Food and Agriculture Organization of the United Nations

General Fisheries Commission for the Mediterranean
Commission générale des pêches pour la Méditerranée

# Scientific Advisory Committee on Fisheries (SAC)

## Deepwater red shrimp in the eastern-central Mediterranean Sea week

## *DWRS WEEK*

## ONLINE, 7-11 February 2022

INFORMATION NOTE & DRAFT AGENDA

### Background

Target 1 of the GFCM mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries was devoted to reversing the declining trend of fish stocks through strengthened scientific advice in support of management. Through output 1.3 - Enhanced science-based GFCM regulations on fisheries management - it sought to increase the quality and breadth of advice on the status of the stocks in the Mediterranean and the Black Sea through a number of important actions. Among these there was the revision of existing management plans / development of new management plans, based on the technical advice provided by the subsidiary bodies, with the objective of addressing the main commercial fisheries as well as those fisheries that rely on or show a strong interaction with resources in need of urgent action. The GFCM mid-term strategy (2017–2020) also aimed to protect the unique marine fauna of the Mediterranean Sea including also deep-sea habitats, which have been impacted by deep-water (DW) bottom trawl fishing. This activity mainly targets DW blue and red shrimp (*Aristeus antennatus*) and the giant red shrimp (*Aristaeomorpha foliacea*) – hereon collectively mentioned as "DWRS". In particular, in the eastern-central Mediterranean this fishery was selected to test the feasibility of the GFCM guidelines on management plans. The feasibility phase ended with the compilation of a background technical document in support of the management plan for bottom trawl fisheries exploiting, in the eastern-central Mediterranean (GSAs 12–16; 18–27).

The forty-first session of the GFCM acknowledged the need to advance towards a management plan for the DWRS fishery, and recommended that a technical session be organized to address this issue. As a result, the Subregional Committees for the eastern and for the central Mediterranean revised the existing background technical document and drafted specific technical elements for the management of the fishery. Owing to the fragmentary information available on the fishery, the SAC stressed the need to provide precautionary advice while collecting data in order to perform a formal analytical assessment of the status of the stocks.

The SAC thus endorsed a work plan for the assessment of the two species and concurrently recommended to establish management rules for a sustainable exploitation. In the former case, particular emphasis was placed on two issues:

i. assessing the staus of the DWRS stocks in the eastern-central Mediterranean

ii. identifying the main fishing grounds and establishing the historical fishing activity, which would also serve as the basis for the future implementation of exploratory fishing protocols, as suggested for deep-sea fisheries by the Working Group on Vulnerable Marine Ecosystems (WGVME).

As a result of the work done, the GFCM adopted three recommendations, one for the Levant Sea (referring to GSAs 24, 25, 26 and 27; Recommendation GFCM/42/2018/4), one for the Ionian Sea (referring to GSAs 19, 20 and 21; Recommendation GFCM/42/2018/3) and one for the Strait of Sicily (GSAs 12, 13, 14, 15 and 16; Recommendation GFCM/43/2019/6), towards establishing multiannual management plans for sustainable trawl fisheries targeting giant red shrimp and blue and red shrimp.

The three recommendations in place are designed to provide high long-term yields of the target shrimp species consistent with MSY and to guarantee a low risk of stocks collapse while maintaining sustainable and relatively stable fisheries. In addition, they foresee that the status of the stocks be regularly assessed, and the biological reference points be set following the collection of relevant data through adequate scientific monitoring and in accordance with the precautionary principle. They also foresee that the biological, economic and social implications of implementing several management scenarios be assessed.

In addition, to enhance the effectiveness of conservation measures in the GFCM area of competence, as outlined in the framework of the WGVME, and move towards the implementation of the management measures foreseen by the three recommendations in place, a complete mapping of the deep-sea fishing footprint was considered crucial. It was also deemed key in view of adopting a process through which to conduct impact assessment of bottom trawl fisheries in agreement with the FAO Deepwater Guidelines (FAO 2008).

In this context a group of experts on different aspects of the assessment and management of deep water red shrimp and deep water bottom trawl fisheries was established under the hat of the GFCM to delve deeper in all the above-mentioned aspects. A work plan was endorsed by the 22$^{nd}$ SAC and 44$^{th}$ Commission to guide the way forward in terms of both the assessment of the status of the two species as well as the determination of the fishing grounds (included here as Appendix 2).

The *DWRS week* seeks to bring together these experts as well as any other interested participants to advance on such work plan, while also transferring knowledge regarding the work done to a wider audience with the aim of enhancing technical knowledge across the GFCM area of competence. The week is this divided into three major sessions:

Session 1: Addressing spatial aspects of the fishery with three workshops foreseen to share the work done as well as the application of the methods employed

Session 2: A session of the Working Group for Stock Assessment of Demersal species (WGSAD) to advance towards the assessment of the two species of DWRS in the eastern-central Mediterranean Sea

Session 3: a session to discuss the advances of Part 1 of the FAO technical paper “Synthesis of the biology, ecology and fisheries of deepwater red shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus* in the central-eastern Mediterranean (GSA 12 – 16, 18 – 27)”

## SESSION 1: The identification of deep water red shrimp fishing grounds in the eastern-central Mediterranean

The spatial analyses performed to underpin the DWRS fishing grounds in the eastern-central Mediterranean, following the agreed roadmap comprise three different components: i) Mapping fishing effort using AIS data, ii) estimating fishing effort using multicriteria decision analysis (MCDA) and iii) species distribution modeling to identify hotspots of the two species. Each one of these resulted in the construction of workshops to demonstrate the work and transfer the technical knowledge required to run the analyses.

### *Workshop 1 on quantitative methods for AIS data using R*

The idea of this workshop is to build upon the extensive work carried out in 2019-2021 on mapping the deep water red shrimp fishing grounds based on available data both on vessel behaviour and on species distribution.

The workshop is aimed at transferring the knowledge required to analyze AIS data and map fishing effort, sharing R scripts. The activities will be organized in three parts:

i. A theoretical session dedicated to showing AIS-based scientific applications in fishery management and introduce the R processing workflow.
ii. A practical session on mapping deep-water fishing grounds: from fishing hauls to metrics and maps of fishing effort (for entry-level R users)
iii. A practical session on processing and classification of AIS data: from raw data to fishing hauls (for advanced R users)

### *Workshop 2 on the estimation of fishing grounds for DWRS using Multi-Criteria Decision Analysis (MCDA)*

The idea of this workshop is to build upon the extensive work carried out in 2019-2021 on using MCDA to estimate the fishing grounds in GSAs 24, 25 and 26.

The workshop is aimed at transferring the knowledge required to run MCDA, sharing R scripts. The activities will be organized in three parts:

i. Estimation of fishing grounds for DWRS in GSAs 24, 25 and 26 using Multi-Criteria Decision Analysis -MCDA: scope, method adjustments, spatial outcomes and FAO technical paper
ii. Practical session on how to perform MCDA for estimating a Fishing Pressure Index from bottom trawl: Case studies GSAs 24, 25, 26 (process planned to be performed using ESRI's: ArcGIS)
iii. Practical session on how to perform MCDA for estimating a Fishing Pressure Index from bottom trawl: An introduction to fprmcda r package

***Workshop 3 on Machine Learning approaches to DWRS distribution modeling***

The idea of this workshop is to explore the work done towards DWRS distribution modeling.

The workshop is aimed at transferring the knowledge required to apply machine learning approaches to distribution modeling of DWRS in the eastern central Mediterranean. The activities will be organized in four parts:

i. Machine Learning – Random Forest
ii. Data exploration
iii. DWRS Modeling
    - Binary Model
    - Semi-quantitative Model
    - Biomass Model
iv. Ecological interpretation

**SESSION 2: a session of the Working Group for Stock Assessment of Demersal species (WGSAD) to advance towards the assessment of the two species of DWRS in the eastern-central Mediterranean Sea**

The idea is to advance on the work done during the 2022 WGSAD on the stock assessment of the two DWRS species towards providing advice on stock status in the eastern-central Mediterranean Sea. The agreed workplan will be followed and demonstrations will be provided using a data rich data set. Participants will then be able to apply the most appropriate method/approach according to the data available for their specific GSA.

**SESSION 3: a session to discuss the advances of Part 1 of the FAO technical paper "Synthesis of the biology, ecology and fisheries of deepwater red shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus* in the central-eastern Mediterranean (GSA 12 – 16, 18 – 27)"**

This session will be aimed at discussing the first draft of Part 1 of the FAO Technical paper – it will be restricted to participants in the work.

**The draft agenda for the week is provided in Appendix 1**

**APPENDIX 1**

**Draft agenda of the DWRS week**

| Session | Details | Dates |
|---|---|---|
| **Session 1:** Addressing spatial aspects of the DWRS fishery Capacity building workshops | Workshop 1: The identification of deep water red shrimp fishing grounds in the eastern-central Mediterranean | 7 February 2022 (AM and PM) |
| | Workshop 2: Estimation of fishing grounds for DWRS using Multi-Criteria Decision Analysis (MCDA) | 8 February 2022 (AM) |
| | Workshop 3: Machine Learning approaches to DWRS distribution modeling | 9 February 2022 (AM) |
| **Session2:** session of the WGSAD on the assessment of DWRS | This session will entail advancing on the work done during the 2022 WGSAD towards finalising the assessment of DWRS in the eastern -central Mediterranean | 8 February 2022 (PM); 9 February 2022 (PM); 10 February 2022 (PM); 11 February 2022 (PM) |
| **Session 3:** Part 1 of the FAO technical paper "Synthesis of the biology, ecology and fisheries of deepwater red shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus* in the central-eastern Mediterranean (GSA 12 – 16, 18 – 27)" | This session will be aimed at discussing the first draft of Part 1; restricted to participants in the publication | 8 February 2022 (AM) |

**APPENDIX 2**

## Work plan for the assessment of stock status and the determination of fishing grounds for deep water red shrimp stock and fisheries in the eastern-central Mediterranean

### 1. Work plan for stock assessment

Following from the recommendations of the data preparation meeting held in Rome in October 2019, the following steps will be taken towards the assessment of giant red shrimp and blue and red shrimp:

- Assessments will be performed in each GSA with the aim of starting with the simpler methods and progressing towards more complex models in GSAs with enough data to do so. A minimum plan for the future is provided in Table 1, noting that these methods should be trialled, as far as possible, in each GSA in order for assessments to be presented at the WGSAD in November/December 2021. Thus each GSA will perform, to the extent permitted by their data, catch curves, LBSPR and LIME. The work will be carried out step-by-step starting from catch curves, then addressing LBSPR and finally LIME. Where possible outcomes between methods will be compared in terms of F/M ratios. Data-rich GSAs may also explore more complex models if deemed useful (e.g. SPiCT, XSA, a4a). In this respect, a number of critical issues by method should be borne in minds:
    - Catch curves: how years are pooled and sensitivity on the time series considered
    - LBSPR: LBSPR is very sensitive to the value of Linf used so in the cases where catch cannot be split by sex, care should be taken with respect to the growth parameters used, and the group agreed to explore two options: i) use female parameters and treat the outcomes as a worst-case scenario, and ii) calculate a new set of combined-sex parameters
    - LIME: the assumed variability of recruitment (sigmaR) is extremely important. The group agreed to calculate it from the MEDITS time series for recruits. GSAs with no surveys can borrow SimgaR from adjacent GSAs if it makes sense
- In order to provide adequate technical assistance in the assessments, a standard capacity-building module for these methods will be developed, using SS-DL for LIME and LBSPR and data from GSAs 18 and 19 as a demo. The module will be illustrated and rolled-out with a workshop which will be followed with bilateral assistance if needed.
- In order to maximize the quality of the results of these data-limited approaches, information on biological parameters should be improved and standardized protocols for data collection across GSAs should be ensured.
- The work towards assessing stocks will proceed step-by-step, starting from the GSA-level (i.e. from the basic unit of data availability) and maintain the prerogative to unify them whenever and if needed, also by performing sensitivity analyses. Overarching this, the concept of keeping all GSAs in the eastern-central Mediterranean together should be maintained as the null hypothesis to be challenged.

Table 1. Summary of available data and possible assessment methods by GSA

| GSA | Available data | Possible assessment methods |
|---|---|---|
| **15** | Medits abundance index | Catch curves |
| | Medits biomass index | LIME |
| | Medits LFD by sex | LBSPR |
| | Catch | LBB |
| | Catch LFD (combined sexes) | AMSY |
| | | SpiCT |
| | | VPA-type |
| **16** | Medits abundance index | Catch curves |
| | Medits biomass index | LIME |
| | Medits LFD by sex | LBSPR |
| | Catch | LBB |
| | Catch LFD (combined sexes) | AMSY |
| | Catch LFD by GSA of origin for selected years (combined sexes) | SpiCT |
| | | VPA-type |
| **18** | Medits abundance index | Catch curves |
| | Medits biomass index | LIME |
| | Medits LFD by sex | LBSPR |
| | Catch | LBB |
| | Catch LFD (combined sexes) | AMSY |
| | | SpiCT |
| | | VPA-type |
| **19** | Medits abundance index | Catch curves |
| | Medits biomass index | LIME |
| | Medits LFD by sex | LBSPR |
| | Catch | LBB |
| | Catch LFD (combined sexes) | AMSY |
| | | SpiCT |
| | | VPA-type |
| | | SCAA |
| **20** | Survey Abundance index | Catch curves |
| | Survey Biomass index | LIME |
| | Survey LFD by sex | LBSPR |
| | | LBB |
| | | AMSY |
| **24** | Survey Abundance index (monthly) | Catch curves |
| | Survey Biomass index (monthly) | LIME |
| | Survey LFD (monthly) | LBSPR |
| | | LBB |
| | | AMSY |
| **25*** | Medits abundance index | Catch curves |
| | Medits biomass index | LIME |
| | Medits LFD by sex | LBSPR |
| | Catch (Issues) | LBB |
| | Catch LFD (combined sexes) (Issues) | AMSY |
| **26** | LFD commercial (2016/2017) | Catch curves |
| | | LIME |
| | | LBSPR |
| | | LBB |
| | | AMSY |

*When overlaying the survey positions onto the hypothetical fishing grounds there was no correspondence so it is not advisable to assume that the LFDs of the survey may include the catch LFDs

## 2. Work plan for the use of composite models for the estimation of fishing grounds for DWRS (using AIS, survey data and other methods)

Following from the recommendations of the data preparation meeting held in Rome in October 2019, the steps outlined in Table 2 and Figure 1 below will be taken to estimate fishing grounds for DWRS:

Table 2. Actions towards the estimation of fishing grounds for DWRS in the E-C Mediterranean

| WHAT TO DO | WHO | RESOURCES NEEDED | TIMEFRAME |
|---|---|---|---|
| Fishing grounds + survey locations | Lorenzo D'Andrea | | DONE |
| Fishing grounds + AIS (2015-2018)<br><br>Assess future possibilities acc. results | Nora Tassetti/Carmen Ferrá Vega | Assess evolution of the fleet | DONE |
| MCDA (in GSA 24, 25, 26) | Irida Maina + help | Info NEEDS<br>• Environmental data + fleet characteristics (DCRF?)<br>• Local knowledge<br>• Legislation (FRAs+national measures?)<br><br>Minimum dataset | DONE |
| Biomass/Abundance data (species distribution modelling) *vs.* LEK (info available) | Lorenzo D'Andrea<br>Tommaso Russo | Info NEEDS:<br>• Survey data | DONE |
| Overlap Analysis | Lorenzo D'Andrea, Tommaso Russo, Irida Maina, Nora Tassetti,Carmen Ferrá Vega | Info NEEDS:<br>• All info available from analyses above | To be finalised |

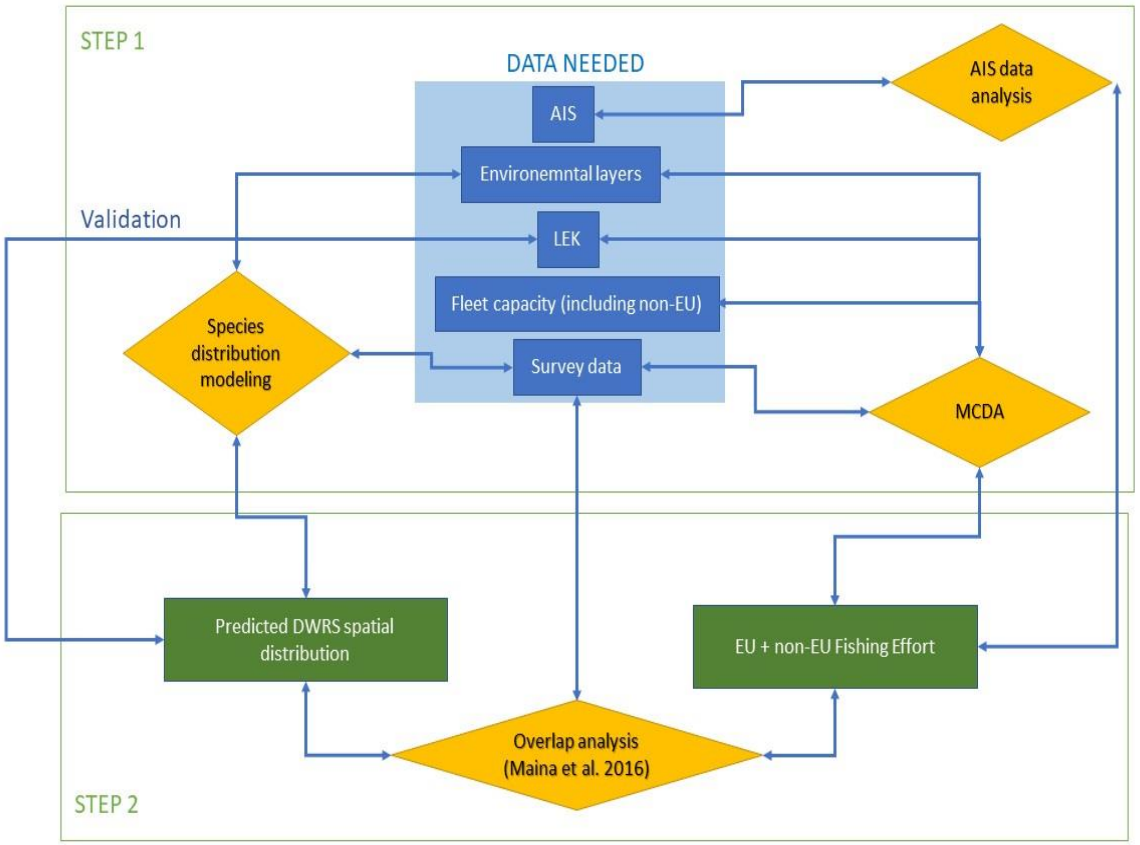


Figure 1. Schematic representation of the actions towards the estimation of fishing grounds for DWRS in the E-C Mediterranean