environmental services provided by the ecosystem". AZE are within AZA and the concept is common in several countries although it is called with different names e.g. mixing zone; allowed zone of effect; local impact zone; aquaculture management areas, etc.

41. To establish AZE the following could be pursued: (i) an administrative process so that AZE is identified according to an EIA, species to be produced, size of production and the carrying or holding capacity of the receiving body of water; (ii) a site specific survey showing the real impact around the fish farm; (iii) by using deposition modelling showing predicted waste distribution around the cages.

42. Within a legislation framework, the definition of AZE through an EIA follows the establishment of AZA within marine spatial planning and precedes the set-up of a proper EQS Monitoring Programme. Generally the spatial scale of AZE boundaries from the cages system is

of about ten meters. From a spatial point of view the AZE is located within the public concessions issued for fish farms activities within the AZA and can or cannot coincide with the public concession.

43. Directly connected with the AZE is the Carrying Capacity concept defined as "the potential maximum production of a defined area of a species or population that can be maintained within that area in relation to the available food and environmental resources". In the case of aquaculture activities where trophic resources are not a limiting factors because the feed is provided, other definitions were created: “holding capacity that is the potential maximum production which is limited by a non-trophic resource; “assimilative capacity that is the ability of an area to maintain a ‘healthy’ environment and ‘accommodate' waste”; “production capacity that is the maximum tonnage level that can be attained without producing a negative impact on the environment and the farmed stock”; ‘environmental capacity that refers to the ability of the environment to accommodate a particular activity or rate of activity without an unacceptable impact” (Fernandes et al., 2001)[5].

44. To manage farming activities in the ecosystem could be very important to calculate the carrying/holding capacity and this can be carried out *a posteriori* by environmental effects assessment on ecosystems or much better *a priori* by studying the environmental interaction between the farming activities and the bio-geochemical involved cycles of fluxes or by predictive models utilization. Connected with the AZE, a monitoring programme should be implemented in order to ensure that this zone will not be degraded to a point beyond which the services provided by the ecosystem will be severely or irreversibly compromised. Three real monitoring plans carried out in three different marine fish farms, located along the Italian coasts, were presented to discuss features of the chemical and biological indicators used: total carbon, total nitrogen, total phosphorus, total organic carbon, redox potential, total sulphur, sulphide, benthic fauna. The real application of a predictive deposition model tested in an Italian fish farm was presented showing the area affected by organic enrichment at different thresholds. The recovery of the AZE should be also considered as estimation of potential removal and burial of wastes by seabed currents, bio-geochemical processes, and consumption of waste nutrients so that impact should be reversed by a year or two.

Environmental monitoring of AZA. Environmental Impact Assessment (EIA) and interactions between aquaculture and other coastal activities *(by Yücel Gier, G.)*

45. Abstract**:** The methodological processes connected with setting up AZA such as spatial planning, EIA, Environmental Monitoring Programme (EMP) and a management plan for AZA were presented. Details on EIA procedures, monitoring techniques, theoretical models and effects on the water column and in the sediments were also introduced. It was emphasized that

[5] Fernandes, T.F.; A. Eleftheriou, H. Ackefors, M. Eleftheriou, A. Ervik, A. Sanchez-Mata, T. Scanlon, P. White, S. Cochrane, T. H. Pearson and P. A. Read (2001) The scientific principles underlying the monitoring of the environmental impacts of aquaculture. Journal of Applied Ichthyology. 17 (4): 181-193.

marine fish farming relies on healthy ecosystems more than other coastal zone activities and thus particular attention should be put on preserving environmental conditions. It was stressed the importance of having a clear environmental monitoring programme with well-defined indices and parameters in place, and effective mechanisms to implement and enforce it. By using a set of diagrams and maps it was clarified that monitoring plans should be flexible and adaptable, taking into account scale (time and space) approach. It was further emphasized that monitoring results should be made public. Monitoring results help judging the success of mitigation measures in protecting the environment and in the management of AZA and AZE.

DISCUSSIONS AND CONCLUSIONS

46. The main points from the questionnaire survey among participants during the T/W (reported in Appendix C to this report) and from the discussion are hereunder summarised:

General consideration about AZA

- AZA is an essential instrument to develop aquaculture activities in the Black Sea area. Some evident differences can be observed among countries in terms of environmental conditions, technical capacity, aquaculture development, knowledge and governance. These differences are also reflected in the development, implementation and management of AZA.

Furthermore AZA gives:

- an added value to aquaculture;
- warrantees for the future of aquaculture;
- legal stability to aquaculture.

AZA contributes to:

- concentrate and differentiate products on offer;
- reduction of production costs;
- sector organization and other secondary dependant sectors;
- aquaculture image building;
- build a dialogue and coordination among administrations through participatory approach.

AZA also serves to determine discipline and responsibility in the development of aquaculture in terms of defining clear objectives of development that need planning in every step and in a transparent manner.

Constraints for the implementation of AZA

- Lack and no clear legislation for aquaculture and licensing and leasing procedures;
- Lack of cooperation and coordination among institutions;
- Lack of technical support for projects regarding viability and technical, socio-economic and environmental aspects.

Needs for the implementation process of AZA

- Facilitation and support through institutional, national capacity building in administration, technical, new knowledge and new know-how to facilitate the process;
- Coordination among the different authorities involved in development plans;
- Adoption of an ICZM protocol implementation within the AZA process.
- Implementation carried out by specific aquaculture agencies which could facilitate the process of AZA;
- Capacity building.

As follow up the participants to the training / workshop suggested the following actions:

- Training on aquaculture general issues (recirculation systems, techniques, marketing, legal aspects, health and safety, animal welfare and handling, production management, good practices, zoning);
- Dissemination of results (pilot studies, experiments; establish an area to develop different model, dissemination of positive results to the private sector; seminars to the different institutions involved on aquaculture about the importance of the sectors);
- Specific dissemination documents and guidelines on aquaculture development for aquaculture in the Black Sea;
- Cooperation among the Black Sea countries; Knowledge and data sharing mechanisms, multi-stakeholders meetings and technical visits, expert exchange and mobility, lending employment;
- Special web pages on practical implementation (cooperation among institutes in different fields of the sector).

APPENDIX A

AGENDA

Introduction and background

- Opening and arrangements of the training/workshop
- 1st sub-session – Aquaculture development in the black Sea countries
- 2nd sub-session – Introduction to the AZA context
- 3rd sub-session – Basic concepts, integrated coastal zone management (ICZM), Ecosystem Approach to Aquaculture (EAA)
- Practical session

Establishment of allocated zones for aquaculture (AZA)

- 1st sub-session – Legal framework to support the establishment and implementation of AZA
- 2nd sub-session – Geographic Information Systems (GIS) in aquaculture and in allocated zones for aquaculture
- 3rd sub-session – Establishment of AZA: Overview of Mediterranean experience and case studies
- Practical session

Management of AZA

- 1st sub-session – Management plan for AZA
- 2nd sub-session – Environmental monitoring of AZA. Environmental Impact Assessment (EIA) and interactions between aquaculture and the other coastal activities
- 3rd sub-session – Environmental monitoring programme
- 4th sub-session – Use of indicators to monitor the development sustainable aquaculture within an AZA
- Analysis and discussion

Training workshop conclusions

- Implementation of an AZA (summary session)
- Presentation of case studies by participants
- Guide and methodological process
- Discussion and conclusions

APPENDIX B

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APPENDIX C

QUESTIONNAIRE FOR PRACTICAL SESSIONS

1. **What do you consider are the main constraints for the development of marine aquaculture in your country?**

2. **How would you define AZA in a few words?**

3. **How do you consider that AZA will contribute to the Sustainable Development of Aquaculture in the following aspects:**
   a. Environment? No Low Medium High
   Comments:
   b. Economics? No Low Medium High
   Comments:
   c. Social? No Low Medium High
   Comments:
   d. Governance? No Low Medium High
   Comments:

4. **Do you have a clear idea of the concepts related to AZA, such as:**
   a. Allowed Zone of Effect (Y/N)
      Define in short sentence:
      … ıf NO, why?
   b. Environmental Quality Standards (Y/N)
      Define in short sentence:
      … ıf NO, why?
   c. Environmental Quality Objectives (Y/N)
      Define in short sentence:
      … ıf NO, why?
   d. Environmental Monitoring Programme. (Y/N)
      Define in short sentence:
      … ıf NO, why?
   e. Environmental Impact Assessment. (Y?N)
      Define in short sentence:
      … ıf NO, why?

5. **What do you consider as the main constraints (obstacles) to implement the AZA in your country?**

6. **How would you consider those constraints to be solved?**
   Discussion comments:

7. **What kind of action do you consider could be useful for the taking off of an AZA process in your Country? Please give some specifications to…**
   ...Pilot actions?
   ... Training?
   ...Cooperation (which field)?
   ...any other suggestions…?