Recovery of fisheries historical time series for Mediterranean and Black Sea stock assessment

FINAL REPORT

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EASME/EMFF/2016/032 Specific Contract No.01

Final Report

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11. Executive summary

The RECFISH project (Specific Contract n. 01 under the Framework Contract EASME/EMFF/2016/032 "Provision of scientific advice for the Mediterranean and the Black Sea") has been developed with the ultimate objective of creating a reference database containing historical fisheries data pre DCR/DCF in the Mediterranean Sea (prior to 2002) and Black Sea (prior to 2008), to provide standardized CPUEs and to build some case studies where historical landings and CPUEs are integrated into recent stock assessments.
In order to fulfil the stated objectives, the project was organised into 5 Work Packages (and 4 Tasks).

Table I. Structure in WPs and Tasks of the project RECFISH.

WP0 Project management and coordination
WP1 Fisheries historical data collection
Task 1.1 Fisheries historical data collection in the Mediterranean
Task 1.2 Fisheries historical data collection in the Black Sea
WP2 Data validation and standardization
Task 2.1 Validation of landings time series
Task 2.2 Standardization of the CPUEs
WP3 Database construction
WP4 Stock assessment using historical data

Each WP/Task included specific activities to achieve the required objectives, had a person in charge as chair (working in cooperation with a co-chair), a core team (composed of one representative of each of the institutes involved in the Task/WP), who carried out the majority of the work, a defined work plan, and a clear set of milestones and deliverables.

WP1 Fisheries historical data collection

WP1 aimed at collecting and classifying all the available fisheries historical data in the Mediterranean and Black Sea. This WP took advantage of the contribution of all the partners of the RECFISH consortium.
In the first months of the Project, the inventory of the information that could be made available to the Project was finalized with the contribution of all the Partners involved in WP1. This information concerns different typologies of fisheries data, coming from different sources: official archives (e.g. FAO, HELSTAT, ISTAT), data collected by means of research projects, grey literature, etc. Most of the information refers to the period before 2002, when the EU DCR/DCF was not yet enforced in most of the EU countries.
Following the discussions made during the first plenary meeting of the project RECFISH (Pisa, 25-26 January 2018, see Annex III of the Inception Report D0.1), the preliminary inventory prepared for the proposal of the project was further refined. This inventory of datasets was delivered as Annex IV of the Inception Report (D0.1).
After the preparation of the inventory of datasets, a common template was built in order to store the collected data ensuring full compatibility with the DCF databases. The encoding of spatial and temporal aspects, as well as of species and gear/fishery/metiér definition have been organized in the template to comply with the DCF tables structure as regards the transversal, biological and experimental fishing data. Concerning this last aspect, the datasets coming from “old” experimental trawl surveys (e.g. the Italian GRUND) were re-organized to guarantee full compatibility with the MEDITS formats (TA, TB, TC).

The template was organized not only to guarantee the compliance with the DCF structure, but also to maintain the finest temporal, geographical and technical resolution of the original data. For example, the geographical encoding reflects the originally reported statistics but an aggregation key at GFCM GSA level is also available. Each dataset collected has been identified and described in the template as METADATA.
The structure of the template was discussed and agreed among the leaders and key persons of WP1 and WP3, as well as the project coordinator; an ad hoc Skype meeting took place on the 17th May 2018. The common template consisted of an Excel file: RECFISH-WP1_input templates.xls.
Following the preparation of the common template, each partner involved in WP1 (Task 1.1 Mediterranean Sea; Task 1.2 Black Sea) organized and stored the available data in the common templates. This process was finalized in December 2018, although the possibility of including further historical data was kept, as requested by the Contracting Authority.
The two deliverables foreseen under WP1, D1.1 (Fisheries historical data in the Mediterranean) and D1.2 (Fisheries historical data in the Black Sea) contain a detailed description of all the datasets collected (e.g. typology of data, spatial and temporal coverage, etc.), together with a critical evaluation of the information collected.

WP2 Data validation and standardization

WP2 was aimed at analysing the data collected under WP1 in order to validate and standardize the time series of data before populating the database. This WP was organized into two tasks, one aimed at validating landings data, the second to standardize survey data and CPUEs.
The start of the activities of WP2 was anticipated to month 3 (March 2018), instead of month 4, as agreed during the 1st Plenary Meeting in Pisa (25-26 January 2018).

Under **Task 2.1**, the landings time series collected in RECFISH from the different sources were evaluated in terms of:

1) quality check that includes:
- avoiding duplication of data
- check for validity of data entered
- check for correctness of Species names

2) internal consistency of data that includes:
- identification of outliers and z-score quantification of each record

3) validation that includes:
- evaluation of agreement among different time series

The *TSval* script was developed in R to perform the analyses expected under Task 2.1 using as input the RECFISH dataset implemented in WP1 (the script is available on the RECFISH sharepoint, https://cloudfs.hcmr.gr/index.php). The *TSval* script is also reported as an appendix in the Deliverable D2.1 “Validation of fisheries historical data”, which is attached to the present report as an annex (see Annex V). The steps implemented into the R script and exemplificative applications are detailed in the Deliverable D2.1.
After the run of all controls and checks, the script produced an output file named “file.res.csv” which is identical for number of records and data to the RECFISH database, but has additional columns containing information for each record useful to understand the results of the whole validation process. These additional columns contain “labels” (classifications) which should help future users of the dataset.
The results of the application of the three-steps approach for data quality check on the RECFISH database are recorded in output files stored in the project sharepoint. A synthesis of the results is here reported as a list of indicators of the outputs that allows a general evaluation of the performance of the script developed under Task 2.1 and the quality of data.

Table II. Synthesis of the application of the validation process to the RECFISH datasets for Mediterranean and Black Sea.

Data set	Mediterranean	Black sea
Data set dimension	212875	22839
Duplicated row	19712	6576
Number of Time series (ts)	6447	357
Number of ts with length <= 15	3102	136
Number of ts with length > 15	3345	221
Outliers (from z.score)	3307 (2%)	488 (2%)
NA (from z.score)	26478 (12%)	490 (2%)
valid data (not outlier from z.score analysis)	183090 (86%)	21861 (96%)
% >3 or <-3 (from z.score)	1.55%	2.13%
% >2 or <-2 (from z.score)	4.06%	5.03%
% >1 or <-1 (from z.score)	15.76%	15.53%
% > 0.2 or <-0.2 (from z.score)	60.91%	60.84%
Number of match: Area vs Region	12458	0
Number of match: GSA vs Region	5881	0
Number of match: Area vs GSA	10447	0
Number of match: FAO vs Area	47176	683
Number of match: FAO vs Region	14086	0
Number of match: FAO vs GSA	14978	1317

The activities performed and the methodological approaches developed under **Task 2.2** are described in the Deliverable D2.2 (see Annex VI). Task 2.2 was aimed at 1) establishing a systematic and harmonized methodology to standardize the scientific survey abundance indices and length-frequency distributions (LFDs) and 2) applying the defined methodology to a wide set of stocks in Mediterranean Sea and Black Sea.

Deliverable D2.2 is organized into 5 main sections, summarizes as follows, and provides a detailed description of the methodologies developed and the results of the analyses performed:

1. a brief introduction, where an overview of the rationale behind the standardization of survey indices, with reference to the relevant literature, is given;
2. a detailed description of the methodological approach for the standardization of density and biomass indices, using Generalized Additive Models (GAM), and of the LFDs, using an approach combining the probabilistic decomposition of the annual LFDs and Generalized Linear Models (GLM); both the characteristics of the survey changing along the years (vessel, survey time) and other factors (e.g. position, environmental variables) that could have potentially influenced the index were considered as explanatory variables. The developed R code is reported for both methodological parts;
3. the results related to the standardization of the biomass and density indices for 43 stocks in Mediterranean and Black Seas are, then, extensively described. For a set of stocks more than one survey was considered (MEDITS and GRUND) and both indices were standardized, for a total of 54 standardizations;
4. the results related to the standardization of LFDs were reported for 3 stocks (*Aristeus antennatus* in GSA 09 and GSA 11 and *Nephrops norvegicus* in GSA 09); for two of them two survey were considered for a total of 5 LFD standardizations;
5. a section summarising the main conclusions completes the deliverable, doing the groundwork for further developments.

The stocks investigated are listed in Table III.

Table III. List of stocks considered for survey indices standardization. The stocks for which more than one index was standardized are highlighted in bold.

Species	GSAs	Type of data	LFDs
1. *Mullus barbatus*	1	Medits biomass	N
2. *Parapenaeus longirostris*	1	Medits biomass	N
3. *Mullus surmuletus*	5	Medits biomass	N
4. *Mullus barbatus*	6	Medits biomass	N
5. *Eledone cirrhosa*	6	Medits biomass	N
6. *Trisopterus capelanus*	7	Medits biomass	N
7. *Mullus barbatus*	7	Medits biomass	N
8. *Trachurus trachurus*	7	Medits biomass	N
9. *Parapenaeus longirostris*	7	Medits biomass	N
10. Aristeus antennatus	**9**	**Medits/Grund biomass**	**Y**
11. Aristeus antennatus	**11**	**Medits/Grund biomass and density**	**Y**
12. Illex coindetii	**11**	**Medits biomass and density**	**N**
13. *Trachurus mediterraneus*	9	Medits biomass	N
14. *Trachurus trachurus*	9	Medits biomass	N
15. *Engraulis encrasicolus*	9	Medits biomass	N
16. Eledone cirrhosa	**9**	**Medits/Grund biomass**	**N**
17. Eledone cirrhosa	**10**	**Medits/Grund biomass**	**N**
18. *Illex coindentii*	10	Medits biomass	N
19. ***Nephrops norvegicus***	**9**	**Medits biomass and density; Grund density**	**Y**
20. *Eledone moschata*	16	Medits biomass	N
21. *Mullus barbatus*	16	Medits biomass	N
22. *Parapenaeus longirostris*	16	Medits biomass	N
23. *Sardina pilchardus*	16	Medits biomass	N
24. Eledone cirrhosa	**18**	**Medits biomass and density**	**N**
25. *Lophius spp*	17	Medits biomass	N
26. *Trachurus spp*	17	Medits biomass	N
27. Trisopterus capelanus	**18**	**Medits biomass and density**	**N**
28. *Trisopterus capelanus*	17	Medits biomass	N
29. *Aristeus antennatus*	18-19	Medits biomass	N
30. *Aristaeomorpha foliacea*	18-19	Medits biomass	N
31. *Pagellus erythrinus*	20	Medits biomass	N
32. *Spicara smaris*	20	Medits biomass	N
33. *Pagellus erythrinus*	22	Medits biomass	N
34. *Spicara smaris*	22	Medits biomass	N
35. *Spicara smaris*	23	Medits biomass	N
36. *Spicara smaris*	22-23	Medits biomass	N
37. *Boops boops*	23	Medits biomass	N
38. *Mullus surmuletus*	25	Medits density	N
39. *Merluccius merluccius*	25	Medits biomass	N
40. *Scophthalmus maximus*	29	biomass	N
41. *Squalus acanthias*	29	biomass	N
42. *Merlangius merlangus*	29	biomass	N
43. *Sprattus sprattus*	29	biomass	N

WP3 Database construction

Most of the activities carried out under WP3 were performed in strict cooperation with WP1. The common template prepared by WP3 leaders (in cooperation with WP1) was used for the temporary storage of data collected under WP1, and represented the basis for the development of the final database.

The encoding of the different variables in the new database is in compliance with the table structure and encoding as specified in Appendix 2 of Annex 2 of the Mediterranean and Black Sea DCF Data Call to ensure full compatibility with the DCF database.

The database was built in a non-proprietary software.

The entry of data was planned according to columns organized in a dropdown menu, following a series of reference tables. The file was developed and built by WP3 leaders (Stefanos Kavadas, HCMR, and Maria Teresa Facchini, COISPA) in cooperation with WP1; in this way, the data stored were already organized according to the structure of the RECFISH database. The following sheets/tables are included in the database:

tblMETADATA: it resumes the basic information of each dataset.

tblLandings: it contains series of data on landings and discards: annual or monthly landings (tons, kg) by country or smaller areas (e.g. administrative regions, ports, etc.).

tblFleet Capacity: it stores data (number of vessels, tonnage, Fishing capacity/activity: data on number of vessels (also tonnage and vessel length) by country (in some cases by port or administrative region).

tblLPUE: it contains data on landing per unit of effort coming from specific research projects, computed on fishing capacity and activity values (e.g. number of vessels, fishing days, fishing hours, HP, etc.).

tblGrowth Param: it includes von Bertalanffy growth parameters, by species and area.

tblSize Struct land_Disc: it includes size structure of samples coming from landing and discard, carried out during research projects prior to EU DCR/DCF.

tblAge Struct Land_Disc: it includes age structure of samples coming from landing and discard, carried out during research projects prior to EU DCR/DCF.

tblALK: this table contains Age Length Key data, by species and area.

tblTrawl Survey CPUE: it contains species density and biomass indices computed according to swept areas or fishing hours. These indices come from experimental trawl surveys performed prior before DCF.

Data on experimental trawl surveys different from those performed in the context of DCF (e.g. the Italian GRUND, HVAR, etc.) have been organized according to the same structure of the MEDITS data, in the following three sheets/tables:

tblTA: it contains detailed data on reach experimental haul.

tblTB: it includes data on catch (number and weight) for each species.

tblTC: it contains biological data (e.g. size, sex, maturity stage at species level.

WP4 Stock assessment using historical data

The aim of Work Package 4 was to develop and test stock assessment methods that can incorporate historical time series of commercial catches and abundance index, using also catch at length/age data.

Once the data gathering activities foreseen under WP1 were almost completed, it became clear that following strictly the criteria proposed in the Terms of Reference of the proposal would have been impossible. This was mostly due to the paucity of historical data on commercial LFDs (or age structure), that hampered the possibility of performing 10 age-based stock assessments. At the same time, it was not possible to perform 10 stock assessments on small pelagic species. Furthermore, due to the lack of suitable data in some of the 10 case study areas, the allocation of 2 stocks per area could not be respected. These issues were presented and discussed with the Contracting Authority during the Progress Meeting held in Brussels on the 27 September 2018. The Contracting Authority agreed on the proposal of deviating from the selection criteria initially proposed, as long as no deviation from the stock assessment models proposed (namely SPiCT for surplus production model assessment, and a4a for age-base assessment) occur.

The stock assessment analyses were performed offline in the view of presenting and discussing the results and preliminary analyses during the working group expected under WP4. The working group on stock assessment was chaired by the WP4 leaders and the Project Coordinator, and took place on the 25-27 February 2019 at the CoNISMa HQ in Rome, and was organized back to back to the 3rd Project Plenary Meeting.

The summary of the results of the 20 stock assessments performed under WP4 is presented in Table IV. Most of the stocks evaluated within this project were assessed for the first time. For the stocks for which an evaluation was already carried out, this project offered the possibility of improving the robustness of the assessment using historical data. Eight stocks resulted in overexploitation, eleven resulted sustainably exploited, and for only one stock (Mullus surmuletus in GSA 25) two stock assessments were carried out resulting in contrasting results. For one stock (*Mullus surmuletus* in GSA 25), two stock assessments were carried out providing contrasting results, even though the general reduction of fishing mortality is confirmed by the two approaches. In general, stock assessments performed by WP4 using the historical data collected under the RECFISH project provided a more optimistic figure of the status of the stocks in the Mediterranean and Black Sea. This can be a result of the higher contrast in the time series due to the inclusion of old data when catches were usually higher than in the recent years.

Table IV. Summary of the stock assessment results.

N.	GSAs	Species	Time span	Method used	Current values	Reference points	F_{curr}/F_{MSY}	Stock status
1	01 – 03 - 04	*Parapenaeus longirostris*	1970 - 2017	SPiCT	F_{curr} = 0.15	F_{MSY} = 0.98	0.15	Sustainably exploited, with high biomass
2	05	*Mullus surmuletus*	1967 - 2017	SPiCT	F_{curr} = 0.49	F_{MSY} = 0.43	1.15	In overexploitation
3	06	*Mullus barbatus*	1991 - 2017	SPiCT	F_{curr} = 0.55	F_{MSY} = 0.66	0.83	Sustainably exploited, with high biomass
4	07	*Trisopterus capelanus*	1977 - 2016	SPiCT	F_{curr} = 0.45	F_{MSY} = 0.24	1.87	In overexploitation
5	09	*Aristeus antennatus*	1988 - 2017	a4a	F_{curr} = 0.26	F_{MSY} = 0.37	0.70	Sustainably exploited
6	09	*Nephrops norvegicus*	1994 - 2016	a4a	F_{curr} = 0.10	F_{MSY} = 0.15	0.67	Sustainably exploited
7	09	*Eledone cirrhosa*	1985 - 2017	SPiCT	F_{curr} = 0.44	F_{MSY} = 0.51	0.87	Sustainably exploited, with high biomass
8	09	*Engraulis encrasicolus*	1972 - 2017	SPiCT	F_{curr} = 0.36	F_{MSY} = 0.62	0.58	Sustainably exploited, with high biomass

8	10	*Eledone cirrhosa*	1972 - 2017	SPiCT	$F_{curr} = 0.66$	$F_{MSY} = 0.3$	2.2	In overexploitation
10	16	*Eledone moschata*	1972 - 2017	SPiCT	$F_{curr} = 1.03$	$F_{MSY} = 0.55$	1.87	In overexploitation
11	16	*Sardina pilchardus*	1985 - 2016	SPiCT	$F_{curr} = 0.66$	$F_{MSY} = 0.51$	1.29	In overexploitation
12	17	*Trachurus* spp.	1956 - 2017	SPiCT	$F_{curr} = 0.01$	$F_{MSY} = 0.14$	0.06	Sustainably exploited
13	17	*Lophius* spp.	1953 - 2017	SPiCT	$F_{curr} = 2.00$	$F_{MSY} = 0.88$	2.28	In overexploitation
14	18	*Aristeus antennatus*	1972 - 2017	SPiCT	$F_{curr} = 0.07$	$F_{MSY} = 0.18$	0.38	Sustainably exploited
15	20	*Spicara smaris*	1990 - 2017	SPiCT	$F_{curr} = 0.04$	$F_{MSY} = 0.46$	0.08	Sustainably exploited, with high biomass
16	22 - 23	*Spicara smaris*	1995 - 2017	SPiCT	$F_{curr} = 0.03$	$F_{MSY} = 0.27$	0.12	Sustainably exploited, with high biomass
17	22	*Pagellus erythrinus*	1994 - 2017	SPiCT	$F_{curr} = 0.70$	$F_{MSY} = 0.47$	1.50	In overexploitation
18	25	*Mullus surmuletus*	1986 – 2017 (a4a)	a4a	$F_{curr} = 0.37$	$F_{MSY} = 0.22$	1.68	In overexploitation
			1967 – 2017 (SPiCT)	SPiCT	$F_{curr} = 0.17$	$F_{MSY} = 0.22$	0.78	Sustainably exploited, with high biomass
19	29	*Sprattus sprattus*	1978 - 2016	a4a	$F_{curr} = 0.48$	$F_{MSY} = 0.64$	0.75	Sustainably exploited
20	29	*Merlangius merlangus*	1971 - 2016	a4a	$F_{curr} = 0.53$	$F_{MSY} = 0.47$	1.13	In overexploitation

12. Résumé

Le projet RECFISH (X) a été développé afin de créer une base de données de référence contenant les données historiques des pêcheries pré DCR/DCF dans la mer méditerranée (avant 2002) et la mer noire (avant 2008) afin de fournier des CPUE standardisés and construire des cas d'études où les débarquements et les CPUE historiques sont intégrés dans les évaluations récentes des stocks. Afin de remplir les objectifs, le projet était organisé en 5 groupes de travail (WP ; « work packages ») (et 4 tâches).

Tableau I. Structure des WP et des tâches du projet RECFISH.

WP0 Gestion de projet et coordination
WP1 Collecte de données historiques sur les pêches
Tâche 1.1 Collecte de données historiques sur les pêches dans la mer méditerranée
Tâche 1.2 Collecte de données historiques sur les pêches dans la mer noire
WP2 Validation et standardisation des données
Tâche 2.1 Validation de la série chronologique des débarquements
Tâche 2.2 Standardisation des CPUE

WP3 Construction de la base de données
WP4 Evaluation des stocks en utilisant les données historiques

Chaque WP/tâche inclue des activités spécifiques pour atteindre les objectifs, notamment une personne responsable en tant que président (travaillant en coopération avec un coprésident), une équipe de base (composée d'un représentant de chacun des instituts impliqués dans la tâche/WP), qui a effectué la majorité des travaux, a défini un plan de travail et un ensemble d'étapes importantes et les livrables.

WP1 Collecte de données historiques sur les pêches

Le WP1 avait pour but la collection et la classification de toutes les données historiques sur les pèches disponible sur la mer méditerranée et la mer noire. Ce WP a joui de la contribution de tous les partenaires du consortium RECFISH. Dans les premiers mois du projet, l'inventaire des possibles informations a été finalisé grâce à la collaboration de tous les partenaires du WP1. Cette information concerne différents types de données des pêcheries provenant de différentes sources : archives officielles (e.g. FAO, HELSTAT, ISTAT), des données recueillies dans le cadre de projet de recherches, littérature grise, etc. La plupart des informations font référence à avant 2002, lorsque la directive DCR/DCF de l'union européenne n'était pas appliquée dans la plupart des pays de l'UE.

A la suite des discussions ayant eu lieu lors da la première réunion plénière du projet RECFISH (Pise, 25-26 Janvier 2018, voir Annexe du de démarrage D0.1), l'inventaire préliminaire préparé pour la proposition du projet a été affinée. Cet inventaire des ensembles de données a été fourni en tant qu'Annexe IV du Rapport de démarrage (D0.1). Apres la préparation de l'inventaire de données, un modèle commun a été créé afin de stocker les données recueillis et ainsi assurer la compatibilité avec les jeux de connées DCF. Le codage des aspects spatiaux et temporels, ainsi que les espèces la définition de l'engin/pêcherie/métier, ont été organisés dans le modèle se conformer à la structure des tableaux DCF en ce qui concerne les données de pêche transversales, biologiques et expérimentales. En ce qui concerne ce dernier aspect, les jeux de données issus des « anciennes » enquêtes expérimentales au chalut (e.g. le GRUND italien) ont été réorganisés pour garantir une compatibilité totale avec les formats MEDITS (TA, TB, TC). Le modèle a été organisé, non seulement pour garantir la conformité avec la structure DCF, mais également pour conserver la résolution temporelle, géographique et technique la plus fine des données d'origine. Par exemple, le codage géographique reflète les statistiques rapportées à l'origine, mais une clé d'agrégation au niveau GSA de la CGPM est également disponible. Chaque jeu de donnée recueillie a été identifié et décrit dans le modèle en tant que METADATA. La structure du modèle a été discutée et accepté parmis les dirigeants et les personnes clés des groupes de travail 1 et 3, ainsi que le coordinateur du projet ; une réunion ad hoc sur Skype a eu lieu le 17 mai 2018. Le modèle commun consistait en un fichier Excel : RECFISH-WP1_input templates.xls. Après la préparation du modèle commun, chaque partenaire impliqué dans le WP1 (tâche 1.1 Mer Méditerranée ; tâche 1.2 mer Noire) a organisé et stocké les données disponibles dans les modèles communs. Ce processus a été finalisé en décembre 2018, bien que la possibilité d'inclure d'autres données historiques ait été conservée, comme demandé par l'autorité contractante.

Les deux livrables prévus dans les WP1, D1.1 (Données historiques de la pêche en Méditerranée) et D1.2 (Données historiques de la pêche en mer Noire) contiennent une description détaillée de tous les jeux de données collectés (e.g. typologie des données, couverture spatiale et temporelle, etc.), ainsi qu'une évaluation critique des informations collectées.

WP2 validation et standardisation des données

Le WP2 visait à analyser les données collectées dans le cadre du WP1 afin de valider et de normaliser les séries chronologiques de données avant d'alimenter la base de données. Ce groupe de travail était organisé en deux tâches : l'une visait à valider les données sur les débarquements,

l’autre était à normaliser les données d’enquête et les CPUE. Le début des activités du groupe de travail 2 était prévu pour le troisième mois (mars 2018) au lieu du quatrième mois, comme convenu lors de la 1ère réunion plénière à Pise (25-26 janvier 2018).
Dans le cadre de la tâche 2.1, les séries chronologiques des débarquements collectées dans RECFISH à partir de différentes sources ont été évaluées en termes de:
1) contrôle de qualité comprenant:
- éviter la duplication des données
- vérifier la validité des données saisies
- vérifier l'exactitude des noms d'espèces
2) la cohérence interne des données incluant:
- identification des valeurs aberrantes et quantification du « score z » de chaque enregistrement
3) la validation qui comprend:
- évaluation de la cohérence entre les différentes séries chronologiques.
Le script TSval a été développé dans R pour effectuer les analyses attendues dans la tâche 2.1 en utilisant comme entrée le jeu de données RECFISH implémenté dans WP1 (le script est disponible sur le sharepoint RECFISH, https://cloudfs.hcmr.gr/index.php). Le script TSval figure également en annexe dans le livrable D2.1 « Validation des données historiques de la pêche », qui est joint au présent rapport en annexe (voir annexe V). Les étapes implémentées dans le script R et les exemples d’applications sont détaillés dans le Livrable D2.1.
Après l'exécution de tous les contrôles et vérifications, le script a généré un fichier de sortie nommé "fichier.res.csv", qui est identique pour le nombre d'enregistrements et pour les données dans la base de données RECFISH, mais comportant des colonnes supplémentaires contenant des informations utiles lié à chaque enregistrement pour aider à la compréhension des résultats de l'ensemble du processus de validation. Ces colonnes supplémentaires contiennent des « étiquettes » (classifications) qui devraient aider les futurs utilisateurs du jeu de données. Les résultats obtenus par l’approche en trois étapes visant à contrôler la qualité des données dans la base de données RECFISH sont enregistrés dans des fichiers de sortie stockés dans les fichiers partagés du projet. Une synthèse des résultats est présentée ici sous la forme d'une liste d'indicateurs des résultats permettant une évaluation générale de la performance du script développé dans la tâche 2.1 et de la qualité des données.

Tableau II. Synthèse de l'application du processus de validation aux jeux de données RECFISH pour la Méditerranée et la mer Noire.

Data set	Mediterranean	Black sea
Data set dimension	212875	22839
Duplicated row	19712	6576
Number of Time series (ts)	6447	357
Number of ts with length <= 15	3102	136
Number of ts with length > 15	3345	221
Outliers (from z.score)	3307 (2%)	488 (2%)
NA (from z.score)	26478 (12%)	490 (2%)
valid data (not outlier from z.score analysis)	183090 (86%)	21861 (96%)
% >3 or <-3 (from z.score)	1.55%	2.13%
% >2 or <-2 (from z.score)	4.06%	5.03%
% >1 or <-1 (from z.score)	15.76%	15.53%
% > 0.2 or <-0.2 (from z.score)	60.91%	60.84%
Number of match: Area vs Region	12458	0
Number of match: GSA vs Region	5881	0
Number of match: Area vs GSA	10447	0
Number of match: FAO vs Area	47176	683
Number of match: FAO vs Region	14086	0
Number of match: FAO vs GSA	14978	1317

Les activités réalisées et les approches méthodologiques développées dans le cadre de la tâche 2.2 sont décrites dans le livrable D2.2 (voir annexe VI). La tâche 2.2 visait 1) à mettre en place une méthodologie systématique et harmonisée afin de normaliser des enquêtes scientifiques à propos des indices d'abondance et les distributions de fréquence de longueur (LFD) et 2) à appliquer la méthodologie définie à un vaste ensemble de stocks en mer Méditerranée et en Mer Noire. Le livrable D2.2 est organisé en 5 sections principales, résumé de la manière suivante, fournit une description détaillée des méthodologies développées et des résultats des analyses effectuées:

1. Une brève introduction, qui donne un aperçu de la logique qui sous-tend la normalisation des indices d'enquête, en se référant à la littérature pertinente;
2. Une description détaillée de l'approche méthodologique pour la normalisation des indices de densité et de biomasse, à l'aide de modèles additifs généralisés (GAM), et des LFD, en utilisant une approche combinant la décomposition probabiliste des LFD annuels et des modèles linéaires généralisés (GLM); les caractéristiques de l'enquête évoluant au fil des années (navire, heure de l'enquête) et d'autres facteurs (par exemple, la position, les variables environnementales) pouvant avoir potentiellement influencé l'indice ont été considérés comme des variables explicatives. Le code R développé est rapporté pour les deux parties méthodologiques;
3. Les résultats liés à la normalisation des indices de biomasse et de densité pour les 43 stocks de la mer Méditerranée et de la mer Noire sont ensuite décrits en détail. Pour un ensemble de stock, plusieurs enquêtes ont été considérées (MEDITS et GRUND) et les deux indices ont été standardisés, pour un total de 54 normalisations;
4. Les résultats relatifs à la normalisation des dispositifs de LFD ont été reportées pour 3 stocks (*Aristeus antennatus* dans GSA 09 et GSA 11 et *Nephrops norvegicus* dans GSA 09); pour deux d'entre eux, deux enquêtes ont été envisagées pour un total de 5 standardisations LFD;
5. Une section résumant les principales conclusions complète le livrable et prépare le terrain pour de futurs développements.

Les stocks étudiés sont énumérés dans le tableau III.

Tableau III. Liste des actions considérées pour la normalisation des indices d'enquête. Les stocks pour les quells plus d'un indice a été normalisé sont indiquées en gras.

Species	GSAs	Type of data	LFDs
1. *Mullus barbatus*	1	Medits biomass	N
2. *Parapenaeus longirostris*	1	Medits biomass	N
3. *Mullus surmuletus*	5	Medits biomass	N
4. *Mullus barbatus*	6	Medits biomass	N
5. *Eledone cirrhosa*	6	Medits biomass	N
6. *Trisopterus capelanus*	7	Medits biomass	N
7. *Mullus barbatus*	7	Medits biomass	N
8. *Trachurus trachurus*	7	Medits biomass	N
9. *Parapenaeus longirostris*	7	Medits biomass	N
10. *Aristeus antennatus*	**9**	**Medits/Grund biomass**	**Y**
11. *Aristeus antennatus*	**11**	**Medits/Grund biomass and density**	**Y**
12. *Illex coindetii*	**11**	**Medits biomass and density**	**N**
13. *Trachurus mediterraneus*	9	Medits biomass	N
14. *Trachurus trachurus*	9	Medits biomass	N
15. *Engraulis encrasicolus*	9	Medits biomass	N
16. *Eledone cirrhosa*	**9**	**Medits/Grund biomass**	**N**
17. *Eledone cirrhosa*	**10**	**Medits/Grund biomass**	**N**
18. *Illex coindentii*	10	Medits biomass	N
19. *Nephrops norvegicus*	**9**	**Medits biomass and density; Grund density**	**Y**
20. *Eledone moschata*	16	Medits biomass	N
21. *Mullus barbatus*	16	Medits biomass	N
22. *Parapenaeus longirostris*	16	Medits biomass	N

Species	GSAs	Type of data	LFDs
23. Sardina pilchardus	16	Medits biomass	N
24. Eledone cirrhosa	**18**	**Medits biomass and density**	**N**
25. Lophius spp	17	Medits biomass	N
26. Trachurus spp	17	Medits biomass	N
27. Trisopterus capelanus	**18**	**Medits biomass and density**	**N**
28. Trisopterus capelanus	17	Medits biomass	N
29. Aristeus antennatus	18-19	Medits biomass	N
30. Aristaeomorpha foliacea	18-19	Medits biomass	N
31. Pagellus erythrinus	20	Medits biomass	N
32. Spicara smaris	20	Medits biomass	N
33. Pagellus erythrinus	22	Medits biomass	N
34. Spicara smaris	22	Medits biomass	N
35. Spicara smaris	23	Medits biomass	N
36. Spicara smaris	22-23	Medits biomass	N
37. Boops boops	23	Medits biomass	N
38. Mullus surmuletus	25	Medits density	N
39. Merluccius merluccius	25	Medits biomass	N
40. Scophthalmus maximus	29	biomass	N
41. Squalus acanthias	29	biomass	N
42. Merlangius merlangus	29	biomass	N
43. Sprattus sprattus	29	biomass	N

WP3 Construction de la base de données

La plupart des activités menées dans le cadre du WP3 ont été réalisées en étroite coopération avec le WP1. Le modèle commun préparé par les responsables du WP3 (en coopération avec le WP1) a été utilisé pour le stockage temporaire des données collectées dans le cadre du WP1 et a constitué la base du développement de la base de données finale.

Le codage des différentes variables dans la nouvelle base de données est conforme à la structure du tableau et au codage spécifié à l'appendice 2 de l'annexe 2 de l'appel de données DCF pour la Méditerranée et la Mer Noire afin d'assurer une compatibilité totale avec la base de données DCF. La base de données a été construite dans un logiciel non propriétaire.

La saisie des données a été planifiée selon des colonnes organisées dans un menu déroulant, suivant une série de tables de référence. Le fichier a été développé et construit par les leaders du WP3 collonnes (Stefanos Kavadas, HCMR et Maria Teresa Facchini, COISPA) en coopération avec le WP1 ; Ainsi, les données stockées étaient déjà organisées en fonction de la structure de la base de données RECFISH. Les feuilles / tableaux suivants sont inclus dans la base de données:

tblMETADATA: il reprend les informations de base de chaque jeu de données.

tblLandings: contient des séries de données sur les débarquements et les rejets: débarquements annuels ou mensuels (tonnes, kg) par pays ou par zones plus petites (par exemple, régions administratives, ports, etc.).

Capacité de pêche: il stocke des données (nombre de navires, tonnage), capacité de pêche / activité: données sur le nombre de navires (également tonnage et longueur des navires) par pays (e.g. région administrative, port, etc.).

tblLPUE: contient des données sur les débarquements par unité d'effort provenant de projets de recherche spécifiques, calculées par rapport à la capacité de pêche et les valeurs d'activité (e.g. nombre de navires, jours de pêche, heures de pêche, HP, etc.).

paramètre tblGrowth: inclut les paramètres de croissance de von Bertalanffy, par espèce et par zone.

tblSize Struct land_Disc: contient la structure de taille des échantillons provenant des débarquements et de rejets, réalisée au cours de projets de recherche antérieurs à l'UE DCR / DCF.

tblAge Struct Land_Disc: contient la structure par âge des échantillons provenant des débarquements et de rejets, réalisée au cours de projets de recherche antérieurs à l'UE DCR / DCF.

tblALK: ce tableau contient les données des données de la clé âge-longueur et, par espèce et par

zone.
tblTrawl Survey CPUE: il contient les indices de densité et de biomasse des espèces calculés en fonction des zones balayées ou des heures de pêche. Ces indices proviennent de relevés expérimentaux au chalut réalisés avant le DCF.
Les données sur les relevés expérimentaux au chalut, différentes de celles réalisées dans le contexte de la DCF (par exemple, le GRUND italien, HVAR, etc.) ont été organisées selon la même structure des données MEDITS, dans les trois feuilles / tableaux suivants:
tblTA: il contient des données détaillées sur chaque trait expérimental.
tblTB: il comprend des données sur les captures (nombre et poids) pour chaque espèce.
tblTC: il contient des données biologiques (e.g. taille, sexe, stade de maturité) au niveau de l'espèce.

WP4 Evaluation des stocks en utilisant les données historiques
L'objectif du groupe de travail 4 était de développer et de tester des méthodes d'évaluation des stocks pouvant incorporer des séries chronologiques historiques de captures commerciales et un indice d'abondance, en utilisant également des données de capture par longueur / âge. Une fois que les activités de collecte de données prévues dans le WP1 étaient presque terminées, il est devenu évident que suivre strictement les critères proposés dans le mandat de la proposition aurait été impossible. Cela était principalement dû au manque de données historiques sur les LFD commerciales (ou la structure par âge), ce qui entravait la possibilité de réaliser 10 évaluations de stock basées sur l'âge. Dans le même temps, il n'a pas été possible de réaliser 10 évaluations de stocks d'espèces de petits pélagiques. En outre, faute de données appropriées dans certaines des 10 zones d'étude de cas, l'attribution de 2 stocks par zone n'a pas pu être respectée. Ces questions ont été présentées et examinées avec le pouvoir adjudicateur lors de la réunion de suivi tenue à Bruxelles le 27 septembre 2018. Le pouvoir adjudicateur a accepté la proposition de déroger aux critères de sélection initialement proposés, à condition de ne pas s'écarter des modèles d'évaluation des stocks proposés (à savoir SPiCT pour l'évaluation du modèle de production excédentaire et a4a pour l'évaluation de la basé sur l'âge).
Les analyses d'évaluation des stocks ont été réalisées hors ligne dans le but de présenter et d'examiner les résultats et les analyses préliminaires au cours des travaux du groupe de travail du WP4. Le groupe de travail sur l'évaluation des stocks, présidé par les responsables du WP4 et le coordinateur du projet, s'est réuni du 25 au 27 février 2019 au siège de CoNISMa à Rome et a été organisé juste avant la 3e réunion plénière du projet.
Le résumé des résultats des 20 évaluations de stock effectuées dans le cadre du WP4 est présenté dans le tableau IV. La plupart des stocks évalués dans le cadre de ce projet ont été évalués pour la première fois. Pour les stocks pour lesquels une évaluation avait déjà été réalisée, ce projet offrait la possibilité d'améliorer la robustesse de l'évaluation à l'aide de données historiques. Huit stocks sont apparus surexploités, tandis que onze sont apparus exploités de manière durable. Pour un stock (*Mullus surmuletus* dans GSA 25), deux évaluations de stock ont été effectuées et donnaient des résultats contrastés, même si la réduction générale de la mortalité par pêche est confirmée par les deux approches. De manière générale, les évaluations de stocks effectuées par le WP4, en utilisant des données historiques recueillies dans le cadre du projet RECFISH, ont permis d'obtenir un chiffre plus optimiste de l'état des stocks en Méditerranée et en mer Noire. Cela peut être dû au contraste plus élevé dans la série chronologique, dû à l'inclusion d'anciennes données lorsque les captures étaient généralement plus élevées qu'au cours des dernières années.

Tableau IV. Résumé des résultats de l'évaluation des stocks.

N.	GSAs	Species	Time span	Method used	Current values	Reference points	F_{curr}/F_{MSY}	Stock status
1	01 – 03 - 04	*Parapenaeus longirostris*	1970 - 2017	SPiCT	F_{curr} = 0.15	F_{MSY} = 0.98	0.15	Sustainably exploited, with high biomass
2	05	*Mullus surmuletus*	1967 - 2017	SPiCT	F_{curr} = 0.49	F_{MSY} = 0.43	1.15	In overexploitation
3	06	*Mullus barbatus*	1991 - 2017	SPiCT	F_{curr} = 0.55	F_{MSY} = 0.66	0.83	Sustainably exploited, with high biomass
4	07	*Trisopterus capelanus*	1977 - 2016	SPiCT	F_{curr} = 0.45	F_{MSY} = 0.24	1.87	In overexploitation
5	09	*Aristeus antennatus*	1988 - 2017	a4a	F_{curr} = 0.26	F_{MSY} = 0.37	0.70	Sustainably exploited
6	09	*Nephrops norvegicus*	1994 - 2016	a4a	F_{curr} = 0.10	F_{MSY} = 0.15	0.67	Sustainably exploited
7	09	*Eledone cirrhosa*	1985 - 2017	SPiCT	F_{curr} = 0.44	F_{MSY} = 0.51	0.87	Sustainably exploited, with high biomass
8	09	*Engraulis encrasicolus*	1972 - 2017	SPiCT	F_{curr} = 0.36	F_{MSY} = 0.62	0.58	Sustainably exploited, with high biomass
8	10	*Eledone cirrhosa*	1972 - 2017	SPiCT	F_{curr} = 0.66	F_{MSY} = 0.3	2.2	In overexploitation
10	16	*Eledone moschata*	1972 - 2017	SPiCT	F_{curr} = 1.03	F_{MSY} = 0.55	1.87	In overexploitation
11	16	*Sardina pilchardus*	1985 - 2016	SPiCT	F_{curr} = 0.66	F_{MSY} = 0.51	1.29	In overexploitation
12	17	*Trachurus* spp.	1956 - 2017	SPiCT	F_{curr} = 0.01	F_{MSY} = 0.14	0.06	Sustainably exploited
13	17	*Lophius* spp.	1953 - 2017	SPiCT	F_{curr} = 2.00	F_{MSY} = 0.88	2.28	In overexploitation
14	18	*Aristeus antennatus*	1972 - 2017	SPiCT	F_{curr} = 0.07	F_{MSY} = 0.18	0.38	Sustainably exploited
15	20	*Spicara smaris*	1990 - 2017	SPiCT	F_{curr} = 0.04	F_{MSY} = 0.46	0.08	Sustainably exploited, with high biomass
16	22 - 23	*Spicara smaris*	1995 - 2017	SPiCT	F_{curr} = 0.03	F_{MSY} = 0.27	0.12	Sustainably exploited, with high biomass
17	22	*Pagellus erythrinus*	1994 - 2017	SPiCT	F_{curr} = 0.70	F_{MSY} = 0.47	1.50	In overexploitation
18	25	*Mullus surmuletus*	1986 – 2017 (a4a)	a4a	F_{curr} = 0.37	F_{MSY} = 0.22	1.68	In overexploitation
			1967 – 2017 (SPiCT)	SPiCT	F_{curr} = 0.17	F_{MSY} = 0.22	0.78	Sustainably exploited, with high biomass
19	29	*Sprattus sprattus*	1978 - 2016	a4a	F_{curr} = 0.48	F_{MSY} = 0.64	0.75	Sustainably exploited
20	29	*Merlangius merlangus*	1971 - 2016	a4a	F_{curr} = 0.53	F_{MSY} = 0.47	1.13	In overexploitation

13. Resumen

El proyecto RECFISH (Specific Contract n. 01 under the Framework Contract EASME/EMFF/2016/032 "Provision of scientific advice for the Mediterranean and the Black Sea") se desarrolló con el objetivo final de crear un database de referencia para los datos históricos de pesca, anteriores al DCR/DCF del Mar Mediterráneo (antes de 2002) y del Mar Negro (antes de 2008), y también con el objetivo de proporcionar CPUE estandarizadas y de construir algunos casos de estudio donde los datos historicos de desembarques y de CPUE se podian integrar en evaluaciones de stocks. Para cumplir con los objetivos establecidos, el Proyecto se organizó en 5 Work Packages (y 4 Tasks).

Tabla I. Estructura en WPs y Tasks del Proyecto RECFISH.

WP0 Gestion y coordinaciòn del Proyecto
WP1 Recogida de datos históricos de pesca
Task 1.1 Recogida de datos históricos de pesca en el Mar Mediterráneo
Task 1.2 Recogida de datos históricos de pesca en el Mar Negro
WP2 Validación y estandarización de datos
Task 2.1 Validación de series historicas de datos de desembarques
Task 2.2 Estandarización de la CPUEs
WP3 Construciòn de la base de datos
WP4 Evaluaciòn de stocks por medio de datos historicos

Cada WP/Task incluía actividades específicas para lograr los objetivos requeridos, y tenía una persona de referencia como chair (que trabajava en cooperación con un co-chair), un core team (formado por un representante de cada uno de Ios institutos participantes en el Task/WP). Este equipo llevò a cabo la mayoría del trabajo, segùn un plan de trabajo definido y especificos Milestones y Deliverables.

WP1 Recogida de datos históricos de pesca

El WP1 tuvo como objetivo recopilar y clasificar todos los datos históricos de pesca disponibles en el Mediterráneo y Mar Negro. Este WP aprovechó de la contribución de todos los Partners del consorcio RECFISH.

En los primeros meses del Proyecto fue finalizado el inventario de la información que podría estar a disposición del Proyecto, con la contribución de todos los Partners involucrados en el WP1. Esta información se refiere a diferentes tipologías de datos de pesca, procedentes de diferentes fuentes: archivos oficiales (por ejemplo, FAO, HELSTAT, ISTAT), datos recopilados por medio de proyectos de investigación, literatura gris, etc. La mayor parte de la información se refiere al período anterior al 2002, cuando el DCR/DCF de la UE aún no se había aplicado en la mayoría de los países de la UE.

Tras las discusiones realizadas durante la primera reunión plenaria del Proyecto RECFISH (Pisa, de 25 a 26 de enero de 2018, véase el Anexo III del Inception Rèport D0.1), el inventario preliminar

que habia sido preparado para la propuesta del Proyecto se refinó aún más. Este inventario de base de datos fue entregado como Anexo IV del Inception Report (D0.1).
Después de la preparación de l'inventario de la base de datos, se construyó una plantilla común para colleccionar los datos recopilados, para garantizar una compatibilidad total con las bases de datos del DCF. La codificación de los parametros espaciales y temporales, así como los codigos de de especies artes/pesquerías/metiérs, fueron organizados con un modelo común para cumplir con la estructura de las tablas del DCF, respecto a los datos de pesca socio-ecomonicos, biológicos y experimentales. Con respecto a este último asunto, las bases de datos procedentes de las "antiguas" campaňas de pesca de arrastre experimentales (por ejemplo, el GRUND italiano) se reorganizaron para garantizar la compatibilidad con los formatos MEDITS (ej. ficheros TA, TB, TC). La plantilla común se organizó no solo para cumplir con la estructura del DCF, sino también para garantizar la mejor resolución temporal, geográfica y técnica de los datos originales. Por ejemplo, la codificación geográfica refleja las estadísticas originalmente reportadas, pero al mismo tiempo es disponible una clave de agregación a nivel de GFCM GSA. Cada grupo de datos recolectado ha sido identificado y descrito en la plantilla común como METADATA.
La estructura del modelo común se discutió entre los coordenadores y personas clave de los WP1 y WP3, así como con el coordinador del Proyecto; una reunión especifica de Skype tuvo lugar el 17 de mayo de 2018. Al final, el modelo común consistió en el fichero de Excel RECFISH-WP1_input templates.xls.
Tras la preparación de la plantilla común, cada Partner involucrado en el WP1 (Task 1.1 Mar Mediterráneo; Task 1.2 Mar Negro) organizó y almacenó los datos disponibles dentro de las plantillas comunes. Este proceso se finalizó en diciembre de 2018, aunque se mantuvo la posibilidad de incluir más datos históricos, según lo solicitado por la Contracting Authority.
Los dos Deliverables previstos para el WP1, D1.1 (Datos históricos de pesca en el Mediterráneo) y D1.2 (Datos históricos de pesca en el Mar Negro) contienen una descripción detallada de todas las series de datos recopilados (ej. tipología de datos, cobertura espacial y temporal), junto con una evaluación crítica de la información recopilada.

WP2 Validación y estandarización de datos

El WP2 tenía como objetivo analizar los datos recopilados en el WP1, para validar y estandarizar las series historicas de datos, antes de entrar las mismas en la base de datos definitiva. Este WP se organizó en dos Tasks, el primero finalizado a validar los datos de desembarques, el segundo para estandarizar los datos de las campaňas de pesca experimentales y de las CPUE. El inicio de las actividades del WP2 se anticipó al mes 3 (marzo de 2018), en lugar del mes 4, según lo acordado durante la 1ª reunion plenaria de Pisa (25-26 de enero de 2018).
En el **Task 2.1**, las series temporales de desembarques recopiladas en RECFISH, por medio de las diferentes fuentes, se evaluaron en términos de:
1) control de calidad:
- evitando la duplicación de datos;
- comprobando la validez de los datos introducidos;
- comprobando los nombres de las especies;
2) consistencia interna de los datos:
- identificación de "outliers" y cuantificación del "z-score";
3) validación:
- evaluación de la correspondencia entre las diferentes series temporales.
El script de R TSval se desarrolló en R para realizar los análisis planeados en el Task 2.1 utilizando como entrada el database RECFISH implementado en WP1 (el script está disponible en el "sharepoint" de RECFISH, https://cloudfs.hcmr.gr/index.php). El script TSval està tembien disponible como un apéndice del Deliverable D2.1 "“Validation of fisheries historical data”, que se adjunta al presente informe (Anexo V). Los pasos implementados en el script de R y las aplicaciones ejemplificativas se detallan en el Deliverable D2.1.

Después de ejecutar todos los controles y comprobaciones, la secuencia de comandos produjo un archivo de salida llamado "file.res.csv" que es igual para la cantidad de registros y de datos a la base de datos RECFISH, pero tiene columnas adicionales que contienen información para cada registro, útiles para comprender todo el proceso de validación. Estas columnas adicionales contienen "etiquetas" (clasificaciones) que pueden ayudar a los futuros usuarios del conjunto de datos. Los resultados de la aplicación del analysis de la calidad de los datos han sido registrados en archivos de salida almacenados en el "sharepoint" del proyecto. Aquí se presenta una síntesis de los resultados por medio de una lista de indicadores, que permite una evaluación general del script desarrollado en el Task 2.1 y de la calidad de los datos.

Tabla II. Síntesis de la aplicación del proceso de validación a la base de datos RECFISH para el Mediterráneo y el Mar Negro.

Base de datos	Mediterraneo	Mar Negro
Dinension de la base de datos	212875	22839
Filas duplicadas	19712	6576
Numero de series historicas (ts)	6447	357
Numero de ts con longitud <= 15	3102	136
Numero de ts con longitud > 15	3345	221
Outliers (de z.score)	3307 (2%)	488 (2%)
Non Aplicable (de z.score)	26478 (12%)	490 (2%)
Datos validos	183090 (86%)	21861 (96%)
% >3 or <-3 (de z.score)	1.55%	2.13%
% >2 or <-2 (de z.score)	4.06%	5.03%
% >1 or <-1 (de z.score)	15.76%	15.53%
% > 0.2 or <-0.2 (de z.score)	60.91%	60.84%
Numero de "match": Area vs Region	12458	0
Numero de "match": GSA vs Region	5881	0
Numero de "match": Area vs GSA	10447	0
Numero de "match": FAO vs Area	47176	683
Numero de "match": FAO vs Region	14086	0
Numero de "match": FAO vs GSA	14978	1317

Las actividades realizadas y los enfoques metodológicos desarrollados en ek **Task 2.2** se describen en el Deliverable D2.2 (ver Anexo VI). El Task 2.2 tenía como objetivo 1) establecer una metodología sistemática y armonizada para estandarizar los índices de las campañas de pesca cientifica y las distribuciones de frecuencia de talla (LFD); 2) aplicar la metodología definida a un amplio conjunto de stocks del Mar Mediterráneo y Mar Negro. El Deliverable D2.2 està organizado en 5 secciones principales y proporciona una descripción detallada de las metodologías desarrolladas y de los resultados de los análisis realizados:

1. Una breve introducción, donde se ofrece una descripción general de los fundamentos de la estandarización de los índices de campañas cientificas, con referencia a la literatura relevante.
2. Una descripción detallada del enfoque metodológico empleado para la estandarización de los índices de densidad y biomasa, a travès de modelos aditivos generalizados (GAM), y de las LFD, utilizando un enfoque que combina la descomposición probabilística de los LFD anuales y los modelos lineales generalizados (GLM); tanto las características de la campañas de pesca que cambiaron a lo largo de los años (barco, tiempo de la encuesta) cuanto otros factores (por ejemplo, la posición, las variables ambientales) que podían haber influido potencialmente en el índice se consideraron como variables explicativas. El código R desarrollado se reporta para ambas partes metodológicas.
3. Los resultados de la estandarización de los índices de biomasa y densidad para 43 stocks en el Mediterráneo y el Mar Negro han sido descritos. Para un conjunto de stoks se considerarò más de una campaña cientifica (MEDITS y GRUND) y se estandarizaron ambos índices, para un total de 54 estandarizaciones;

4. Los resultados relacionados con la estandarización de las LFD se producieron para 3 stocks (*Aristeus antennatus* en GSA 09 y GSA 11 y *Nephrops norvegicus* en GSA 09); para dos de ellos, se consideraron dos campañas, para un total de 5 estandarizaciones de LFD;
5. Una sección que resume las principales conclusiones completa el Deliverable, haciendo de referencia para futuros desarrollos.
Los stocks investigados se muestran en la Tabla III.

Tabla III. Listado de los stocks considerados para la estandarización de los índices de pesca experimental. Los stocks para los cuales se estandarizó más de un índice se resaltan en negrita. LFDs = estructuras de distribucion de talla.

Especie	GSA	Tipo de datos	LFDs
1. *Mullus barbatus*	1	Medits biomasa	N
2. *Parapenaeus longirostris*	1	Medits biomasa	N
3. *Mullus surmuletus*	5	Medits biomasa	N
4. *Mullus barbatus*	6	Medits biomasa	N
5. *Eledone cirrhosa*	6	Medits biomasa	N
6. *Trisopterus capelanus*	7	Medits biomasa	N
7. *Mullus barbatus*	7	Medits biomasa	N
8. *Trachurus trachurus*	7	Medits biomasa	N
9. *Parapenaeus longirostris*	7	Medits biomasa	N
10. *Aristeus antennatus*	**9**	**Medits/Grund biomasa**	**S**
11. *Aristeus antennatus*	**11**	**Medits/Grund biomasa y abundancia**	**S**
12. *Illex coindetii*	**11**	**Medits biomass y abundancia**	**N**
13. *Trachurus mediterraneus*	9	Medits biomasa	N
14. *Trachurus trachurus*	9	Medits biomasa	N
15. *Engraulis encrasicolus*	9	Medits biomasa	N
16. *Eledone cirrhosa*	**9**	**Medits/Grund biomasa**	**N**
17. *Eledone cirrhosa*	**10**	**Medits/Grund biomasa**	**N**
18. *Illex coindentii*	10	Medits biomasa	N
19. ***Nephrops norvegicus***	**9**	**Medits biomass y abundancia; Grund abundancia**	**S**
20. *Eledone moschata*	16	Medits biomasa	N
21. *Mullus barbatus*	16	Medits biomasa	N
22. *Parapenaeus longirostris*	16	Medits biomasa	N
23. *Sardina pilchardus*	16	Medits biomasa	N
24. *Eledone cirrhosa*	**18**	**Medits biomasa y abundancia**	**N**
25. *Lophius spp*	17	Medits biomasa	N
26. *Trachurus spp*	17	Medits biomasa	N
27. *Trisopterus capelanus*	**18**	**Medits biomass y abuncancia**	**N**
28. *Trisopterus capelanus*	17	Medits biomasa	N
29. *Aristeus antennatus*	18-19	Medits biomasa	N
30. *Aristaeomorpha foliacea*	18-19	Medits biomasa	N
31. *Pagellus erythrinus*	20	Medits biomasa	N
32. *Spicara smaris*	20	Medits biomasa	N
33. *Pagellus erythrinus*	22	Medits biomasa	N
34. *Spicara smaris*	22	Medits biomasa	N
35. *Spicara smaris*	23	Medits biomasa	N
36. *Spicara smaris*	22-23	Medits biomasa	N
37. *Boops boops*	23	Medits biomasa	N
38. *Mullus surmuletus*	25	Medits adundancia	N
39. *Merluccius merluccius*	25	Medits biomasa	N
40. *Scophthalmus maximus*	29	Biomasa	N
41. *Squalus acanthias*	29	Biomasa	N
42. *Merlangius merlangus*	29	Biomasa	N
43. *Sprattus sprattus*	29	Biomasa	N

WP3 **Construcción de la base de datos**

La mayoría de las actividades llevadas a cabo bajo el WP3 se realizò en estricta cooperación con el WP1. La plantilla común preparada por los coordenadores del WP3 (en colaboración con el WP1) se usó para el almacenamiento de los datos recopilados bajo WP1, y representó la base para el desarrollo de la base de datos final.
La codificación de las diferentes variables en la nueva base de datos cumple con la estructura y la codificación especificada en el Apéndice 2 del Anexo 2 de la Data Call DCF del Mediterráneo y Mar Negro; esto para garantizar la compatibilidad total con la base de datos DCF.
La base de datos fue construida en un software no propietario.
La entrada de datos se planificó según columnas organizadas en un menú desplegable, siguiendo una serie de tablas de referencia. El archivo fue desarrollado y construido por los líderes de WP3 (Stefanos Kavadas, HCMR, y Maria Teresa Facchini, COISPA) en cooperación con WP1; de esta manera, los datos almacenados ya fueron organizados de acuerdo con la estructura de la base de datos RECFISH. En la base de datos se incluyeron las siguientes hojas/tablas:
tblMETADATA: resume la información básica de cada conjunto de datos.
tblLandings: contiene una serie de datos sobre desembarques y descartes: desembarques anuales o mensuales (toneladas, kg) por país o zonas más pequeñas (por ejemplo, regiones administrativas, puertos, etc.).
tblFleet Capacity: contiene datos (número de barcos, tonelaje, capacidad/actividad pesquera, también tonelaje y longitud de barcos) por país (en algunos casos por puerto o región administrativa).
tblLPUE: incluye datos sobre desembarcos por unidad de esfuerzo procedentes de proyectos de investigación específicos, calculados sobre valores de capacidad y actividad de pesca (por ejemplo, número de barcos, días de pesca, horas de pesca, HP, etc.).
tblGrowth Param: incluye los parametros de crecimiento de von Bertalanffy, para especie y area.
tblSize Struct land_Disc: incluye la estructura de talla de muestras procedentes de datos de desembarque y descarte, recogidos durante proyectos de investigación antes del DCR/DCF de la UE.
tblAge Struct Land_Disc: incluye la estructura de edad de muestras procedentes de datos de desembarque y descarte, recogidos durante proyectos de investigación antes del DCR/DCF de la UE.
tblALK: esta tabla contiene datos de clave talla-edad, para especie y area.
tblTrawl Survey CPUE: contiene indices de densidad y de biomasa para especie, calculados según zonas barridas o horas de pesca. Estos índices provienen de campañas de pesca experimentales de arrastre realizadas antes del DCF.
Los datos sobre campañas de pesca experimentales diferentes de los realizados en el contexto del DCF (por ejemplo, el GRUND italiano, el HVAR, etc.) se organizaron con la misma estructura de los datos MEDITS, en las tres hojas/tablas siguientes:
tblTA: contiene datos detallados de los lances experimentales.
tblTB: incluye datos sobre las capturas (número y peso) de cada especie, por cada lance.
tblTC: contiene datos biológicos (por ejemplo, tamaño, sexo, estado de madurez) a nivel de especie.

WP4 Evaluación de stocks por medio de datos históricos
El objetivo del WP4 fue desarrollar y probar métodos de evaluación de stock que podian incorporar series históricas de datos de capturas comerciales e índices de abundancia, utilizando también datos de talla/edad.
Una vez que las recopilaciónes de datos previstas en el WP1 fueron casi terminadas, quedó claro que seguir estrictamente los criterios de los Term of Reference del proposal habría sido imposible. Esto se debió principalmente a la escasez de datos históricos sobre las LFD comerciales (y sobre estructura de edad), lo que dificultó realizar 10 evaluaciones de stock basadas en datos de edad. Al mismo tiempo, no fue posible realizar 10 evaluaciones de stocks de especies de pequeños

pelágicos. Además, debido a la falta de datos adecuados en algunas de las 10 áreas de estudio, no se pudo respetar la asignación de 2 stocks por área. Estas cuestiones se presentaron y se debatieron con la Contracting Authority durante la Reunión de Bruselas del 27 de septiembre de 2018. La Contracting Authority acordó la propuesta de desviarse de los criterios de selección propuestos inicialmente, siempre que no fuese desviación de los modelos de evaluación de stock propuestos (ej. SPiCT para el surplus production model assessment, y a4a para la evaluación basada en edad).

Los análisis de evaluación de stocks se realizaron "offline" con el fin de presentar y discutir los resultados y los análisis preliminares durante el grupo de trabajo previsto para el WP4. El grupo de trabajo sobre evaluación de stocks fue presidido por los líderes del WP4 y por el Coordinador del Proyecto, y tuvo lugar del 25 al 27 de febrero de 2019 en la sede de CoNISMa en Roma, y se organizó "back to back" de la 3ª Reunión Plenaria del Proyecto.

El resumen de los resultados de las 20 evaluaciones de stock realizadas en el marco del WP4 se presenta en la Tabla IV. La mayoría de los stocks evaluados dentro de este Proyecto, fueron evaluados por primera vez. Respectos a los stocks para los las que ya existia una evaluación, este Proyecto ofreciò la posibilidad de mejorar la "robustness" de los resultados por medio de los datos históricos. Ocho stocks resultaron en una sobreexplotación, mientras que once stocks resultaron explotados de manera sostenible. Para el salmonete de roca, *Mullus surmuletus* (en GSA 25), se llevaron a cabo dos evaluaciones de stock, que proporcionaron resultados contrastantes, aunque la reducción general de la mortalidad por pesca se confirmò para ambos los metodos. En general, las evaluaciones de stock realizadas por el WP4 utilizando los datos históricos recopilados con el proyecto RECFISH proporcionaron un cuadro más optimista sobre del estado de los stocks del Mediterráneo y Mar Negro de lo habitualmente conocido. Esto puede ser el resultado del mayor contraste en los datos utilizados debido a la inclusión de datos "antiguos", procedientes de una temporada cuando las capturas eran generalmente más altas que las de los últimos años.

Tabla IV. Resumen de los resultados de las evaluaciones de stocks.

GSAs	Species	Time span	Method used	Current values	Reference points	F_{curr}/F_{MSY}	Stock status
01, 03, 04	*Parapenaeus longirostris*	1970 - 2017	SPiCT	F_{curr} = 0.15	F_{MSY} = 0.98	0.15	Explotado de forma sustenible, con alta biomasa
05	*Mullus surmuletus*	1967 - 2017	SPiCT	F_{curr} = 0.49	F_{MSY} = 0.43	1.15	Sobreexplotado
06	*Mullus barbatus*	1991 - 2017	SPiCT	F_{curr} = 0.55	F_{MSY} = 0.66	0.83	Explotado de forma sustenible, con alta biomasa

07	*Trisopterus capelanus*	1977 - 2016	SPiCT	F_{curr} = 0.45	F_{MSY} = 0.24	1.87	Sobreexplotado
09	*Aristeus antennatus*	1988 - 2017	a4a	F_{curr} = 0.26	F_{MSY} = 0.37	0.70	Explotado de forma sustenible
09	*Nephrops norvegicus*	1994 - 2016	a4a	F_{curr} = 0.10	F_{MSY} = 0.15	0.67	Explotado de forma sustenible
09	*Eledone cirrhosa*	1985 - 2017	SPiCT	F_{curr} = 0.44	F_{MSY} = 0.51	0.87	Explotado de forma sustenible, con alta biomasa
09	*Engraulis encrasicolus*	1972 - 2017	SPiCT	F_{curr} = 0.36	F_{MSY} = 0.62	0.58	Explotado de forma sustenible, con alta biomasa
10	*Eledone cirrhosa*	1972 - 2017	SPiCT	F_{curr} = 0.66	F_{MSY} = 0.3	2.2	Sobreexplotado
16	*Eledone moschata*	1972 - 2017	SPiCT	F_{curr} = 1.03	F_{MSY} = 0.55	1.87	Sobreexplotado
16	*Sardina pilchardus*	1985 - 2016	SPiCT	F_{curr} = 0.66	F_{MSY} = 0.51	1.29	Sobreexplotado
17	*Trachurus* spp.	1956 - 2017	SPiCT	F_{curr} = 0.01	F_{MSY} = 0.14	0.06	Explotado de forma sustenible
17	*Lophius* spp.	1953 - 2017	SPiCT	F_{curr} = 2.00	F_{MSY} = 0.88	2.28	Sobreexplotado
18	*Aristeus antennatus*	1972 - 2017	SPiCT	F_{curr} = 0.07	F_{MSY} = 0.18	0.38	Explotado de forma sustenible
20	*Spicara smaris*	1990 - 2017	SPiCT	F_{curr} = 0.04	F_{MSY} = 0.46	0.08	Explotado de forma sustenible, con alta biomasa
22 - 23	*Spicara smaris*	1995 - 2017	SPiCT	F_{curr} = 0.03	F_{MSY} = 0.27	0.12	Explotado de forma sustenible, con alta biomasa
22	*Pagellus erythrinus*	1994 - 2017	SPiCT	F_{curr} = 0.70	F_{MSY} = 0.47	1.50	Sobreexplotado
25	*Mullus surmuletus*	1986 – 2017 (a4a)	a4a	F_{curr} = 0.37	F_{MSY} = 0.22	1.68	Sobreexplotado
		1967 – 2017 (SPiCT)	SPiCT	F_{curr} = 0.17	F_{MSY} = 0.22	0.78	Explotado de forma sustenible, con alta biomasa
29	*Sprattus sprattus*	1978 - 2016	a4a	F_{curr} = 0.48	F_{MSY} = 0.64	0.75	Explotado de forma sustenible
29	*Merlangius merlangus*	1971 - 2016	a4a	F_{curr} = 0.53	F_{MSY} = 0.47	1.13	Sobreexplotado

14.1. Background

Quantitative-analytical assessment of commercial stocks in the Mediterranean started about 20 years later compared to northern European (Colloca et al., 2013; STECF, 2016a) due to the lack of a standardized and systematic data collection that hindered the assessment of fisheries resources in the Mediterranean and Black Sea until the 2000s, when the EU Data Collection Regulation (DCR, EU reg. 1543/2000) was enforced in all EU Member States (MSs). In addition, the standardized collection of fisheries-independent data (i.e. MEDITS bottom trawl survey) started in the beginning of 1990s, relatively later compared to northern Europe. The delay in starting collecting data in a standardized way and the significant complexity of mixed fisheries, consisting of a variety of stocks with different ecological traits and conservation needs, has certainly contributed to the fact that advice for managers on sustainable exploitation of fisheries and stocks, along with the agreement and enforcement of appropriate measures, is overdue and insufficient (Rätz et al., 2013).

The contrast between the length of exploitation (in the order of hundreds of years) and the shortness of the fisheries data (15 years at most) is extreme and the worse combination for extracting reliable information on the status and properties of fish stocks. Biomass reference points determined on the basis of short time series are not reliable and their use is subject to strong assumptions about the initial status of the stock. For this reason, biomass reference points are hardly used in the Mediterranean stock assessments with the exceptions of few stocks where B/B_{MSY} were estimated with production models with long time series of data. Similarly to other systems, it is extremely difficult to derive meaningful stock-recruitment relationships.

Short time series of fisheries data create two additional problems with current stock assessments: i) instability and high uncertainty in parameter estimates, ii) future projections outside parameter space of the models.

The second point is particularly critical for the long-term projections used in a Management Strategy Evaluation that underlies Long Terms Management Plans (Punt et al., 2016; STECF, 2016b). When a stock assessment model is fitted to fisheries data from only periods of high exploitation and low abundance, it will have a limited capability of predicting, with reasonable uncertainty, how the stocks will perform when catches are reduced and stocks start recovering. Conversely, analyses based on longer time series more likely include periods with different exploitation rates and different exploitation conditions of stocks, thus might provide more reliable future projections and indications for management (Engelhard et al., 2016). Additionally, expanding time series of biomass and recruitment is key for detecting a stock-recruitment relationship, which is also important for long-term simulations (e.g., Cardinale et al., 2009).

The EU DCF has focused on collecting high precision data at a high yearly cost, but in the Mediterranean all pre-existing information on fisheries and surveys (e.g., Fortibuoni et al., 2017) is currently not used in stock assessment. These data could be difficult to standardize, to validate and might have limited spatial representation. Nevertheless, the use of such data before DCR/DCF, for current stock assessments might avoid the waste of information, time and money invested by the Member States in the past for data collection and scientific research. With a small marginal investment, it is possible to acquire decades of data that might contain information on stock status before the past 14 years. This historical information despite some limitations compared to DCF data in terms of spatial-temporal coverage, lack of sampling standardization and biological and temporal resolution, may be useful for better understanding stock dynamics and ecosystem status over the past decades till now and for better predicting effects of future management. From a methodological point of view, using historical data sampled in different ways than DCF will present new challenges for stock assessment which has been carried out very seldom in the Mediterranean, but has been addressed in other parts of the world (Cardinale et al., 2009; Punt et al., 2016).

However, difficulties in standardization and validation processes, as well as strong differences from the current geographical aggregation level of the data, are risks that may partially hamper the usefulness of extending time series backwards for stock assessment. DG MARE has already funded a project aiming at reconstructing data sources of historical

fisheries data through the EVOMED project (see Sartor, 2010). This project documented numerous sources of information that could be recovered at MS level and showed how CPUE time series should be standardized. However, EVOMED did not create a reference database of raw historical data and did not incorporate historical data into stock assessments. Several new initiatives have been put in place in recent years to recover historical data and find methodologies for incorporating in stock assessment.
The project RECFISH (Specific Contract n. 01 under the framework contract EASME/EMFF/2016/032 "Provision of scientific advice for the Mediterranean and the Black Sea") has been developed with the ultimate objective of creating a reference database containing historical fisheries data pre DCR/DCF in the Mediterranean Sea (prior to 2002) and Black Sea (prior to 2008), to provide standardized CPUEs and to build some case studies where historical landings and CPUEs are integrated into recent stock assessments.
The study has four specific objectives:
1. Construction of a database with fisheries data and metadata:
   - Database of national landings;
   - Database of landings at length/age;
   - Database of fishing capacity and activity;
   - Geo-referenced data base of trawl surveys;
   - Commercial CPUE.
2. Validation of data (Landings).
3. Standardization of various sources of CPUE (i.e. survey indices, LFDs).
4. Case studies of stock assessment with historical data series.

The present document represents the **Draft Final Report (D0.3)**, and contains the main project results in accordance with the project work plan. It also contains the description of the data gathered under WP1 and stored in the final database designed under WP3.

15.2. Work programme, activities carried out and main results of the project

Project structure
In order to fulfil the stated objectives, the project was organised into 5 Work Packages (and 4 Tasks). Each WP/Task included specific activities to achieve the required objectives, had a person in charge as chair (working in cooperation with a co-chair), a core team (composed of one representative of each of the institutes involved in the Task/WP), who carried out the majority of the work, a defined work plan, and a clear set of milestones and deliverables. Furthermore, two key persons were identified in WP2 (Tasks 2.1 and 2.2) and WP4, who provided support to the WP/Task leaders, in view of the considerable number of data to be analysed and assessed in a short time. Additional experts within the institutes involved have also actively supported the work performed under each Task/WP of the project.
The work comprised desk-based studies and dedicated meetings that were the occasion to discuss results and refine the work done if necessary. One of these meetings (the

Working Group on stock assessment foreseen under WP4) was specifically dedicated to refine/review the assessments, following a similar working method as in STECF and GFCM working groups on stock assessment. Part of the work of WPs 1, 2, and 3 has been running in parallel with the aim of decreasing the risk of delays in the delivery of outputs and products. A scheme of the priorities in terms of data collection (e.g. by type of data, species, FAO sub-region, etc.) was prepared during the 1st Project Plenary Meeting and attached to the Inception Report (D0.1). The priority list was compiled taking into account a list of potential stock assessments.
The project benefited from the contribution of external experts (not included among the partners and subcontractors of the FWC), who provided historical data from non-EU waters in the Mediterranean and Black sea.

Table 2.1 – Structure in WPs and Tasks of the project RECFISH.

WP0 Project management and coordination
WP1 Fisheries historical data collection
Task 1.1 Fisheries historical data collection in the Mediterranean
Task 1.2 Fisheries historical data collection in the Black Sea
WP2 Data validation and standardization
Task 2.1 Validation of landings time series
Task 2.2 Standardization of the CPUEs
WP3 Database construction
WP4 Stock assessment using historical data

16. 2.1 Work Package 0: Project management and coordination

Responsible: Alessandro Ligas, CIBM
Partners involved: all partners
Core team: WP leaders
Duration: 18 months, from 21 December 2017 to June 2019.

WP0 is the work package for the Project Coordination and management. The aim of this WP was to ensure a smooth running of all the project activities and the successful accomplishment of the project goals. The progress of the activities have been monitored by the Project Coordinator supported by the project WP and Task leaders, with the collaboration of the Framework Contract (FWC) leading partner (CONiSMa) and the FWC Scientific Coordinator, Maria Teresa Spedicato.

To fulfil the objectives set in the framework contract (FWC) EASME/EMFF/2016/032, the Specific Contracts (SCs) can make use of different types of data from diverse sources related to the objectives of the FWC. To this end, a Data Sharing Agreement (DSA) was prepared by the scientific coordinator of the FWC, Maria Teresa Spedicato. The DSA refers to the Consortium Agreement and it is supplementary to the Consortium Agreement. All the partners and sub-contractors of the FWC signed the DSA.
Besides historical data, data collected under DCR/DCF were necessary for the activities of the project (e.g. data standardization and stock assessment). To this end, a specific Data Call was prepared by the Specific Project Coordinator and issued on the 1st March 2018. The data was received in May 2018 and have been made available for the specific tasks. A

new Data Call was issued on the 15th October 2018 in order to gather data from EU DCR/DCF (including surveys) up to 2017. The data were used for the standardization of the survey indices and LFDs performed under Task 2.2 and the stock assessments performed under WP4.
A major gap in the Mediterranean database is represented by the lack of fisheries historical data from the Spanish GSAs, with the only exception of GSA 6 (mostly Catalonia, with the bulk of data collected under the EVOMED project; see Sartor, 2010).

Project meetings
The **1st project plenary meeting** was held in Pisa, 25-26 January 2018, and was aimed at preparing the Inception Report and discussing on the work plan. Staff from most of the partners, the Project Coordinator and the Framework Coordinator attended the meeting. The minutes of the meeting are available as an attachment to this report (Annex I).

The **2nd Project Plenary Meeting** was expected to take place as a web meeting for the preparation of the Progress Meeting (with the Contracting Authority), and to discuss the progressing of the activities of the project WPs and Tasks and issues that may have arisen, and highlight possible solutions. It was initially planned for month 7 of the project (July 2018). One representative for each partner should have attended this meeting, plus the Project Coordinator and the FWC Coordinator. However, due to overlapping working commitments, it was decided to organize separate Skype meetings involving the project coordinator and WP1, WP2, and WP3 leaders.
An *ad hoc* Skype meeting on the preparation of a common template for the temporary storage of data collected under WP1 took place on the 17th May 2018 involving leaders and key persons of WP1 and WP3, as well as the project coordinator. The outputs of the meeting are represented by the preparation of the Excel template file for the temporary storage of the data collected under WP1. The file was prepared by the WP3 leaders. After circulating the draft versions of the template, the final version was agreed by all the partners of WP1, and finalized by the WP3 leaders.
Another *ad hoc* Skype meeting was held on the 13th June, and attended by the Task 2.2 leaders (Isabella Bitetto, COISPA, and George Tserpes, HCMR), Walter Zupa (COISPA) and Alessandro Ligas (CIBM, project coordinator). The meeting was organized to discuss the methodological aspects of standardization of survey indices and LFDs foreseen under Task 2.2. The outcomes of the meeting represented the starting point of the preparation of the methodological approach to be applied to survey time series for the standardization of survey indices and LFDs. The methodological approach with detailed description of scripts, routines, and outputs was attached as Annex VI to the Interim Report (D0.2).

The **3rd Project Plenary Meeting** was held in Rome at the CoNISMa headquarters on the 28th February 2019. The meeting was organized in parallel with the workshop of WP4 on stock assessment. The plenary meeting was aimed at discussing the outputs of the workshop on stock assessment, the progressing and finalization of the activities of the WPs, and the preparation of the Draft Final Report (D0.3). The minutes of the 3rd Project Plenary Meeting are attached as Annex II to this report.

Official meeting in Brussels

The **kick-off meeting** took place on the 28th March 2018 at the DG MARE premises in Brussels. The meeting was attended by EASME and DG MARE officers, and the coordinator of the project RECFISH. The kick-off meeting was aimed at discussing the details of the project plan and the Inception Report. The minutes of the Kick-off meeting are reported in this document as Annex III.
The **Progress meeting** took place on the 27th September 2018 at EASME premises in Brussels. In this meeting, the Draft Interim Report was revised and discussed, and the activities for the forthcoming period were presented. The meeting was attended by EASME and DG MARE officers, the RECFISH coordinator, the framework contract scientific coordinator (Maria Teresa Spedicato), the WP4 chair (Silvia Angelini), and the WP1 co-chair (Violin Raykov). The minutes of the Progress meeting are attached as an annex to this Final Report (Annex IV).
The **Final meeting** with the Contracting Authority took place on the 13th June 2019, and was focussed on the discussion of the Draft Final Report (D0.3). The meeting was attended by EASME and DG MARE officers, the RECFISH coordinator, the Task 2.1 and Task 2.2 leaders (Simone Libralato and Isabella Bitetto), and Mr Diego Panzeri (OGS). Mr Stefanos Kavadas (WP3 leader) participated via Skype. The minutes of the Final meeting are attached as an annex to the Final Report (Annex V).

Official reports
Three reports were submitted to the Contracting Authority prior to this one:
- The Inception Report was submitted on the 15th February 2018, and it was accepted in March 2018 (Deliverable D0.1).
- The Interim Report was submitted the 29th August 2018, and it was accepted in October 2018 (Deliverable D0.2).
- The Draft Final Report was submitted the 23rd April 2019, and it was discussed at the Final meeting (Deliverable D0.3).
The present document represents the Final Report (D0.4). At the end of this document, there is the detailed timetable of the project listing milestones and deliverables (Tables 4.1-4.2). All milestones and deliverables were successfully completed.

17. 2.2 Work Package 1: Fisheries historical data collection
Responsible: Paolo Sartor, CIBM; Co-chair Violin Raykov, IO-BAS
Partners involved: CIBM, CNR, COISPA, CONISMA, CSIC-ICM, DFMR, HCMR, IBER-BAS, IEO, IO-BAS, IOF, NIMRD, NISEA, OGS
Core team: Pierluigi Carbonara, Charis Charilaou, Andrea De Felice, Maria Cristina Follesa, Tomaso Fortibuoni, Germana Garofalo, Beatriz Guijarro, Stefanos Kavadas, Iole Leonori, Simone Libralato, Porzia Maiorano, Francesc Maynou, Gheorghe Radu, Rosaria Sabatella, Mario Sbrana, Nedo Vrgoc, Radoslava Bekova, Georgi Daskalov, Petya Ivanova, Marina Panayotova, Violin Raykov, Maria Yankova
Duration 14 months: from 21 December 2017 to February 2019.

WP1 aimed at collecting, inventorying, and archiving fisheries historical data and/or metadata from all the possible sources, including data from past and ongoing projects. WP1 has been working in close cooperation with WP2, aimed at validating and standardizing the data collected by WP1, and with WP3, aimed at building a database to be populated with the fisheries historical data collected by WP1.

WP1 was organized in two tasks.

Task 1.1 Fisheries historical data collection in the Mediterranean (Responsible Paolo Sartor, CIBM; Co-chair Tomaso Fortibuoni, OGS)
Partners involved: CIBM, CNR, COISPA, CONISMA, CSIC-ICM, DFMR, HCMR, IEO, IOF, NISEA, OGS
Core team: Pierluigi Carbonara, Charis Charilaou, Andrea De Felice, Maria Cristina Follesa, Simone Libralato, Germana Garofalo, Beatriz Guijarro, Stefanos Kavadas, Porzia Maiorano, Francesc Maynou, Rosaria Sabatella, Mario Sbrana, Nedo Vrgoc

Task 1.2 Fisheries historical data collection in the Black Sea (Responsible Aurelia Totoiu, NIMRD; Co-chair Maria Yankova, IO-BAS)
Partners involved: IBER-BAS, IO-BAS, NIMRD
Core team: Radoslava Bekova, Georgi Daskalov, Petya Ivanova, Marina Panayotova, Violin Raykov
Gheorghe Radu (NIMRD) was originally indicated as responsible of Task 1.2; however, due to his retirement, he was replaced by Aurelia Totoiu (NIMRD).

The work under WP1 took advantage of the support of the FAO Regional Projects, and benefited of the fisheries historical data from non-EU waters provided by external contributors: Dr Aylin Ulman, who provided landing data from the eastern Mediterranean and the Black Sea, Prof. Othman Jarboui, who provided historical data (including LFDs) from Tunisian waters, Prof. Ertug Duzgunes and Prof. Ahmet Kideys, who provided historical data from Turkey (Black Sea), Dr Hatem Hanafy, who provided historical landings of red mullets from Egypt, and Prof. Hisham M. Ghmati, for providing information on historical data from Libya.

In the first months of the Project, the inventory of the information that could be made available to the Project was finalized with the contribution of all the Partners involved in WP1. This information concerns different typologies of fisheries data, coming from different sources: official archives (e.g. FAO, HELSTAT, ISTAT), data collected by means of research projects, grey literature, etc. Most of the information refers to the period before 2002, when the EU DCR/DCF was not yet enforced in most of the EU countries.
Following the discussions made during the first plenary meeting of the project RECFISH (Pisa, 25-26 January 2018, see Annex III of the Inception Report D0.1), the preliminary inventory prepared for the proposal of the project was further refined. This inventory of datasets was delivered as Annex IV of the Inception Report (D0.1).
After the preparation of the inventory of datasets, a common template was built in order to store the collected data ensuring full compatibility with the DCF databases. The encoding of spatial and temporal aspects, as well as of species and gear/fishery/metiér definition have been organized in the template to comply with the DCF tables structure as regards the transversal, biological and experimental fishing data. Concerning this last aspect, the datasets coming from "old" experimental trawl surveys (e.g. the Italian GRUND) were re-organized to guarantee full compatibility with the MEDITS formats (TA, TB, TC).
The template was organized not only to guarantee the compliance with the DCF structure, but also to maintain the finest temporal, geographical and technical resolution of the original data. For example, the geographical encoding reflects the originally reported statistics but an aggregation key at GFCM GSA level is also available. Each dataset collected has been identified and described in the template as METADATA.
The structure of the template was discussed and agreed among the leaders and key persons of WP1 and WP3, as well as the project coordinator; an ad hoc Skype meeting

took place on the 17th May 2018. The common template consisted of an Excel file: RECFISH-WP1_input templates.xls.
Following the preparation of the common template, each partner involved in WP1 (Task 1.1 Mediterranean Sea; Task 1.2 Black Sea) organized and stored the available data in the common templates. This process was finalized in December 2018, although the possibility of including further historical data was kept, as requested by the Contracting Authority. In fact, some data from non-EU countries were gathered and incorporated into the RECFISH database in January and February 2019.
The two deliverables foreseen under WP1, D1.1 (Fisheries historical data in the Mediterranean) and D1.2 (Fisheries historical data in the Black Sea) contain a detailed description of all the datasets collected (e.g. typology of data, spatial and temporal coverage, etc.), together with a critical evaluation of the information collected. The two deliverables are attached to the Final Report as Annexes VI and VII. The summary of the data collected for the Mediterranean Sea is provided in Table 2.2.1, while Table 2.2.2 is summarizing the historical data from the Black Sea collected and stored into the RECFISH database.
A major gap in the Mediterranean database is represented by the lack of fisheries historical data from the Spanish GSAs, with the only exception of GSA 6 (mostly Catalonia, with the bulk of data collected under the EVOMED project; see Sartor, 2010).

Table 2.2.1. Summary of the datasets stored in the Mediterranean historical fishery database.

Partner	***Type of data***	***Country***	***Area***	***Geographical resolution***	***Time span***	***Time resolution***	***No. of records***
DFMR	Age Length Key	CYP	GSA 25	GSA	1984-2004	Year	135
DFMR	Age structure Lan/Dis	CYP	GSA 25	GSA	1967-2004	Year	509
IOF	Age structure Lan/Dis	HRV	GSA 17	GSA	2001-2013	Year	64
CIBM	Fleet Capacity	ITA	GSA 9	Fishing area	1850-2008	Year	540
CNR	Fleet Capacity	ITA	GSA 16	GSA	1985-87, 1990-93	Year	140
CNR	Fleet Capacity	ITA	GSA 16	GSA	1968-1990	Year	23
CNR	Fleet Capacity	ITA	GSA 16	Region	1982	Year	14
CNR	Fleet Capacity	ITA	GSA 16	GSA	1985-2003	Year	342
CSIC-ICM	Fleet Capacity	ESP	GSA 6	Fishing area	1907-2008	Year	1939
DFMR	Fleet Capacity	CYP	GSA 25	GSA	1967-2004	Year	81
HCMR	Fleet Capacity	GRC	all		1991-2008	Year	857
IEO	Fleet Capacity	ESP	GSA 5	GSA	1965-2008	Month	528
NISEA	Fleet Capacity	ITA	all	Region	1998-2002	Year	305
NISEA	Fleet Capacity	ITA	all	Littoral	1968-1989	Year	1760
NISEA	Fleet Capacity	ITA	all		1968-1990	Year	184
NISEA	Fleet Capacity	ITA	all	Maritime Compartment	1972-1992	Year	874
NISEA	Fleet Capacity	ITA	all	Maritime Compartment	1972-1992	Year	874
O. Jarboui	Fleet Capacity	TUN	GSA 12-13-14	Region	1953-2016	Year	256
OGS	Fleet Capacity	ITA	GSA 17	Fishing area	1951-1993	Year	1548
OGS	Fleet Capacity	HRV	GSA 17	Fishing area	1929	Year	32
OGS	Fleet Capacity	ITA	GSA 17	Fishing area	1929	Year	64
OGS	Fleet Capacity	HRV	GSA 17	Fishing area	1925-1929	Year	15
OGS	Fleet Capacity	ITA	GSA 17	Fishing area	1884-1914;1925-1930	Year	137
OGS	Fleet Capacity	ITA	GSA 17	Fishing area	1961-1999	Year	70
CIBM	Growth Parameters	ITA	GSA 9	Fishing area	1990-1998	Year	79
CNR-ISMAR	Growth Parameters	ITA	GSA 16	GSA	n.a.	n.a.	24
DFMR	Growth Parameters	CYP	GSA 25	GSA	1984-2004	Year	4

Table 2.2.1. (continue)

Partner	***Type of data***	***Country***	***Area***	***Geographical resolution***	***Time span***	***Time resolution***	***No. of records***
A. Ulman	Landings	TUR	22 & 24	GSA	1950-2014	Year	63050
A. Ulman	Landings	PSE	GSA 27	GSA	1951-2014	Year	752
A. Ulman	Landings	PSE	GSA 27	GSA	1954-2012	Year	508
A. Ulman	Landings	LBN	GSA 27	GSA	1950-2014	Year	5643
A. Ulman	Landings	SYR	GSA 27	GSA	1950-2014	Year	7193
CIBM	Landings	FRA	GSA 7	Fishing area	1969-1997	Year	894
CIBM	Landings	ITA	GSA 9	Fishing area	1998-1999	Month	366
CNR	Landings	ITA	GSA 16	GSA	1985-87	Quarter	594
CNR	Landings	ITA	GSA 16	Region	1982	Month	636
CNR	Landings	ITA	GSA 16	GSA	1947-2000	Year	162
CNR	Landings	ITA	GSA 16	Fishing area	1997-2015	Month	896
CNR	Landings	ITA	GSA 17	GSA	1972-2016	Year	2017
COISPA	Landings	ITA	GSA 10	GSA	1982	Month	5400
COISPA	Landings	ITA	GSA 19	GSA	1982	Month	4320
COISPA	Landings	ITA	GSA 18	GSA	1982	Month	6480
CONISMA	Landings	ITA	GSA 19	Fishing area	1995-2000	Month	136
CSIC-ICM	Landings	ESP	GSA 6	Fishing area	1907-2008	Year	4659
DFMR	Landings	CYP	GSA 25	GSA	1967-2004	Year	428
H. Anafy	Landings	EGY	GSA 26	GSA	1964-2012	Year	46
HCMR	Landings	GRC	all		1964-2008	Year	954
IEO	Landings	ESP	GSA 5	GSA	1965-2008	Month	528
IEO	Landings	ESP	GSA 6	GSA	1971-2017	Year	215
IOF	Landings	HRV	GSA 17	GSA	1970-2015	Year	216
NISEA	Landings	ITA	all	Maritime Compartment	1972-2003	Year	59408
NISEA	Landings	ITA	all	Region	1998-2002	Year	1830
O. Jarboui	Landings	TUN	GSA 12-13-15	Region	1995-2016	Month	5589
OGS	Landings	ITA	GSA 17	Port	1902-1914;1921-1934;1938;1951-1968	Month	6480
OGS	Landings	ITA	GSA 17	Port	1902-1917;1919-1935;1938-1939;1950-1968	Year	6187
OGS	Landings	HRV	GSA 17	Port	1914-1932	Year	1729
OGS	Landings	ITA	GSA 17	Port	1905;1910;1919-1927	Year	620
OGS	Landings	ITA	GSA 17	Port	1953-2012	Year	12845
OGS	Landings	ITA	GSA 17	Port	1989-2006	Month	5412

Table 2.2.1. (continue)

Partner	Type of data	Country	Area	Geographical resolution	Time span	Time resolution	No. of records
CIBM	Landings per unit effort	ITA	GSA 9	GSA	1991-2009	Month	2977
CNR	Landings per unit effort	ITA	GSA 16	GSA	1985-87	Quarter	594
CNR	Landings per unit effort	ITA	GSA 16	Region	1982	Month	48
CNR	Landings per unit effort	ITA	GSA 16	Fishing area	1995-2000	Quarter	588
CNR	Landings per unit effort	ITA	GSA 16	Fishing area	1997-2015	Month	896
CSIC-ICM	Landings per unit effort	ESP	GSA 6	Fishing area	1907-2008	Year	1806
DFMR	Landings per unit effort	CYP	GSA 25	GSA	1967-2004	Year	266
HCMR	Landings per unit effort	GRC	all		1995-2008	Year	10414
IEO	Landings per unit effort	ESP	GSA 5	GSA	1965-1994	Month	528
CIBM	Medits TA	ITA	GSA 9	Fishing area	1985-2008	Quarter	3210
CNR	Medits TA	ITA	GSA 16	GSA	1990-91, 1994-1998, 2000-06, 2008	Quarter	3218
COISPA	Medits TA	ITA	GSA 10	GSA	1985-2008	Quarter	1272
COISPA	Medits TA	ITA	GSA 18	GSA	1996-2008	Quarter	889
CONISMA	Medits TA	ITA	GSA 19	GSA	1991-2008	Year	2050
CONISMA	Medits TA	ITA	GSA 11	GSA	1991-2008	Year	2265
IOF	Medits TA	HRV	GSA 17	GSA	1996-2017	Year	1024
IOF	Medits TA	HRV	GSA 17	GSA	2002-2004;2006;2007	Year	180
OGS	Medits TA	HRV	GSA 17		1957-1958	Month	126
OGS	Medits TA	HRV	GSA 17		1956-1971	Month	447
OGS	Medits TA	ITA	GSA 17		1975; 1981	Year	26
OGS	Medits TA	HRV	GSA 17-18		1948-1949	Month	271
OGS	Medits TA	ITA	GSA 17-18		1982	Year	100
OGS	Medits TA	ITA	GSA 17		1988; 1991	Year	26
OGS	Medits TA	ITA	GSA 17		1972	Year	6

Table 2.2.1.

Partner	*Type of data*	*Country*	*Area*	*Geographical resolution*	*Time span*	*Time resolution*	*No. of records*
CNR	Medits TB	ITA	GSA 16		1990-91, 1994-1998, 2000-06, 2009	Quarter	12143
COISPA	Medits TB	ITA	GSA 10	GSA	1985-2008	Quarter	63576
COISPA	Medits TB	ITA	GSA 18	GSA	1996-2008	Quarter	23897
CONISMA	Medits TB	ITA	GSA 19	GSA	1991-2008	Year	4368
CONISMA	Medits TB	ITA	GSA 11	GSA	1991-2008	Year	10809
IOF	Medits TB	HRV	GSA 17	GSA	1996-2017	Year	33285
IOF	Medits TB	HRV	GSA 17	GSA	2002-2004;2006;2007	Year	5441
OGS	Medits TB	HRV	GSA 17		1957-1958	Month	6730
OGS	Medits TB	HRV	GSA 17		1956-1971	Month	19756
OGS	Medits TB	ITA	GSA 17		1975; 1981	Year	1225
OGS	Medits TB	HRV	GSA 17-18		1948-1949	Month	25745
OGS	Medits TB	ITA	GSA 17-18		1982	Year	2451
OGS	Medits TB	ITA	GSA 17		1988; 1991	Year	1807
OGS	Medits TB	ITA	GSA 17		1972	Year	246
CIBM	Medits TC	ITA	GSA 9	Fishing area	1985-2008	Quarter	348936
COISPA	Medits TC	ITA	GSA 10	GSA	1985-2008	Quarter	51065
COISPA	Medits TC	ITA	GSA 18	GSA	1996-2008	Quarter	104132
CONISMA	Medits TC	ITA	GSA 19	GSA	1991-2008	Year	64384
CONISMA	Medits TC	ITA	GSA 11	GSA	1991-2008	Year	113778
IOF	Medits TC	HRV	GSA 17	GSA	1996-2017	Year	161927
IOF	Medits TC	HRV	GSA 17	GSA	2002-2004;2006;2007	Year	13558
CIBM	Size structure Lan/Dis	ITA	GSA 9	Fishing area	1993-1999	Month	3778
CNR	Size structure Lan/Dis	ITA	GSA 16	Fishing area	1995-2000	Quarter	5152
CONISMA	Size structure Lan/Dis	ITA	GSA 19	Fishing area	1995-2002	Month	4129
DFMR	Size structure Lan/Dis	CYP	GSA 25	GSA	1967-2004	Year	2880
IOF	Size structure Lan/Dis	HRV	GSA 17	GSA	2008-2017	Year	2029

Table 2.2.2. Summary of the datasets stored in the Black Sea historical fishery database.

Partner	*Type of data*	*Country*	*Area*	*Geographical resolution*	*Time span*	*Time resolution*	*No. of records*
A. Ulman	Landings	UKR	GSA 29	Region	1950-2014	year	4150
A. Ulman	Landings	RUS	GSA 29	Region	1950-2014	year	11041
A. Ulman	Landings	GEO	GSA 29	Region	1950-2014	year	5004
E. Duzgunes	Age structure Lan/Disc	TUR	GSA 29	Region	1990-2018	year	634
E. Duzgunes	Fleet capacity	TUR	GSA 29	Region	1980-2017	year	133
E. Duzgunes	Growth parameters	TUR	GSA 29	Region	1991-2014	year	179
E. Duzgunes	Landings	TUR	GSA 29	Region	1980-2017	year	414
E. Duzgunes	Landings per unit effort	TUR	GSA 29	Region	1980-2017	year	133
E. Duzgunes	Size structure Lan/Dis	TUR	GSA 29	Region	1970-2016	year	1929
IBER-BAS	Landings	BGR	GSA 29	Country	1925-1996	year	1208
IO-BAS	Age length key	BGR	GSA 29	Country	205-2016	year	164
IO-BAS	Age structure Lan/Disc	BGR	GSA 29	Country	2015	quarter	164
IO-BAS	Growth parameters	BGR	GSA 29	Country	1996-2016	year	32
IO-BAS	Landings	BGR	GSA 29	Country	1950-2017	year/semester	309
IO-BAS	Size structure Lan/Dis	BGR	GSA 29	Country	2015-2016	year	97
NIMRD	Age structure Lan/Disc	ROU	GSA 29	Country	1971-2007	year	906
NIMRD	Fleet capacity	ROU	GSA 29	Country	1981-2007	year	27
NIMRD	Growth parameters	ROU	GSA 29	Country	1990-2016	year	76
NIMRD	Landings	ROU	GSA 29	Country	1950-2007	year	713
NIMRD	Landings per unit effort	ROU	GSA 29	Country	1953-2007	year	369
NIMRD	Size structure Lan/Dis	ROU	GSA 29	Country	1970-2017	year	3349
NIMRD	Trawl survey CPUE	ROU	GSA 29	Country	1995-2008	year	146

18. 2.3 Work Package 2: Data validation and standardization

Responsible Cosimo Solidoro, OGS; Co-chair George Tserpes, HCMR)
Partners involved: CIBM, CNR, COISPA, CSIC-ICM, HCMR, IBER-BAS, NISEA, OGS
Key persons: Isabella Bitetto, Simone Libralato
Core team: Monica Gambino, Mario Sbrana, Michela Martinelli, Vasiliki Sgardeli, Maria Teresa Spedicato, Georgi Daskalov, Tomaso Fortibuoni, Francesc Maynou, Giacomo Milisenda, Claudia Musumeci, Marina Panayotova, Walter Zupa
Duration 12 months: from March 2018 to February 2019.

WP2 was aimed at analysing the data collected under WP1 in order to validate and standardize the time series of data before populating the database. This WP was organized into two tasks, one aimed at validating landings data, the second to standardize survey data and CPUEs.
The start of the activities of WP2 was anticipated to month 3 (March 2018), instead of month 4, as agreed during the 1st Plenary Meeting in Pisa (25-26 January 2018).

Task 2.1 Validation of landings time series (Responsible Simone Libralato, OGS; Co-chair Marina Panayotova, IBER-BAS)
Partners involved: CIBM, CNR, COISPA, HCMR, IBER-BAS, NISEA, OGS
Key persons: Mario Sbrana, Tomaso Fortibuoni
Core team: Monica Gambino, Mario Sbrana, Michela Martinelli, Vasiliki Sgardeli, Maria Teresa Spedicato
Duration 12 months: from March 2018 to February 2019.

Under Task 2.1, the landings time series collected in RECFISH from the different sources were here evaluated in terms of:

i) quality check that includes:
- avoiding duplication of data
- check for validity of data entered
- check for correctness of Species names

ii) internal consistency of data that includes:
- identification of outliers and z-score quantification of each record

iii) validationthat includes:
- evaluation of agreement among different time series

The *TSval* script was developed in R to perform the analyses expected under Task 2.1 using as input the RECFISH dataset implemented in WP1. The *TSval* script is described in much more detail in the Deliverable D2.1 “Validation of fisheries historical data”, which is attached to the present report as an annex (see Annex VIII). The steps implemented into the R script and exemplificative applications are detailed in the Deliverable D2.1.
As an example, the “RECFISH-WP1_Mediterranean.csv” is obtained directly from the dataset “RECFISH-WP1_Mediterranean.xlsx”, taking only the sheet containing the Landings dataset (sheet “Landings”). After the run of all controls and checks, the script produces an output file named “file.res.csv” which is identical for number of records and data to the input file but has additional columns containing information for each record useful to understand the results of the whole validation process. These additional columns contain

“labels” (classifications) which should help future users of the dataset or part of it for stock assessments (WP4).

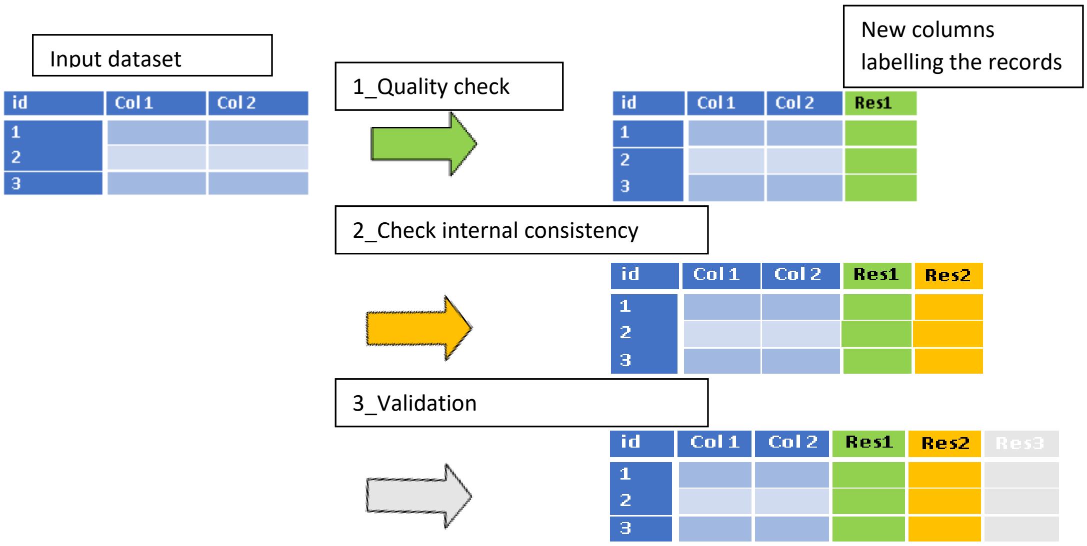

Figure 2.3.1. Scheme of the approach used to perform the quality checks on the RECFISH landings dataset.

The quality check included the control of the validity of data, identification of duplicated records and the check of species names. Two rows are defined identical when country, year, time unit, GSA, geographical unit, port name, gear used, species and landings reported are identical. This is a very restrictive approach that avoids possible erroneous elimination of valid data. This duplication search was tested manually and on the whole dataset and proved to be efficient and effectively correct.

This quality check produces two new columns: *dup* with logic label TRUE or FALSE (TRUE when the row is a duplicated) and *ref* containing the record.ID of the duplicated row. In this way, the user can successively decide the action to take (e.g., which of the duplicate rows are to be removed).

The check for the validity of the data was devoted to the identification of unrealistic values and was done by looking at negative values introduced in landings. The negative values were replaced with NA, and the records were flagged with the label “negative value” to facilitate filtering/identification of unrealistic records.

As concerns the check for correct species names, two different methods were identified. The first approach is based on matching species names included in the RECFISH database with the available websites, such as WORMS (World Register of Marine Species, http://www.marinespecies.org), ITIS (Integrated Taxonomic Information System, https://www.itis.gov), etc. The second method is checking the species names with the online databases available in the packages. As the first method (offline) requires frequent updates, we preferred the second method which allows a direct link with the online list, which is very often updated.

The checks for internal consistency of data aimed at evaluating the presence of extreme values or outliers. The landings time series, in fact, can include not only missing data (discontinuity), but also odd values that can be identified as outliers on the basis of statistical analysis. Cook’s distance and ARIMA are powerful diagnostic tests used for continuous data, but not for series with missing data: these approaches, although used for testing the other methods in selected time series, were not implemented. For permitting a

general application of the approach, Z-Score test and Studentized residual test were thus preferred. All methods were compared and the Z-score was implemented because of its inherent simplicity and powerful characterization of outputs.
In fact, Z-score could be used a posteriori not only for defining outliers and extreme values, but also to give a weighting factor to any record of a time series, which can be a valuable information for stock assessment approaches. Whenever possible, z-scores were determined on the basis of a "distance of data" from the best polynomial fit, otherwise the average was used. The polynomial fitting of the 5th order was considered as the most appropriate for data smoothing/fitting (after a set of tests). Notably, 15 data in the time series were considered as a minimal number to apply a 5th polynomial function, and Z-scores calculated as the standardized distance between data and smoothing function. In other cases (data <15), the average and standard deviation of the data were used to calculate Z-score.
The purpose of the internal consistency of data was to identify and report all values that could be potential outliers, as a guidance to decide whether to consider or not them for the stock assessment procedure. The value of Z-score ≤ 3 was used as a limit for correct data definition; for Z-scores larger than 3, a column was added to 'flag' the records as possible outliers.
Some outputs of the application of the internal consistency check on striped red mullet time series in GSA 05 are reported below. More details are available in D2.1 (see Annex VIII).

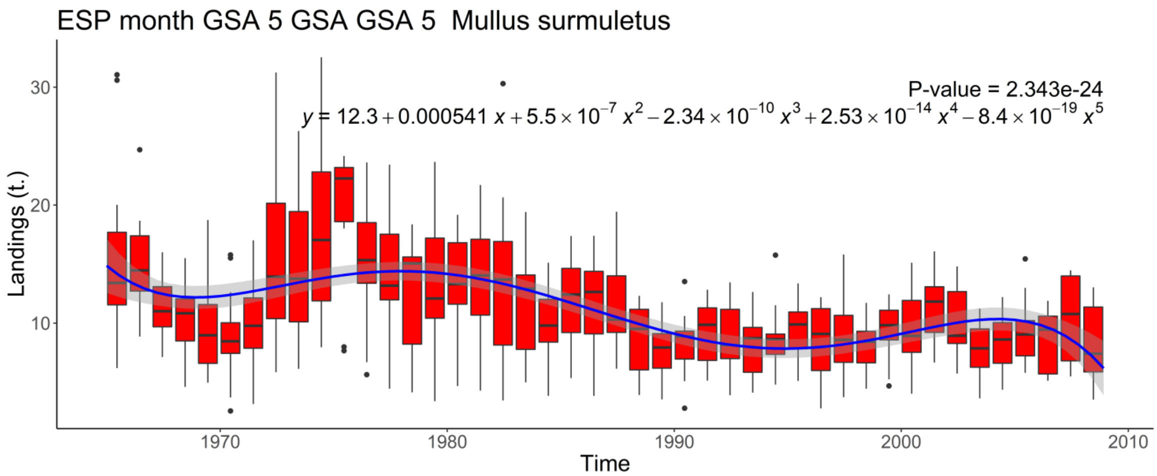

Figure 2.3.2. Box-plot of monthly time series of *Mullus surmuletus* in GSA 05 (case 2) with 5th polynomial fit (equation and blue line). Dotted red line represent the outlier limits (± Interquartile range * 1.5) of the whole distribution.

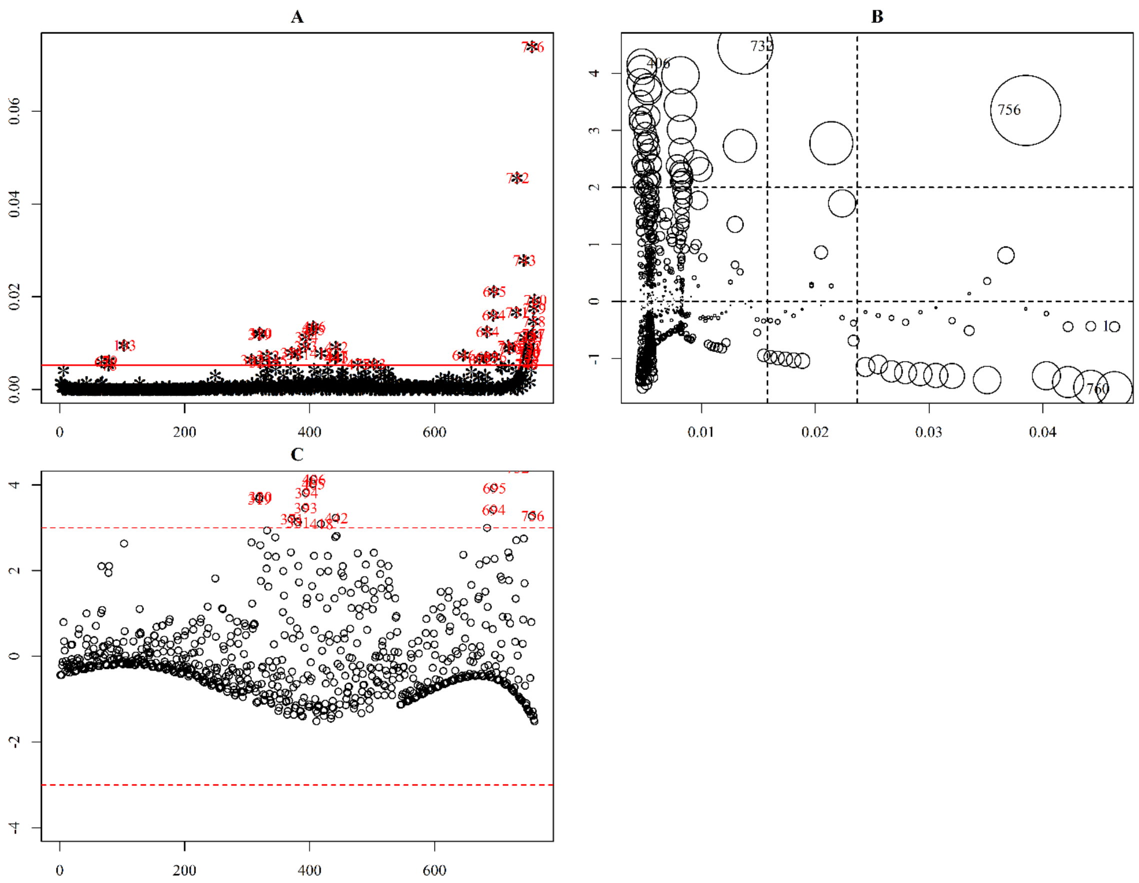

Figure 2.3.3. Analysis of outlier of striped red mullet time series (monthly data) in GSA 05 (case 2) with different methods: a: Cook's distance (red line indicate the outlier limits, index on x, Cook's values on y); b: Studentized residuals (outliers are the encircled number, hat-values on x, studentized values on y); c: z-score analysis (dashed red line indicates the z-score limits -3 & 3, index on x, z-scores on y).

These applications showed that Cook's distance and ARIMA are powerful diagnostic tests used for continuous data, but not for series with missing data. For permitting a general application of the approach, Z-Score test and Studentized residual test were thus preferred, but the z-score was implemented because of its inherent simplicity and powerful characterization of outputs. In fact, z-score could be used a posteriori not only for defining parsimoniously outliers and extreme values, but also to give a weighting factor to any record of a time series, which can be a valuable information for stock assessment approaches.
The results of this part of the script produce 5 additional columns (Table 2.3.1) reporting the identification of time series, the z-scores and the outliers identification.

Table 2.3.1. Output dataset after the application of the fun.check, with new additional columns with the results for the outliers' identification procedure.

TimeSeries	TimeSeriesID	TimeSeriesLength	UnivocalCode	z.score	outliers
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	1	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.1	-0.10579	not outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	2	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.2	-0.10932	not outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	3	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.3	0.510927	not outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	4	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.4	1.220416	not outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	5	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.5	3.673359	outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	6	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.6	3.597914	outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	7	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.7	-0.34113	not outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	8	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.8	-0.90889	not outlier
ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus	9	528	ESP, Month, GSA 5, GSA, GSA 5, , NA, Mullus surmuletus.9	-1.69967	not outlier

The validation of the data set was performed internally, among time series within the RECFISH dataset, and externally, by means of the comparison with official FAO statistics. The difference between the time series for the same area/port/location/region was considered an indication of the degree of validity of the time series. Time series were compared in terms of general agreement through correlation coefficient and a degree of consistency for all data pertaining to the two compared time series was also reported.
The internal validation was performed to evaluate the difference between time series reconstructed at GSA level using data at different geographical unit level (GSA, fishing area or region). The external validation was performed comparing those reconstructed time series with the FAO official statistics (as available on the FishStatJ data set).
The objective of this validation was to evaluate the difference in terms of landings between data from various sources. The approach also tested how much the aggregated data were different from the official FAO data set.
Comparison among datasets at GSA level with different original spatial units (GSA, region, fishing areas) resulted in three comparisons (units GSA *vs* unit region; units GSA *vs* unit fishing area; unit fishing area *vs* unit region).
An example of the analysis and a graphic representation of results is reported in the following figure for landings data for *Sardina pilchardus* in GSA 17 (Italian data). Figure 2.3.4 reports the comparison GSA vs Region.

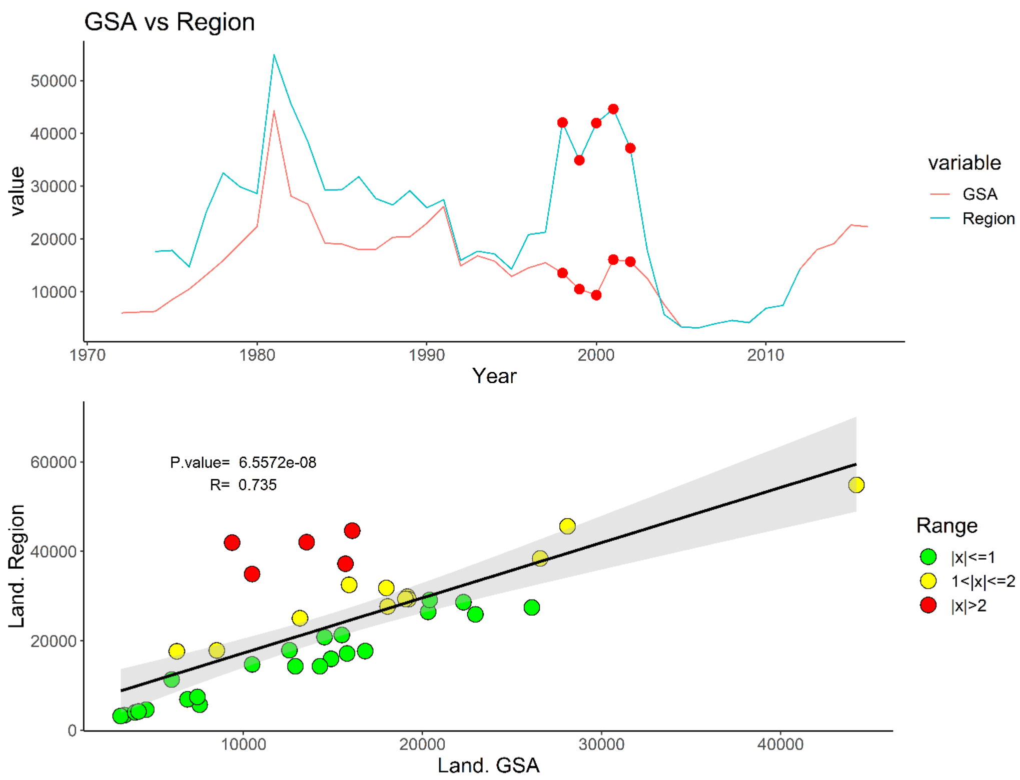

Figure 2.3.4. Comparison between data from GSA and Region for Sardina pilchardus in GSA17 (above). Red points indicate the data for which the calculation of z-score with eq. 1 gives |z-score| > 2. Below, scatterplot with Spearman test (p-values and R) between the two sources of data: the points 'colour indicate the range of values for z-score.

The results of the application of the three-steps approach for data quality check on the RECFISH database are recorded in output files stored in the project sharepoint. A synthesis of the results is here reported as a list of indicators of the outputs that allows a general evaluation of the performance of the script developed under Task 2.1 and the quality of data.

Table 2.3.2. Synthesis of the application of the validation process to the RECFISH datasets for Mediterranean and Black Sea.

Data set	Mediterranean	Black sea
Data set dimension	212875	22839
Duplicated row	19712	6576
Number of Time series (ts)	6447	357
Number of ts with length <= 15	3102	136
Number of ts with length > 15	3345	221
Outliers (from z.score)	3307 (2%)	488 (2%)
NA (from z.score)	26478 (12%)	490 (2%)
valid data (not outlier from z.score analysis)	183090 (86%)	21861 (96%)
% >3 or <-3 (from z.score)	1.55%	2.13%
% >2 or <-2 (from z.score)	4.06%	5.03%
% >1 or <-1 (from z.score)	15.76%	15.53%
% > 0.2 or <-0.2 (from z.score)	60.91%	60.84%
Number of match: Area vs Region	12458	0
Number of match: GSA vs Region	5881	0
Number of match: Area vs GSA	10447	0
Number of match: FAO vs Area	47176	683
Number of match: FAO vs Region	14086	0
Number of match: FAO vs GSA	14978	1317

A specific code was prepared for making a synthesis of the validation statistical process. The code allows to synthesize the time series for a selected species and GSA in terms of indicators of quality (% outlier) reporting also Time Unit and number of records (see Table 2.3.3). Additional code allows to synthesize the validation (matches intra and inter data set) process for GSA, Time Unit, Country and species.

Table 2.3.3. Synthesis of the statistical validation process (% outlier) to the RECFISH dataset for GSA, time unit (Year, month and quarter) and species (in this example Engraulis encrasicolus) for Mediterranean data set.

	GSA	Time Unit	Species (scientific name)	Start_series	End_series	n_records	Outlier
1	GSA 10	Month	Engraulis encrasicolus	1982	1982	60	0 %
2	GSA 10	Year	Engraulis encrasicolus	1972	2003	225	1.78 %
3	GSA 11.2	Year	Engraulis encrasicolus	1972	2003	108	1.85 %
4	GSA 16	Month	Engraulis encrasicolus	1982	2015	496	1.61 %
5	GSA 16	Quarter	Engraulis encrasicolus	1985	1987	54	0 %
6	GSA 16	Year	Engraulis encrasicolus	1947	2000	138	0.72 %
7	GSA 17	Month	Engraulis encrasicolus	1902	2006	756	1.85 %
8	GSA 17	Year	Engraulis encrasicolus	1902	2016	875	1.03 %
9	GSA 18	Month	Engraulis encrasicolus	1982	1982	72	0 %
10	GSA 18	Year	Engraulis encrasicolus	1972	1999	112	2.68 %
11	GSA 19	Month	Engraulis encrasicolus	1982	1982	48	4.17 %
12	GSA 19	Year	Engraulis encrasicolus	1972	1999	224	0.45 %
13	GSA 20	Year	Engraulis encrasicolus	2002	2006	5	0 %
14	GSA 22	Year	Engraulis encrasicolus	2002	2006	5	0 %
15	GSA 22 & 24	Year	Engraulis encrasicolus	1950	2014	195	2.05 %
16	GSA 27	Year	Engraulis encrasicolus	2005	2008	8	0 %
17	GSA 6	Year	Engraulis encrasicolus	1929	2008	108	0.93 %
18	GSA 9	Year	Engraulis encrasicolus	1972	2003	328	1.52 %
19	NA	Year	Engraulis encrasicolus	1998	2003	115	1.74 %
20	NA	Year	Engraulis encrasicolus	1990	2008	19	5.26 %

As mentioned before, more details on the scripts and the procedure used for the data quality checks and the validation are described in the Deliverable D2.1 (see Annex VIII). In addition, in D2.1 a series of tables summarizes the most reliable landing time series per

GSA and species. For each GSA, all species showing long time series (number of records > 20) and reliable (> 80% data with |z-score| > 3) were reported. A total of 311 time series across the Mediterranean Sea and 30 for the Black Sea fulfil these constrains. This synthesis represents a first check useful to detect species for which enough data are available and reliable for producing a long term assessment of the stocks.
For some GSAs, there are several time series of relevance (GSA 9, 10, 11.2, 16, 17, 18, 19, 27 and 29). For GSA 7 and 25, a limited numbers of reliable and long time series were identified. For the Adriatic Sea (GSA 17), 138 time series were identified as reliable and long, as a result of intense attention that this area received from historical reconstructions of fish and fisheries data (Ferretti et al., 2013; Fortibuoni et al., 2017). For the sake of short reporting, only the first 85 reliable and long time series are reported below for the GSA 17. Notably, for several GSAs there were no long time series considered reliable enough with the criteria defined above.

Task 2.2 Standardization of the CPUEs (Responsible Isabella Bitetto, COISPA; Co-chair George Tserpes, HCMR)
Partners involved: CIBM, CNR, COISPA, CSIC-ICM, HCMR, IBER-BAS, OGS
Key persons: Georgi Daskalov, Walter Zupa
Core team: Simone Libralato, Francesc Maynou, Giacomo Milisenda, Claudia Musumeci
Duration 12 months: from March 2018 to February 2019.

Task 2.2 took advantage from the work started in the EVOMED project (Sartor, 2010), developping a more systematic approach to the standardization of the scientific survey abundance indices and CPUE. The work by McCullagh and Nelder (1989) related to spatial modelling of scientific survey indices and CPUE using Generalized Linear Models, as well as the work of Wood (2017), investigating the use of Generalized Additive Models (GAM) were considered as starting points for developing the methodology applied in Task 2.2. Furthermore, the applications in Mateo and Hanselman (2014) and Katsanevakis and Maravelias (2008) were taken into consideration for this aim, as well as the application of zero-inflated models, often present in literature (Zuur et al., 2012; Andrade, 2009; Tsai et al., 2015; Stefánsson, 1996), in case of considerable numbers of zero-catch in the data. To deal with environmental variables (e.g. sea surface temperature, depth, etc.), several applications were considered, such as those reported in Howell and Kobayashi (2006), Bigelow and Maunder (2007) and Hazin and Erzini (2008). In order to explore and define a methodology for LFDs standardization directly applicable to survey data, based on the hypothesis that the observed LFDs can be expressed as combination of probability functions (e.g. Gaussian, Lognormal, Gamma, etc.), the approaches developed in Macdonald and Green (1988) were also investigated.
The methodology was applied to 43 stocks in the Mediterranean and Black Sea (Table 2.3.4). Compared to the preliminary list presented in the Inception Report, the final list was slightly modified and expanded, in order to cover more than the 40 stocks foreseen in the contract. Furthermore, in some cases, more than one index was standardized, such as biomass and density indices from the MEDITS survey and the Italian national trawl survey (GRUND). Although we have tried as much as possible to stick with the rule of 4 time series to be standardized in each of the ten case study areas, due to data availability issues and local expertise, we focussed the attention on some of the case study areas. However, we have assured the analyses of at least two stock for each case study area. The use of about 20 out of the standardized time series was investigated by Work Package 4 in the stock

assessment analyses, together with the information on the historical landings before 2002 (EU DCR/DCF) gathered form WP1 and Task 2.1.

The standardization process was divided into 2 main phases: the first was represented by the standardization of the abundance time series (biomass and/or density), and the second by the standardization of the length-frequency distribution. This second phase was dependent on the first one and it was also the more time consuming; for this reason, it was carried out only for the stocks for which an analytical age structured stock assessment was planned in the WP4.

Table 2.3.4. List of stocks considered for survey indices standardization. The stocks for which more than one index was standardized are highlighted in bold.

Species	GSAs	Type of data	LFDs
1. *Mullus barbatus*	1	Medits biomass	N
2. *Parapenaeus longirostris*	1	Medits biomass	N
3. *Mullus surmuletus*	5	Medits biomass	N
4. *Mullus barbatus*	6	Medits biomass	N
5. *Eledone cirrhosa*	6	Medits biomass	N
6. *Trisopterus capelanus*	7	Medits biomass	N
7. *Mullus barbatus*	7	Medits biomass	N
8. *Trachurus trachurus*	7	Medits biomass	N
9. *Parapenaeus longirostris*	7	Medits biomass	N
10. Aristeus antennatus	**9**	**Medits/Grund biomass**	**Y**
11. Aristeus antennatus	**11**	**Medits/Grund biomass and density**	**Y**
12. Illex coindetii	**11**	**Medits biomass and density**	**N**
13. *Trachurus mediterraneus*	9	Medits biomass	N
14. *Trachurus trachurus*	9	Medits biomass	N
15. *Engraulis encrasicolus*	9	Medits biomass	N
16. Eledone cirrhosa	**9**	**Medits/Grund biomass**	**N**
17. Eledone cirrhosa	**10**	**Medits/Grund biomass**	**N**
18. *Illex coindentii*	10	Medits biomass	N
19. ***Nephrops norvegicus***	**9**	**Medits biomass and density; Grund density**	**Y**
20. *Eledone moschata*	16	Medits biomass	N
21. *Mullus barbatus*	16	Medits biomass	N
22. *Parapenaeus longirostris*	16	Medits biomass	N
23. *Sardina pilchardus*	16	Medits biomass	N
24. Eledone cirrhosa	**18**	**Medits biomass and density**	**N**
25. *Lophius spp*	17	Medits biomass	N
26. *Trachurus spp*	17	Medits biomass	N
27. Trisopterus capelanus	**18**	**Medits biomass and density**	**N**
28. *Trisopterus capelanus*	17	Medits biomass	N
29. *Aristeus antennatus*	18-19	Medits biomass	N
30. *Aristaeomorpha foliacea*	18-19	Medits biomass	N
31. *Pagellus erythrinus*	20	Medits biomass	N
32. *Spicara smaris*	20	Medits biomass	N
33. *Pagellus erythrinus*	22	Medits biomass	N
34. *Spicara smaris*	22	Medits biomass	N
35. *Spicara smaris*	23	Medits biomass	N
36. *Spicara smaris*	22-23	Medits biomass	N
37. *Boops boops*	23	Medits biomass	N
38. *Mullus surmuletus*	25	Medits density	N
39. *Merluccius merluccius*	25	Medits biomass	N
40. *Scophthalmus maximus*	29	biomass	N
41. *Squalus acanthias*	29	biomass	N
42. *Merlangius merlangus*	29	biomass	N
43. *Sprattus sprattus*	29	biomass	N

The dataset for the indices standardization was prepared using the formats agreed within WP1 and applied in WP3 for the design of Database structure and specifications; in particular, for survey data (both in Mediterranean and Black Sea), the agreed formats are fully in line with the ones from the DCF trawl surveys in the Mediterranean and, thus, with the MEDITS TA, TB and TC (MEDITS handbook, 2017) file structure.

The preparation of the dataset for modelling and standardization is based on merging TA and TB tables and TA and TC tables (the last one for modelling length-frequency distributions) through the haul number and the year, taking into account also the hauls with zero-catch.

The explanatory variables taken into account in the exploratory analysis and in the standardization are:

- Geographical Position (latitude, longitude and depth);
- Year;
- Month;
- Shooting/hauling time.

Sea Surface Temperature (SST) has been explored in several case studies, if considered relevant for the analysis. Another variable taken into account is the vessel and the sampling intensity. These two explanatory variables were defined as factors, differentiating the different vessels and years according to the number of hauls carried out. This was explored to investigate the effect of the change in the sampling intensity occurred in many GSAs because of the inclusion of MEDITS survey in the DCF in 2002.

In this phase, the preferred depth range was also selected in order to avoid an excessive number of zeros in the modelling of the distribution of each stock in the space and along the years (e.g. for red mullet the depth range 10-200 m was generally selected).
The Variance Inflation Factor (VIF) was used to evaluate the autocorrelation among the covariates and combined with the evaluation of the correlation matrix, taking into account the corresponding significance levels. If the VIF for all the variables is smaller than 3 (Zuur, 2010) and if in the correlation matrix the Pearson’s coefficients are all smaller than 0.5 (generally, absolute values of Pearson’s coefficient between 1 and 0.5 are indicated as strong correlation), all the explanatory variables can be chosen, because not correlated. If in the dataset there are two variables with the coefficients higher than 0.5, only one of these two variables should be included in the model.
In most cases, the transformation of the dependent variable (according to logarithm, inverse, quadratic, square root functions) was also considered to improve the fitting.

A stepwise (backward/forward) selection procedure was generally used to select the best Generalized Additive Model. This procedure was applied fitting a wide range of models, including the different explanatory variables at a time and excluding the ones not significant or, alternatively, starting from the basic models using only one explanatory variable, and including step by step one variable at a time, according to its significance. In both cases, the model characterized by the lowest Generalized Cross-Validation (GCV), by significant explanatory variables and the highest explained deviance was selected for the next step, until the final phase, where the best model for the standardization of abundance indices is selected.
In case the Tweedie probability distribution was used in the selection phase, REML was used as the default smoothing approach. Given that REML values cannot be used for model comparisons, as illustrated in Wood (2011), in such a case the automate selection was preferred. Indeed, in this specific case, the use of select=TRUE, in combination with method=”REML”, shrinks several terms to 0, giving an informative model selection.
Generally, the basis dimension of the smoothers (indicated as k and equal to the degree of the spline + 1) was selected automatically in the fitting of the GAM, adding the instruction select=T to the gam command. The `gam.check` instruction was used to verify the appropriateness of the k for the different splines; low p-values may indicate that the basis

dimension k has been set too low, especially if the reported edf (estimated degrees of freedom) is close to k', the maximum possible for the term.
At each step, the computed splines on the explanatory variables should be inspected in order to retain only the ones making sense from an ecological and biological point of view. In case the degree of the spline seems to be too high, producing too many oscillations difficult to be biologically explained, the degree of the spline can be constrained, indicating in the corresponding spline the k to be used as starting point (e.g. `s(depth,k=7)`), or fixing the k to 9, adding fx=TRUE.
The option gamma=1.4 was used in the cases where there was the possibility of overfitting, as suggested by Wood (2006).
Model fitting was accomplished, by means of the "mgcv" library under the R language environment and the smoothing function was represented using penalized cubic spline shrinkage smoothers (Wood, 2017). This approach facilitates fully automatic model selection by allowing smooths to be shrunk to zero as part of the smoothness selection procedure. In this way unimportant terms are removed, resulting in parsimonious models that describe well the response variable and are as simple as possible. The GAM procedure automatically selects the degree of smoothing based on the Residualized Maximum Likelihood (REML) score, which is a proxy for the model predictive performance. Deficiencies of the fitted models were diagnosed by means of randomized quantile residual plots (Foster and Branvington, 2013) and all statistical inferences were based on the 95% confidence level.
The probability distributions that generally are used to model the abundance indices are Gaussian (with link functions: identity, log, inverse, etc.) and Tweedie. Usually, the latter is used in case of zero-inflated datasets, before using more complex models and/or delta approach. The same distributions were used for the case studies foreseen in the Task 2.2.
The diagnostic plots of the residuals was inspected for selecting the best model: to define the best model as correctly specified, the residuals were as much as possible close to a normal distribution; `gam.check` command function was used to produce diagnostic plots.

The predictive grid is represented by a set of points with regular positions characterized by equal distance from the neighbours. In the grid, each couple of coordinates (latitude and longitude) has to be linked to the value of all the explanatory variables (different from the month and the year) detected as significant by the best GAM model. This part of the grid has to be the same for all the years to be considered in the standardization; the month has to be put equal to the month defined by the survey protocol or equal to the month more frequently sampled according to the available data. A spatial resolution of 0.01 or 0.03 degrees was used.
In order to estimate the time series of the indices, the mean index by depth stratum was estimated. Then, the annual index was computed as the mean of these values by stratum, weighted by the stratum surface according to the formula provided by Souplet (1996).

More details on the methodological aspects are provided in the Deliverable D2.2 "Standardization of CPUEs" that is attached to this report as an annex (Annex VI). Here we report the main outcomes of the analyses performed on the biomass and density indices of trawl surveys. Figures 2.3.5-2.3.23 show the plots of the standardized indices against the observed values of the 43 stocks considered in the analyses under Task 2.2.

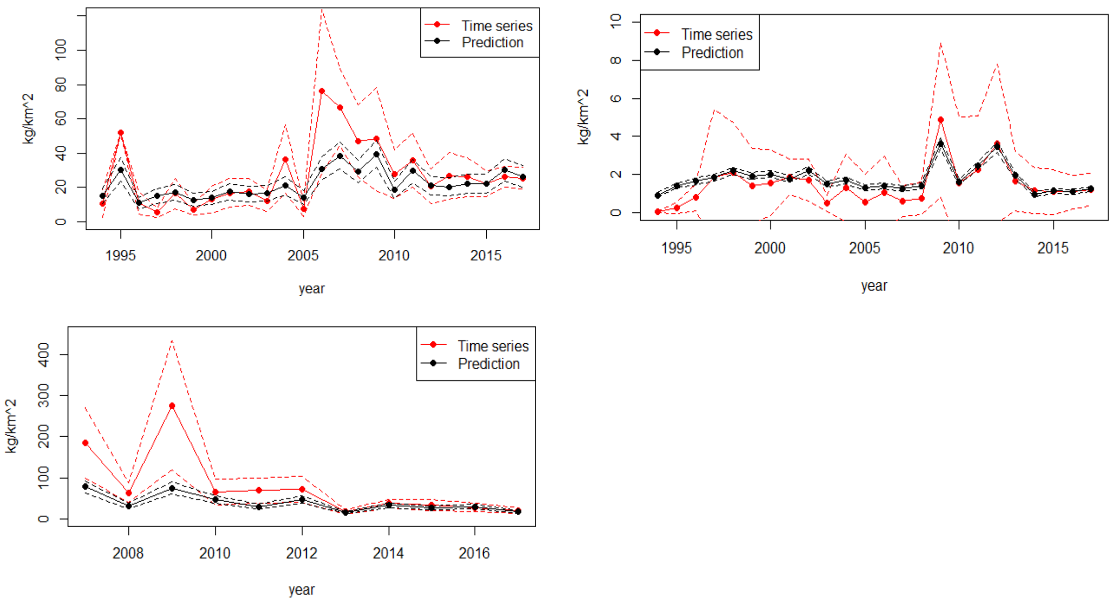

Figure 2.3.5. Comparison between original (red line) and standardized MEDITS biomass indices (black line) of red mullet, *M. barbatus*, (top-left panel) and deep-water rose shrimp, *P. longirostris*, (top-right panel) in GSA 01, and striped red mullet, *M. surmuletus*, in GSA 05 (bottom-left panel).

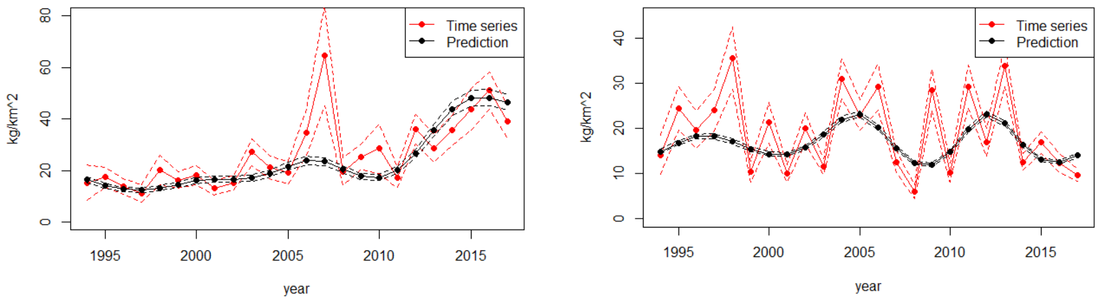

Figure 2.3.6. Comparison between original (red line) and standardized MEDITS biomass indices (black line) of red mullet, *M. barbatus*, (left panel) and horned octopus, *E. cirrhosa*, (right panel) in GSA 06.

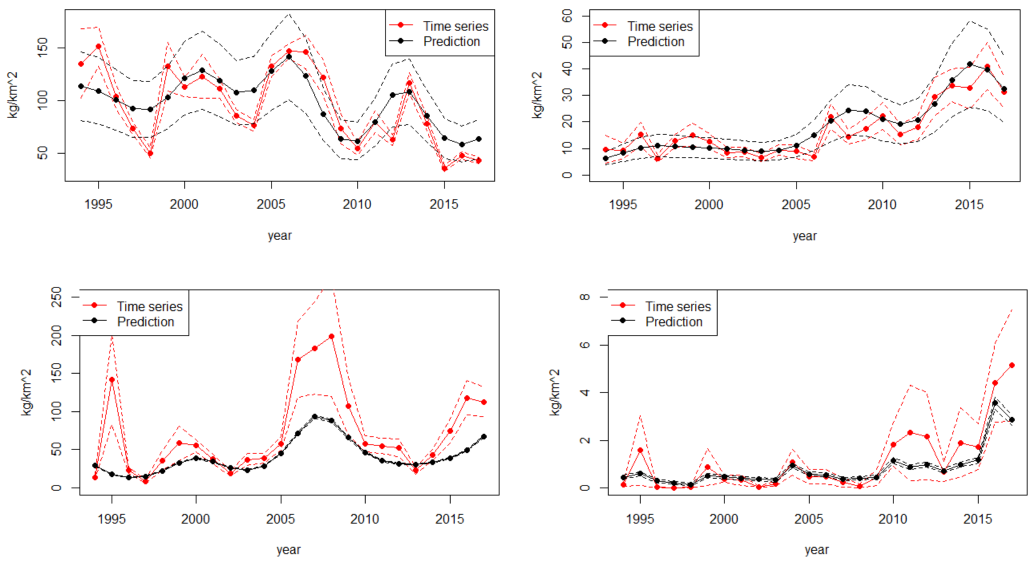

Figure 2.3.7. Comparison between original (red line) and standardized MEDITS biomass indices (black line) of poor cod, *T. capelanus*, (top-left panel), red mullet, *M. barbatus*, (top-right panel), Atlantic horse mackerel, *T. trachurus*, (bottom-left panel), and deep-water rose shrimp, *P. longirostris*, (bottom-right panel) in GSA 07.

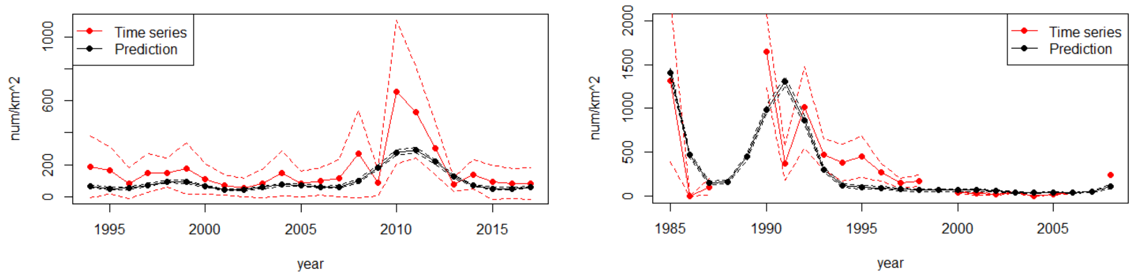

Figure 2.3.8. Comparison between original (red line) and standardized indices (black line) of blue and red shrimp, *A. antennatus*, in GSA 09; MEDITS density index (upper panel), GRUND density index (lower panel).

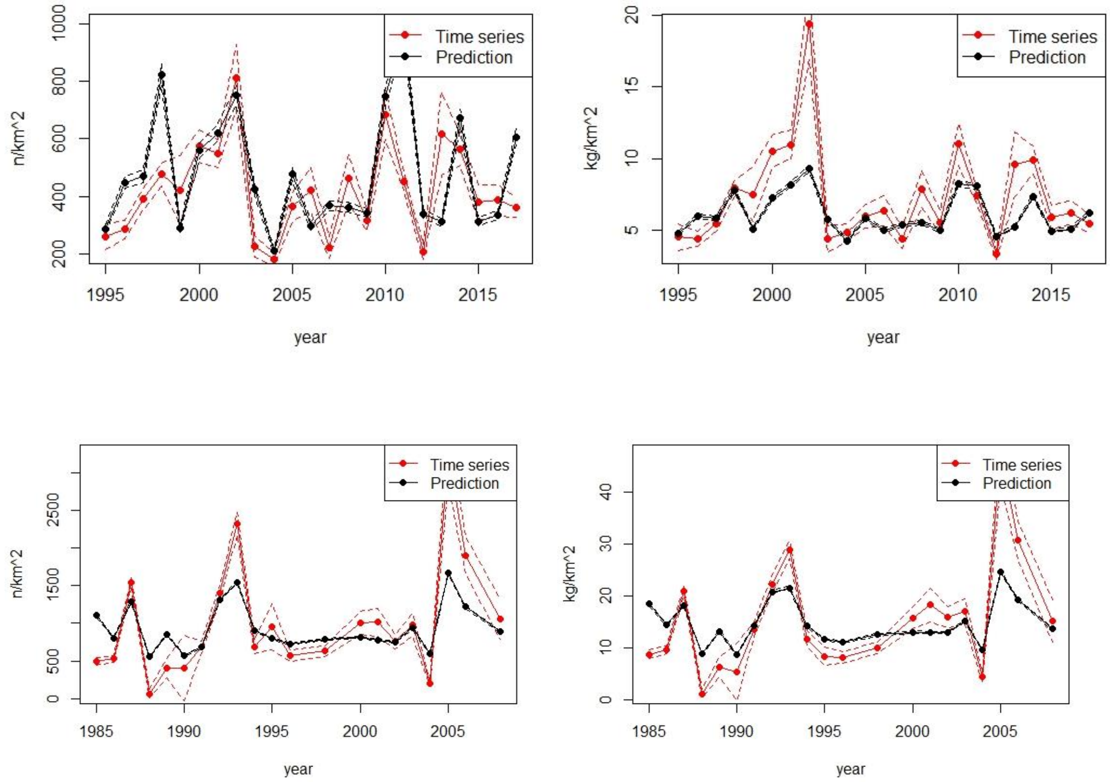

Figure 2.3.9. Comparison between original (red line) and standardized indices (black line) of blue and red shrimp, *A. antennatus*, in GSA 11; MEDITS density index (top-left panel), MEDITS biomass index (top-right panel), GRUND density index (bottom-left panel), GRUND biomass index (bottom-right panel).

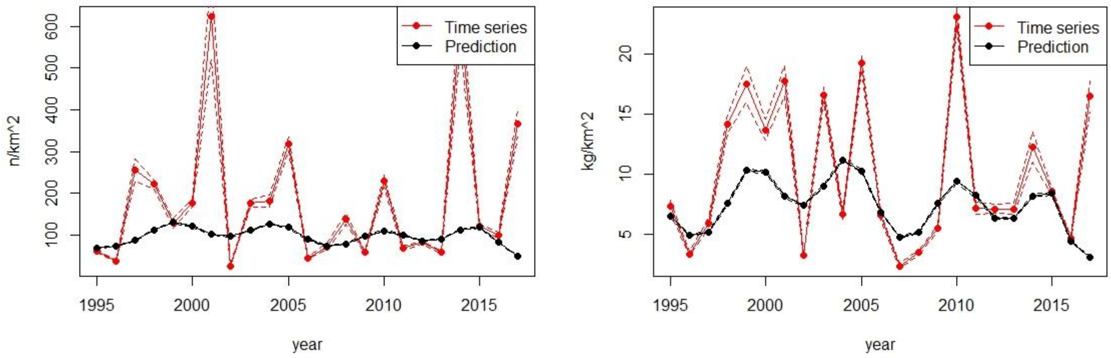

Figure 2.3.10. Comparison between original (red line) and standardized indices (black line) of broadtail shortfin squid, *I. coindetii*, in GSA 11; MEDITS density index (left panel), MEDITS biomass index (right panel).

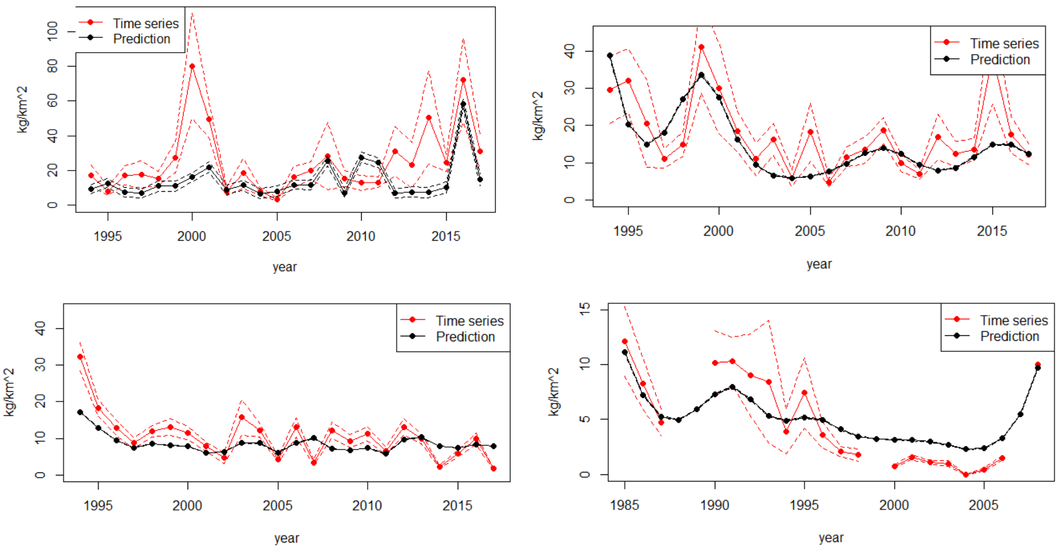

Figure 2.3.11. Comparison between original (red line) and standardized biomass indices (black line) of Mediterranean horse mackerel, *T. mediterraneus*, (top-left panel), Atlantic horse mackerel, *T. trachurus*, (top-right panel) in GSA 09, and horned octopus, *E. cirrhosa*, in GSA 09 (MEDITS biomass index, bottom-left; GRUND biomass index, bottom-right).

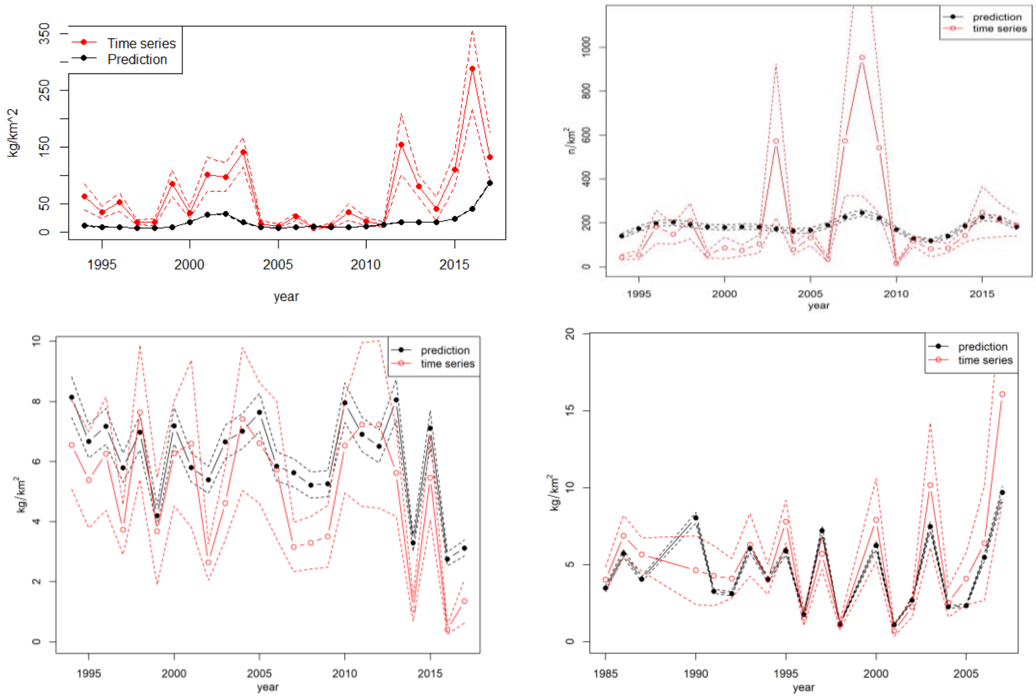

Figure 2.3.12. Comparison between original (red line) and standardized MEDITS biomass indices (black line) of anchovy, *E. encrasicolus*, in GSA 09 (top-left panel); MEDITS density indices of broadtail shortfin squid, *I. coindetii*, in GSA 10 (top-right panel); horned octopus, *E. cirrhosa*, in GSA 10 (MEDITS biomass indices, bottom-left, GRUND biomass indices, bottom-right).

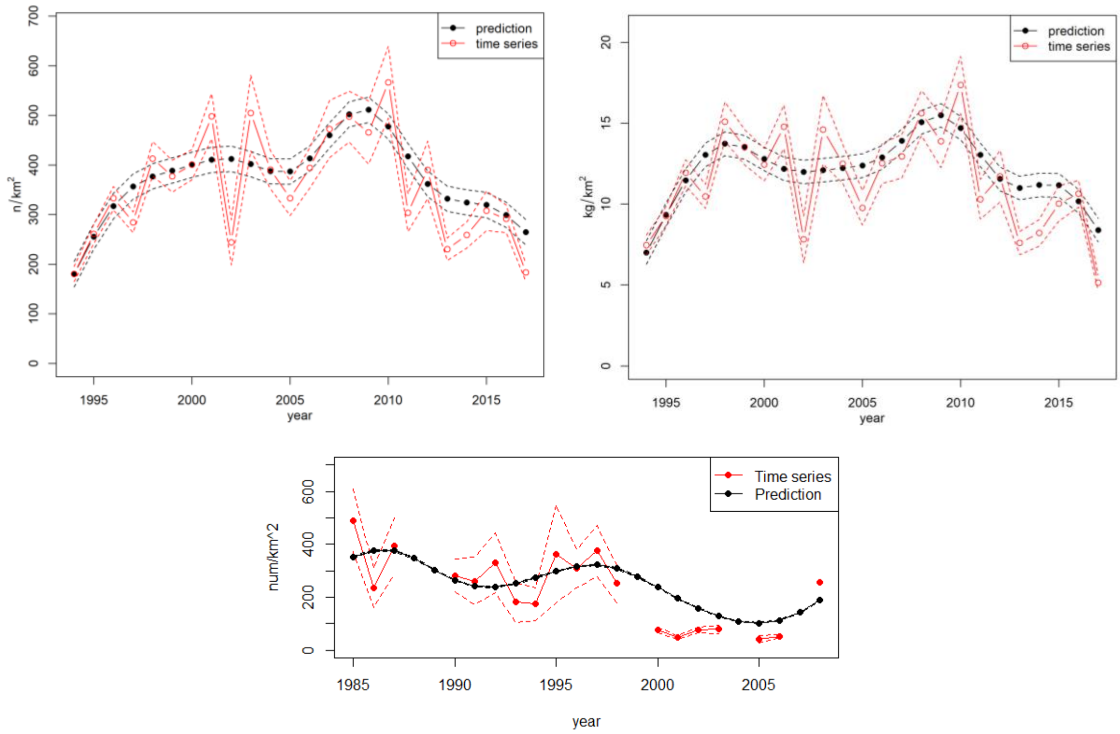

Figure 2.3.13. Comparison between original (red line) and standardized indices (black line) of Norway lobster, *N. norvegicus*, in GSA 09; MEDITS density indices (upper-left), MEDITS biomass indices (upper-right), GRUND density indices (lower panel).

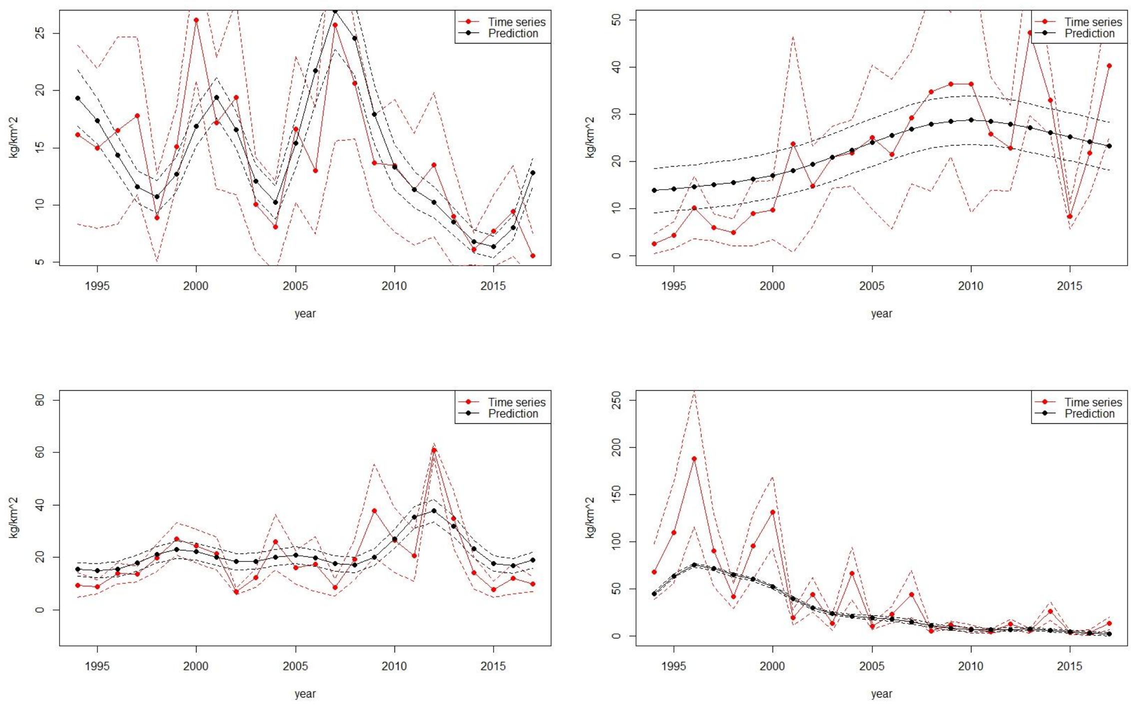

Figure 2.3.14. Comparison between original (red line) and standardized biomass indices (black line) of musky octopus, *E. moschata*, (top-left panel), red mullet, *M. barbatus*, (top-right panel), deep-water rose shrimp, *P. longirostris*, (bottom-left panel), and sardine, *S. pilchardus*, (bottom-right panel) in GSA 16.

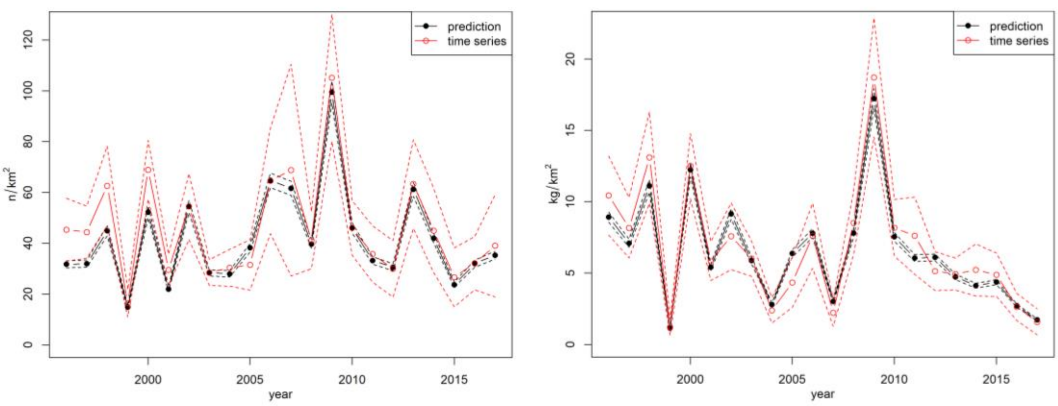

Figure 2.3.15. Comparison between original (red line) and standardized indices (black line) of horned octopus, *E. cirrhosa*, in GSA 18; MEDITS density (left panel) and biomass (right panel) indices.

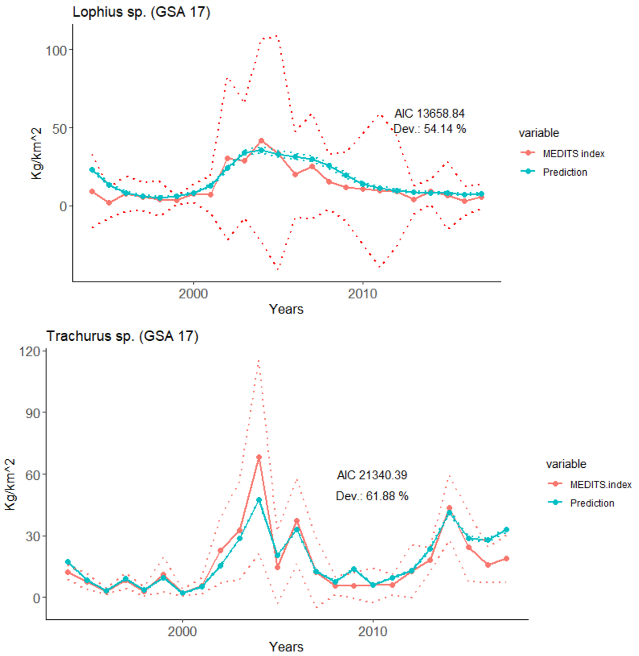

Figure 2.3.16. Comparison between original (red line) and standardized MEDITS biomass indices (green line) of anglerfish (*L. budegassa* and *L. piscatorius*) and horse mackerel (*Trachurus* spp.) in GSA 17.

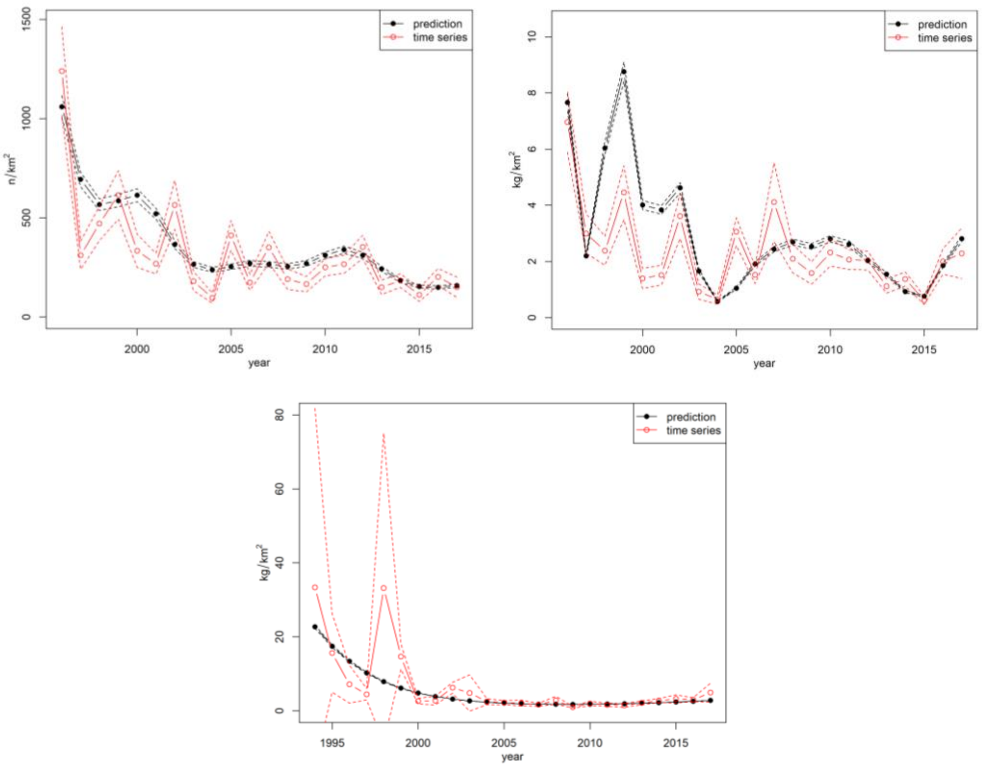

Figure 2.3.17. Comparison between original (red line) and standardized indices (black line) of poor cod, *T. capelanus*: MEDITS density (top-left panel) and biomass (top-right panel) indices in GSA 18; MEDITS biomass indices (lower panel) in GSA 17.

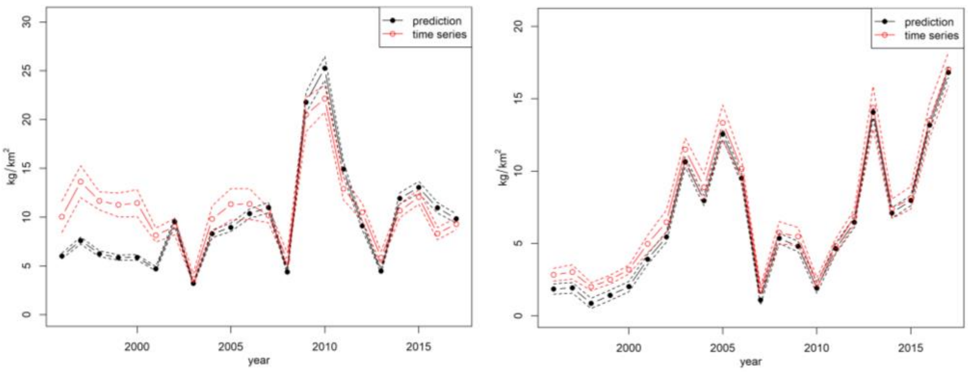

Figure 2.3.18. Comparison between original (red line) and standardized MEDITS biomass indices (black line) of blue and red shrimp, *A. antennatus*, (left panel) and giant red shrimp, *A. foliacea*, (right panel) in GSAs 18-19.

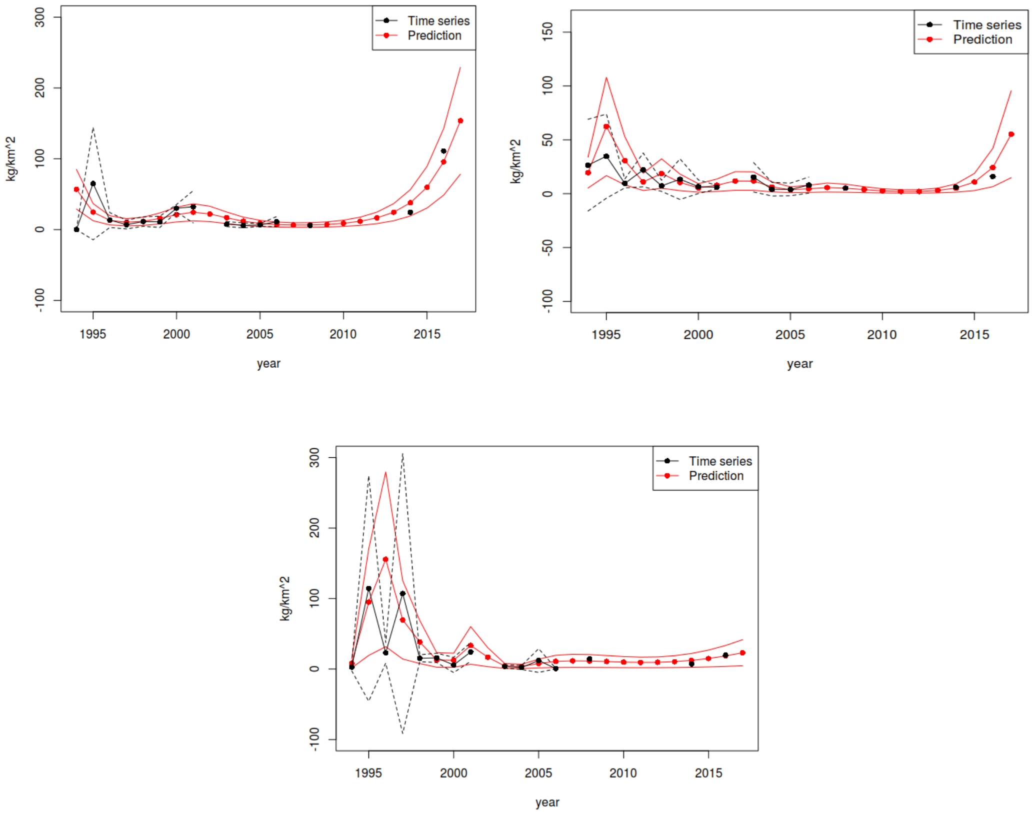

Figure 2.3.19. Comparison between original (black line) and standardized MEDITS biomass indices (red line) of common pandora, *P. erythrinus*, in GSA 20 (top-left panel) and GSA 22 (top-right panel), and bogue, *B. boops*, in GSA 23 (lower panel).

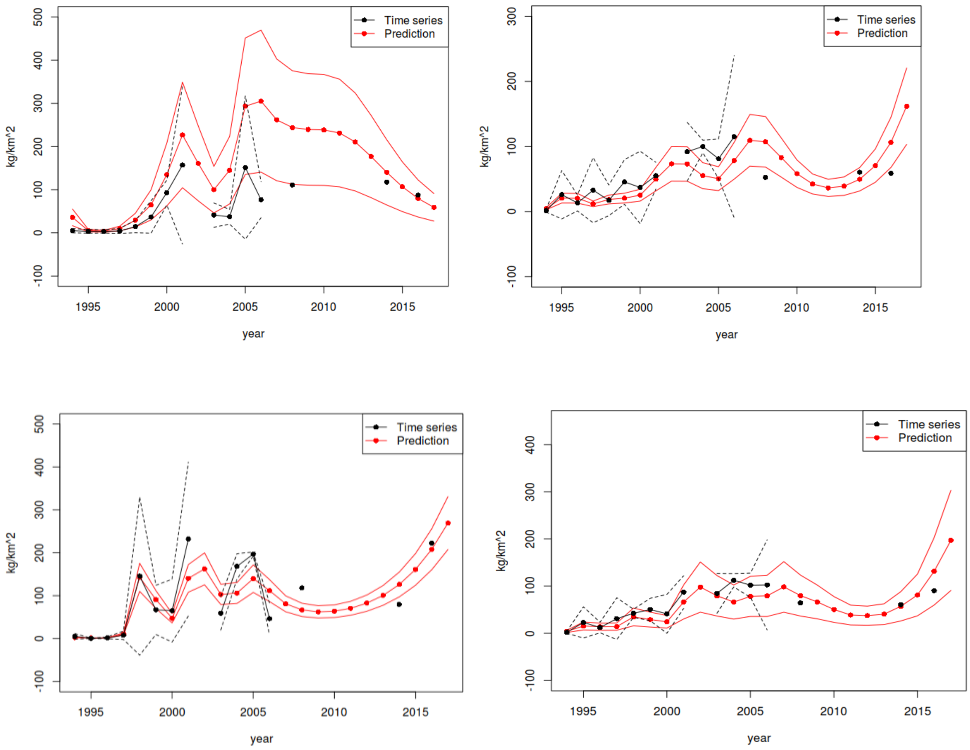

Figure 2.3.20. Comparison between original (black line) and standardized MEDITS biomass indices (red line) of picarel, *S. smaris*, in GSA 20 (top-left panel), GSA 22 (top-right panel), GSA 23 (bottom-left panel), and GSAs 22-23 (bottom-right panel).

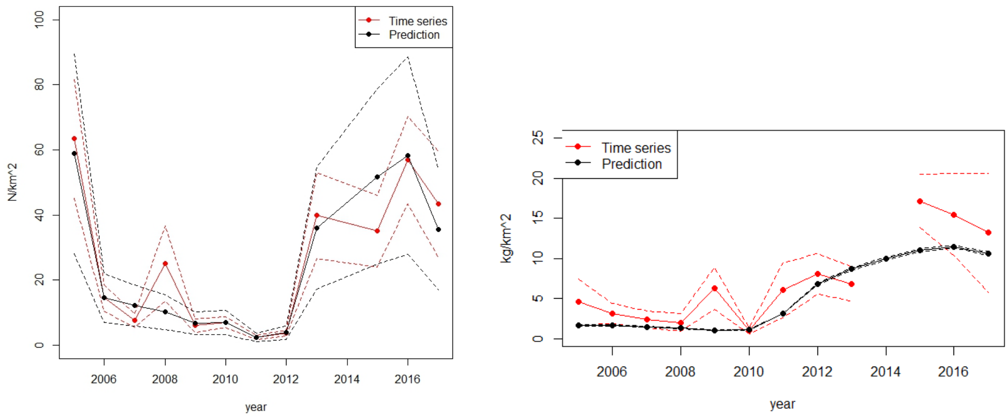

Figure 2.3.21. Comparison between original (red line) and standardized indices (black line) of striped red mullet, *M. surmuletus*, (left panel), and European hake, *M. merluccius*, (right panel) in GSA 25.

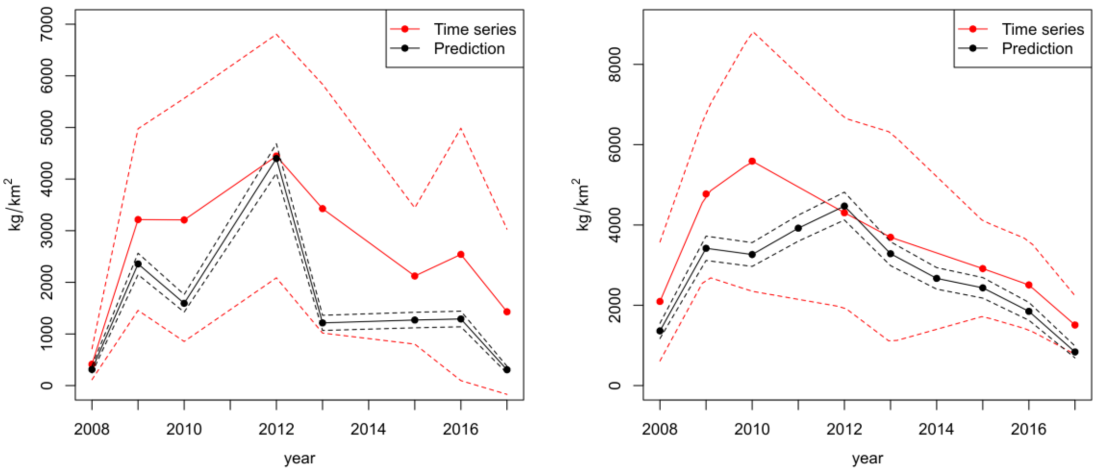

Figure 2.3.22. Comparison between original (red line) and standardized biomass indices (black line) of sprat, *S. sprattus*, in GSA 29; Romanian survey, left panel, Bulgarian and Romanian surveys combined, right panel.

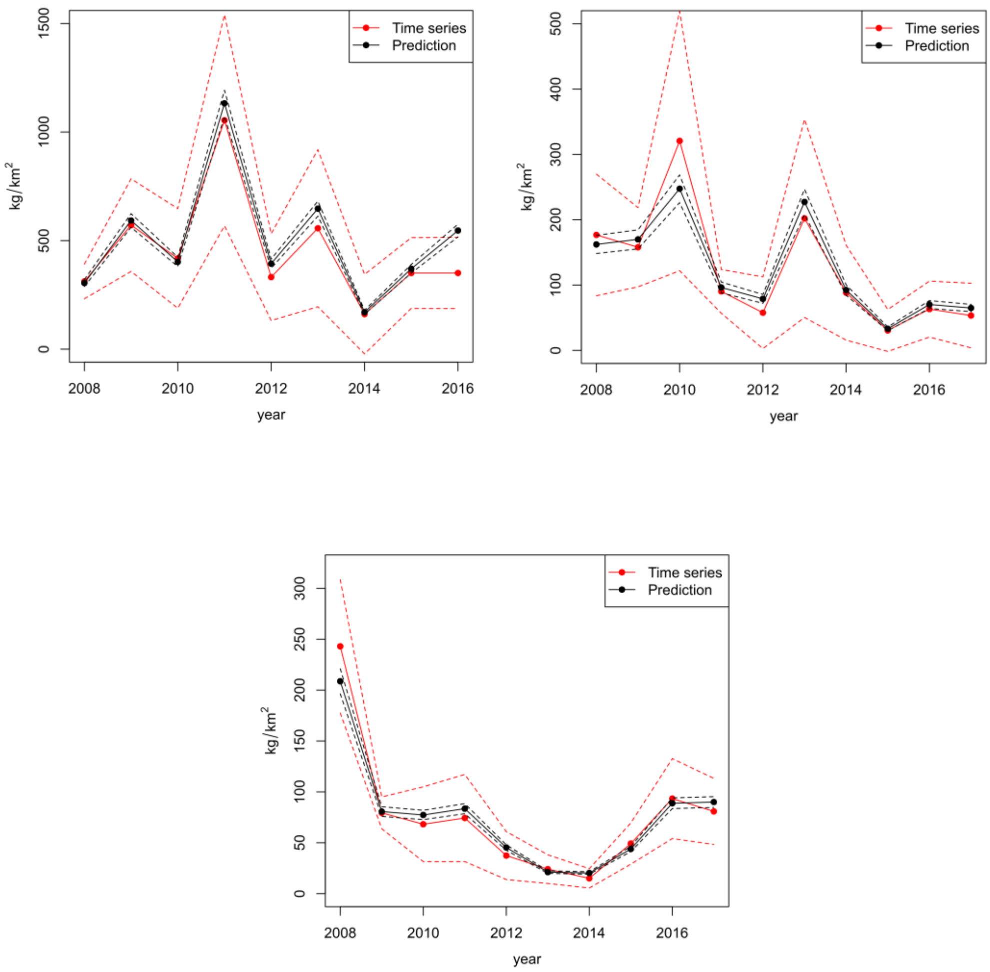

Figure 2.3.23. Comparison between original (red line) and standardized indices (black line) of whiting, *M. merlangus*, in GSA 29 (Romanian survey, top-left panel), spurdog, *S. acanthias*, in GSA 29 (Romanian survey, top-right panel), and turbot, *S. maximus*, in GSA 29 (Romanian survey, bottom panel).

The standardization of the length-frequency distributions (LFD) was carried out in 3 steps:

1. Characterization of the LFDs as sum of normal or lognormal distributions;

2. Modelling of the parameters related to the detected distributions;
3. Estimation of standardized LFD.

The method used for the preparation of the dataset for LFD modelling was the same used in the GAM modelling for standardized indices, except that the merge was made between TA and TC, instead of TA and TB. The depth range was selected also in this case in order to estimate the LFD to be characterized on the basis of the preference habitat of the stock. The numbers per km^2 were estimated taking into account the sub-sampling, if present.
The annual LFDs obtained using the original survey data according to Souplet (1996) were firstly characterized in order to be expressed as a sum of one or more probability distributions. The characterization was carried out as the best fit to LFD, using a combination of a Newton-type method and Expected Maximization (EM) algorithm. This approach is implemented by the R package *mixdist*, developed by Mcdonald (the method implemented is described in Mcdonald, 1988). The package allows to estimate the parameters of the distributions (e.g. mean, standard deviation) and the weight of each distribution in the sum. The algorithm needs that seed values are provided for each parameter to be estimated.

At the end of the LFDs decomposition by year, a data frame was created containing the means and the standard deviations of the detected distributions for each year as well as the weight of each distribution within the year; in a second step, the information of the month during which most part of the hauls in the selected depth range were carried out is externally included in the data frame. Then, the modes detected for each year were externally numbered by the user.

Each parameter of the detected distributions was modelled separately from the other. Hence, the number of linear models to be fitted was equal to the number of detected modes multiplied by the number of parameters estimated for each mode. For example, if two modes were detected with normal or log-normal distribution (the probability distribution can be chosen according to the LFDs), the number of models to be fitted was 4 for the parameters (2 modes x 2 parameters [mean and sd]) and 2 for the weights (total of 6).
It was important to identify the characteristics of the LFDs coming from the surveys carried out in the period established by the survey protocol, in order to select the number of distributions actually useful to describe the standardized LFD. Depending on the occurrence of each type of mode in the time series, it was possible to fit the models varying the level of complexity choosing among a linear model, a GLM or a simple mean of the parameters in the different years.
The outcome of this phase was the set of parameters and weights fitted by the models (linear model, a GLM or a simple mean) and that was used to define to theoretical LFD of the survey in the month established in the survey protocol.

In order to obtain the standardized number of the individuals by length class for every year, the yearly index (aggregated, not by length) obtained by the GAM modelling (see Standardization of abundance indices) was split according to the frequency derived in the previous step.

The standardization of LFDs was performed on blue and red shrimp, *A. antennatus*, in GSA 9 and GSA 11, and Norway lobster, *N. norvegicus*, in GSA 9. For all the three stocks, both the MEDITS and GRUND LFDs were standardized.

In the case of blue and red shrimp and Norway lobster in GSA 9, the standardized LFDs were considered also for stock assessment purposed under WP4.
More details on the methodological approach and the results are available on the Deliverable D2.2 (see Annex IX).

Here we present a brief summary of the results of the analyses performed on blue and red shrimp in GSA 9 (MEDITS and GRUND); the analyses were conducted considering the depth range 500-800 m; in general, three modes were detected in the original LFDs from the MEDITS survey, though in some cases the second and the third modes were overlapping (e.g. 1995, 1997), while in other cases, only one mode was detectable (e.g. 2011).

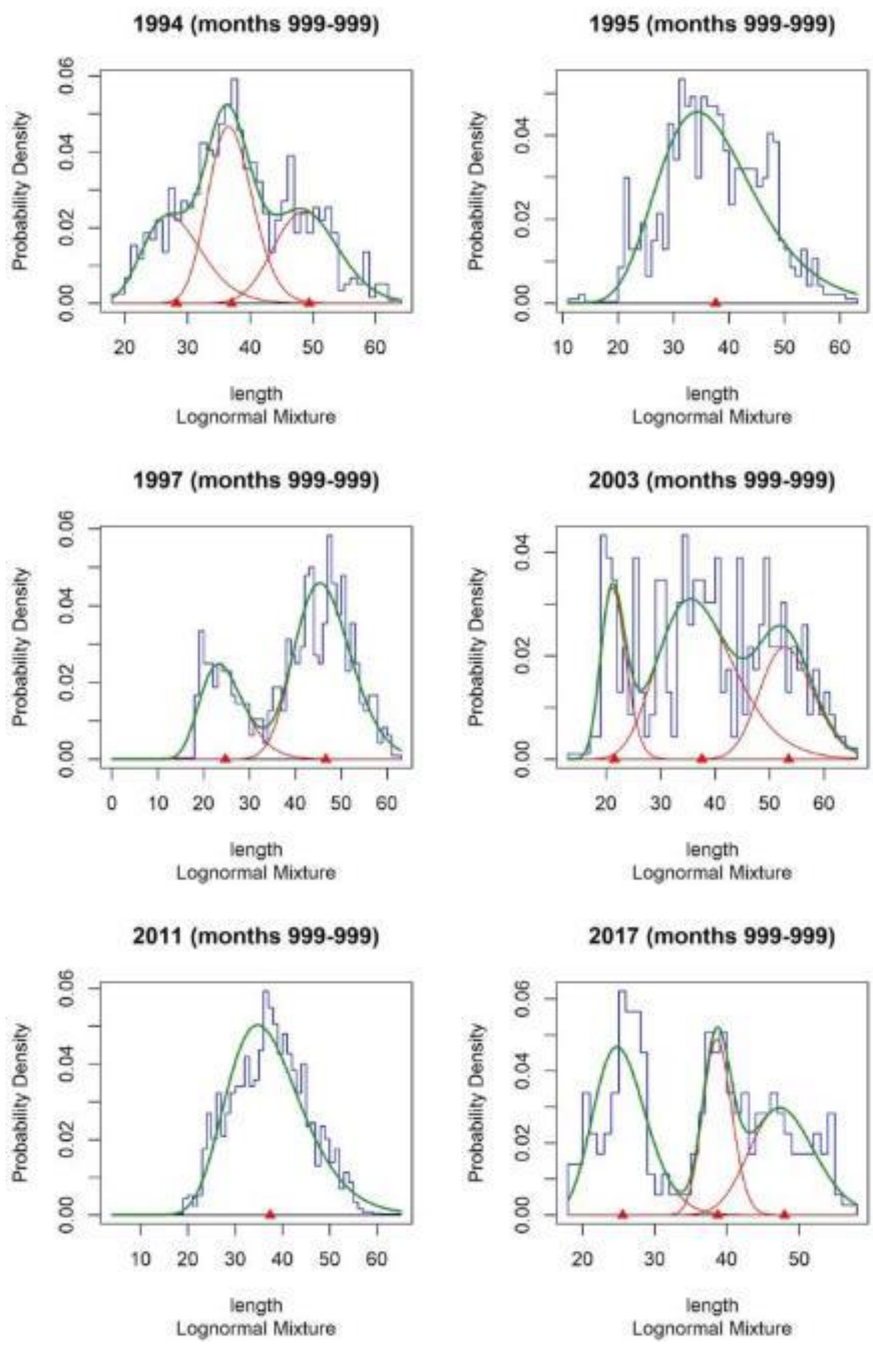

Figure 2.3.24. Original LFDs decomposition of blue and red shrimp from MEDITS in GSA 9. Only some years of the whole time series (1994-2017) are shown.

The subset of the first modes detected (defined in the data frame as Mode 1) was used to test the significance of the explanatory variables year, month and SST. The results showed that the three variables separately were significant on the value of the first mode, but combining them in a unique model produced no significance of all of them. The same result was obtained on the modes 2 and 3. This could be due to the link among the three variables. For this reason, it was preferred to model the modes using the Month and to predict the values of the three modes on the reference month 6 (June). Only for Mode 3, the model seemed to underestimate the mean length and it was preferred to use an average on the third mode observed in the month of June.
The standardized frequency was, then, obtained as the sum of three log-normal distributions (Table 2.3.5).

Table 2.3.5. Characteristics of the 3 log-normal distributions representing the standardized LFDs of blue and red shrimp in GSA 9 (MEDITS data).

Mode	mu	sd	pi
1	26.9	5.23	0.3
2	36.8	4.6	0.44
3	49.5	4.1	0.26

The standardized LFDs standardized resulted quite different in the years when the survey was not carried out in June (e.g. 1997, 2005, 2007, etc.). However, also in some year when the survey was carried out in June, some differences are also present, suggesting that the shape of the LFD modelled using the year among the explanatory variables should better represent the change in the sampled population, besides the month. This will be possibly explored in the future, when more years of data will be available to allow this kind of analysis.

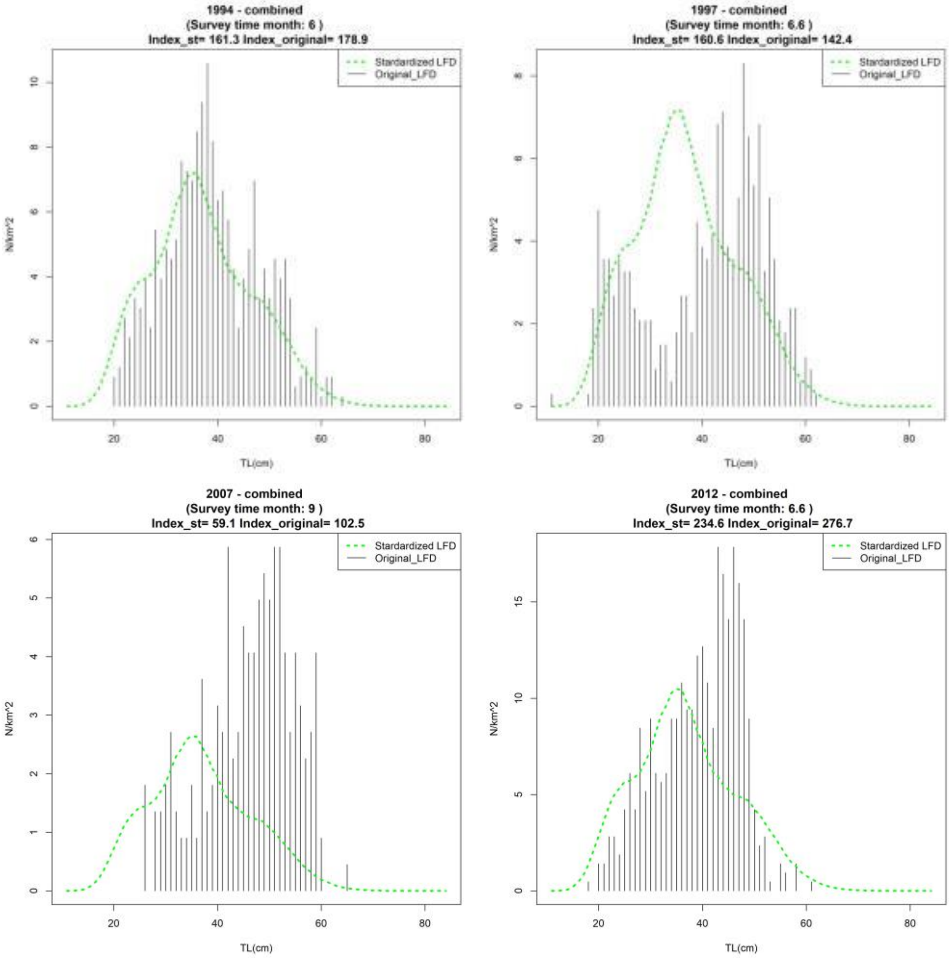

Figure 2.3.25. Comparison between the original and the standardized LFDs of blue and red shrimp from the MEDITS in GSA 9. Only some years are shown as example.

The LFDs of *A. antennatus* from the GRUND survey were available starting from 1994, as it was not possible to adequately adapt data from 1985 to 1993 to the TC format. In general, the GRUND LFDs were characterized by 2-3 modes (Figure 2.3.26).

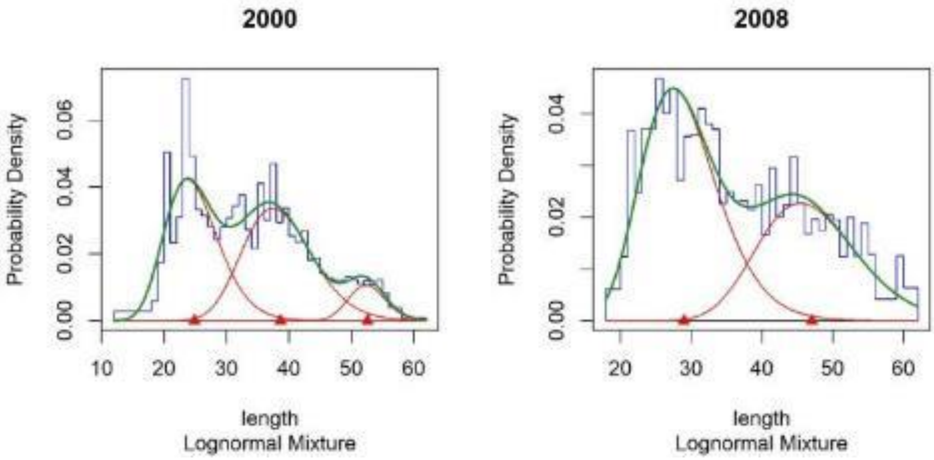

Figure 2.3.26. Original LFDs decomposition of blue and red shrimp from GRUND in GSA 9. Only some years of the whole time series available (1994-2008) are shown.

The subset of the first modes detected (defined in the data frame as Mode 1) was used to test the significance of the explanatory variables year and month. The results showed that the two variables separately were significant on the value of the first mode, but combining them in a unique model produced no significance of all of them. The same result was obtained on the mode 2. This could be due to the link between the two variables. For this reason, it was preferred to model the modes using the Month and to predict the values of the three modes on the reference month 10 (October). The standardized frequency was, then, obtained as the sum of two log-normal distributions (6).

Table 1 Characteristics of the 2 log-normal distributions representing the standardized LFD (GRUND *A. antennatus* GSA 9)

Mode	mu	sd	pi
1	29.96	6.04	0.57
2	47.63	5.48	0.40

The reference month used for the standardization was October. The standardized LFDs resulted quite different in the years when the survey was not carried out in reference month.

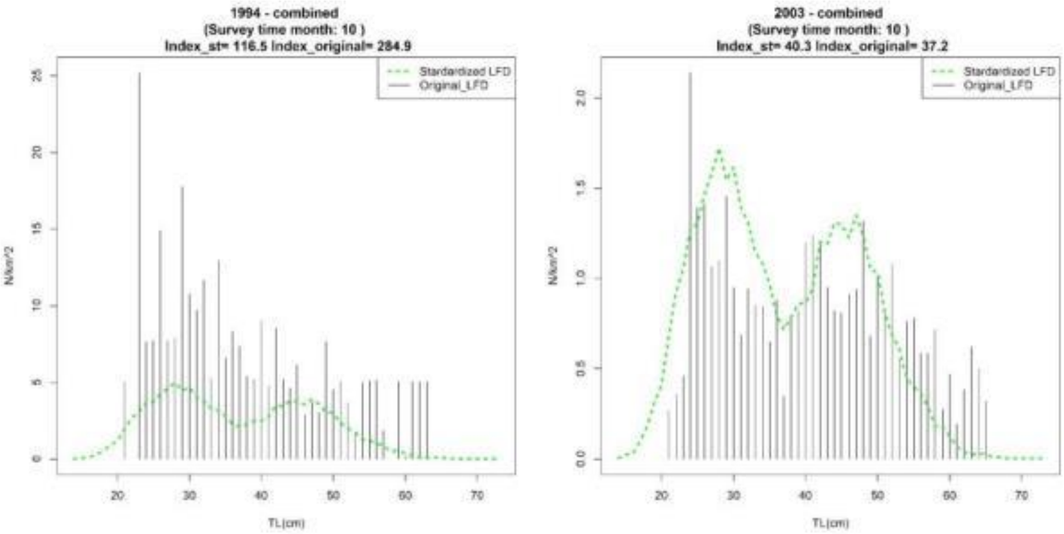

Figure 2.3.27. Comparison between the original and the standardized LFDs of blue and red shrimp from the GRUND in GSA 9. Only some years are shown as example.

The work done under Task 2.2 of the RECFISH project, and presented in this document (Deliverable D2.2), allowed developing and implementing a systematic and harmonized methodology to standardize the scientific survey biomass and density indices and length-frequency distributions (LFDs), and apply the defined methodology to a wide set of stocks in the Mediterranean Sea and Black Sea.

The obtained results are related to the standardization of the biomass and density indices of 43 stocks in the Mediterranean and Black Sea. For a set of stocks more than one survey was considered (Medits and Grund) and both indices were standardized, for a total of 55 standardizations.

As required by the Contracting Autority during the RECFISH final meeting in Brussels, the use of the variable “year”, alternatively as a factor and as a spline, was further inspected, with the aim to highlight the role of this variable into these two main forms within the GAM models. In particular, the standardization of the stocks in GSAs 20, 22 and 23 were revised increasing the number of knots of the splines of the year, to accommodate the variability of the indices, to maintain as much as possible the contrast in the time series and to allow the time series to be more informative for stock assessment purposes (estimating missing years). This aspect was also revised in the standardization of the survey indices of several stocks in GSAs 1, 5, 9 and 7. For example, the factor year was used in the case of striped red mullet in GSA 05, and the standardized series was included as tuning information into the assessment model (SPiCT; see Deliverable D4.2). The use of the factor year was also tested in the standardization of the MEDITS biomass index of anchovy in GSA 09, not providing any improvement in both the standardization and the stock assessment model.

In the light of the results and experience gained under Task 2.2 (and WP4) on the use of the variable year as a smoother or a factor, we recommend further investigation to be performed on a case-by-case basis.

Furthermore, the use of the dummy variable sampling intensity (number of hauls) was investigated in some of the case studies in terms of improvement of the standardization perfomances. To this aim, the standardization of GSA 16 stocks was further revised in order to test the effects of using this dummy variable.

The methodology for LFD standardization was applied to 3 stocks (*A. antennatus* in GSA 09 and GSA 11, and *N. norvegicus* in GSA 09); for two of them, two surveys were considered for a total of 5 LFD standardizations. In the applications, it was necessary to make the assumption of the same theoretical decomposition for all the years, due to the impossibility to model different characteristics of the distributions by year with the available number of years. In all the applications, the effect of the year on the mean, standard deviations and proportion was found not significant, forcing to assume the same LFD shape along the years.

The standardization of LFDs is an important and thorny topic, strongly impacting on stock assessment process. For this reason, the defined methodology should be applied to a wider range of case studies. Indeed, a more extended application could surely contribute to a generalization and an improvement of the methodology itself, highlighting possible differences among the species, according to their growth and their type of recruitment.

More complex approaches, combining a dynamical length-based component population modelling of fish and a statistical modelling of catch observation component (e.g. Berg and Kristensen, 2018), could be in future explored, taking eventually advantage of a longer time series and in the hypothesis of longer time period to work on this task.

19. 2.4 Work Package 3: Database construction

Responsible Stefanos Kavadas, HCMR; Co-chair Maria Teresa Facchini, COISPA Partners involved: CIBM, CNR, COISPA, HCMR, IO-BAS, NIMRD, NISEA, OGS
Core team: Tomaso Fortibuoni, Michela Martinelli, Gheorghe Radu, Evelina Sabatella, Mario Sbrana, Maria Yankova, Walter Zupa
Duration 16 months: from February 2018 to May 2019.

The aim of the WP3 (database construction) was to construct a database for the Mediterranean and Black Sea ensuring full compatibility with the Data Collection Framework (DCF) data calls. The database was built in postgreSQL, a non-proprietary Relational Database Management System (RDBMS). The codification system of species, gear, area, quarter, etc. as specified in DCF Appendix 2 of Annex 2 was fully adopted. The temporal and geographical resolution was the finest possible. Geographical encoding reflected the originally reported statistics but an aggregation key at GFCM/GSA level is also made available. Each data source used in the database was identified in all records and metadata description was built for each data set. The following data sets are the main components of the RECFISH database:

i) landings-discards
ii) landings-discards at length/age
iii) fishing capacity and activity time series
iv) Geo-referenced data base of trawl surveys
v) commercial CPUE
vi) landings validated

It is worth pointing out that it is the first time that historical information from experimental fishing, fisheries statistics and landings is collected and recorded in a database over the Mediterranean and Black Sea. In the RECFISH database, 33 tables were constructed: 13 are the main tables and 20 are lookup tables that provide the essential function to maintain data integrity in the database environment. The main and lookup tables are presented in the Figure 2.4.1, where the database structure and the description of each filed is given (the name of each lookup table starts with p_).

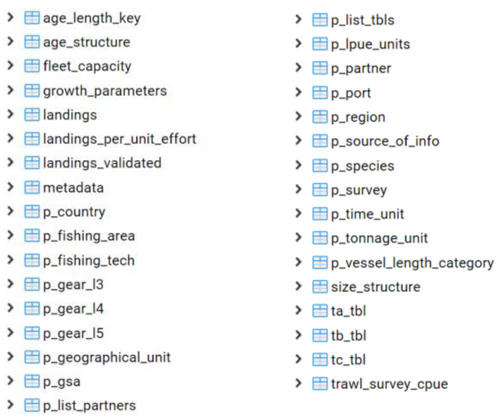

Fig. 2.4.1. The main and lookup tables in the RECFISH database.

To import the database in a new machine, the following steps are required:

step 1: install the postgreSQL (11.2 or later version downloaded *https://www.postgresql.org/download/).* The pgAdmin management tool for PostgreSQL is optional.

step 2: create a database and a schema

step 3: from the command line run the following statement to restore the RECFISH database in the new machine (5432 is the default port):

pg_restore -h localhost -p 5432 -U postgres -d RECFISHdb.dmp -v

If pgAdmin is installed, the above procedure can be done using the restore tool

A similar view as below is expected if everything was executed successfully

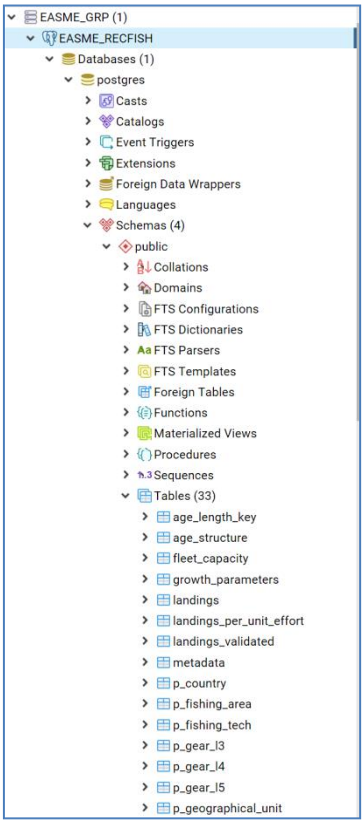

Fig. 2.4.2. View of the structure of the RECFISH database.

To make a database back-up, the following code can be used (or similar coding):

pg_dump.exe -U postgres -d postgres -n public > RECFISHdb_1.dmp

If pgAdmin is installed, then the backup tool can be used

Further details on the structure of the RECFISH database are provided in Deliverable D3.1 “Database and user manual”, along with the instructions to download and manage the database. (see Annex VII).
The RECFISH database can be downloaded using the following link:
https://cloudfs.hcmr.gr/index.php/s/1C3fqVKaFuLLAhb/authenticate
The name of the file is PostgreSQL_RECFISHdb.zip, and is stored in the folder WP3/D3.2.

20. 2.5 Work Package 4: Stock assessment using historical data

Responsible Silvia Angelini, CNR; Co-chair Georgi Daskalov, IBER-BAS
Partners involved: CIBM, CNR, COISPA, CONISMA, CSIC-ICM, DFMR, HCMR, IBER-BAS, IEO, IO-BAS, IOF, NIMRD, NISEA, OGS
Key persons: Giuseppe Scarcella, George Tserpes
Core team: Vanja Cikes Kec, Simone Libralato, Francesc Maynou, Marina Panayotova, Bernardo Patti, Paola Pesci, Toni Quetglas, Violin Raykov, Gheorghe Sarbu, Evelina Sabatella, Mario Sbrana, Maria Teresa Spedicato, Ioannis Thasitis,
Duration 10 months: from August 2018 to May 2019.

The work of WP4 was based on the outputs of the previous WPs, especially WP1 and WP2. The team working on WP4 started checking the data collected under WP1 in order to refine the list of possible candidate stocks for assessment that was drafted and attached to the Inception Report (Deliverable D0.1).

The list was updated according to the data collected under WP1 and the analyses performed under Task 2.1 and Task 2.2. The new list of candidate stocks for stock assessment is summarized in Table 2.5.1. In most of the cases, it was not possible to perform stock assessment combining 2 or more GSAs due to the lack of suitable data. For example, in the case of some age-based assessments, such as Norway lobster and blue and red shrimp, old LFD data (prior to DCR/DCF) were available only for GSA 9 (or parts of GSA 9, in the case of blue and red shrimp). Therefore, it was considered as a too strong assumption performing an assessment combining GSAs 9, 10 and 11, as it was proposed in the initial plan of case studies for stock assessment.
For each stock, the experts in charge of performing the stock assessment is reported, as well as the assessment method used.

Table 2 List of stocks considered for stock assessment under WP4.

No.	Species	3-alpha code	GSAs	Method	Stock coordinator

1	Deep-water rose shrimp, *Parapenaeus longirostris*	DPS	1,3,4	SPiCT	Ligas
2	Striped red mullet, *Mullus surmuletus*	MUR	5	SPiCT	Quetglas
3	Red mullet, *Mullus barbatus*	MUT	6	SPiCT	Esteban
4	Poor cod, *Trisopterus capelanus*	POD	7	SPiCT	Ligas, Maynou
5	Blue and red shrimp, *Aristeus antennatus*	ARA	9	a4a	Musumeci, Ligas
6	Norway lobster, *Nephrops norvegicus*	NEP	9	a4a	Musumeci, Ligas
7	Horned octopus, *Eledone cirrhosa*	EOI	9	SPiCT	Ligas
8	European anchovy, *Engraulis encrasicolus*	ANE	9	SPiCT	Ligas
9	Musky octopus, *Eledone moschata*	EDT	16	SPiCT	Milisenda
10	Sardine, *Sardina pilchardus*	PIL	16	SPiCT	Patti
11	Anglerfish, *Lophius* spp.	MNZ	17	SPiCT	Angelini, Panzeri
12	Horse mackerel, *Trachurus* spp.	JAX	17	SPiCT	Panzeri, Angelini
13	Horned octopus, *Eledone cirrhosa*	EOI	10	SPiCT	Bitetto
14	Blue and red shrimp, *Aristeus antennatus*	ARA	18-19	SPiCT	Bitetto
15	Picarel, *Spicara smaris*	SPC	20	SPiCT	Tserpes, Sgardeli
16	Common Pandora, *Pagellus erythrinus*	PAC	22	SPiCT	Tserpes, Sgardeli
17	Picarel, *Spicara smaris*	SPC	22-23	SPiCT	Tserpes, Sgardeli
18	Striped red mullet, *Mullus surmuletus*	MUR	25	a4a / SPiCT	Ligas, Musumeci, Thasitis
19	Sprat, *Sprattus sprattus*	SPR	29	a4a	Daskalov
20	Whiting, *Merlangius merlangus*	WHG	29	a4a	Daskalov

The stock assessment analyses were performed offline in the view of presenting and discussing the results and preliminary analyses during the working group expected under WP4.

The working group on stock assessment was chaired by the WP4 leaders and the Project Coordinator, and took place on the 25-27 February 2019 at the CoNISMa HQ in Rome. The working group was aimed at presenting and discussing the stock assessments performed using the historical data collected and stored in the database, and was organized back to back to the 3rd Project Plenary Meeting.

The working group was attended by 16 experts (including the WP4 leaders and the Project Coordinator, Table 2.5.2), and represented a sort of benchmark where the assessments were discussed and refined on the basis of agreed input data and methods. The assessments were then finalized in the two weeks after the working group.

Table 3 List of participants to the WP4 working group. G. Tserpes, F. Maynou, A. Quetglas, and G. Milisenda could not attend the working group, and provided their support and contribution offline.

Expert name	**Affiliation**
Alessandro Ligas	CIBM, project coordinator
Claudia Musumeci	CIBM
Antonio Esteban	IEO
Isabella Bitetto	COISPA

Silvia Angelini	CNR, WP4 Chair
Bernardo Patti	CNR
Georgi Daskalov	IBER-BAS, WP4 co-Chair
Simone Libralato	OGS
Diego Panzeri	OGS
Cristina Follesa	CoNISMa
Paola Pesci	CoNISMa
Stefanos Kavadas	HCMR
Vassiliki Sgardeli	HCMR
Gheorghe Sarbu	NIMRD
Ioannis Thasitis	DFMR
Monica Gambino	NISEA

The outputs of the working group on stock assessment are reported in the Deliverable 4.1 (Draft Report of the stock assessment working group). A final report of the working group taking into account the suggestions and comments arising from the Project Final Meeting with the Contracting Authority will be completed by month 17 (May 2019). This final report represents the Deliverable D4.2 that will be attached to the Project Final Report (D0.4 to be submitted by June 2019).

Here we report a brief summary of the main outcomes of the stock assessments performed under WP4. The results of the stock assessments are presented in the Figures 2.5.1-2.5.20.

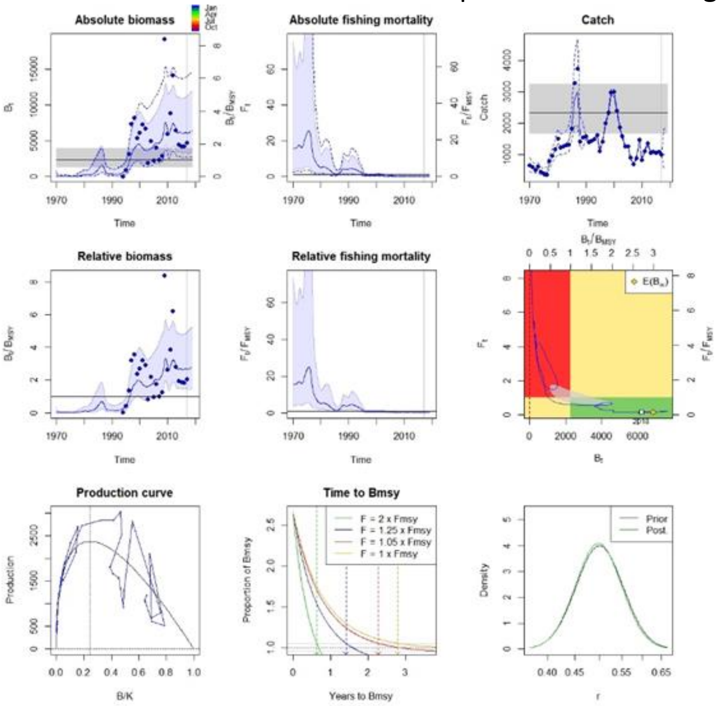

Figure 2.1.1. DPS in GSAs 1, 3, 4 - Plot of the main results of the SPiCT assessment.

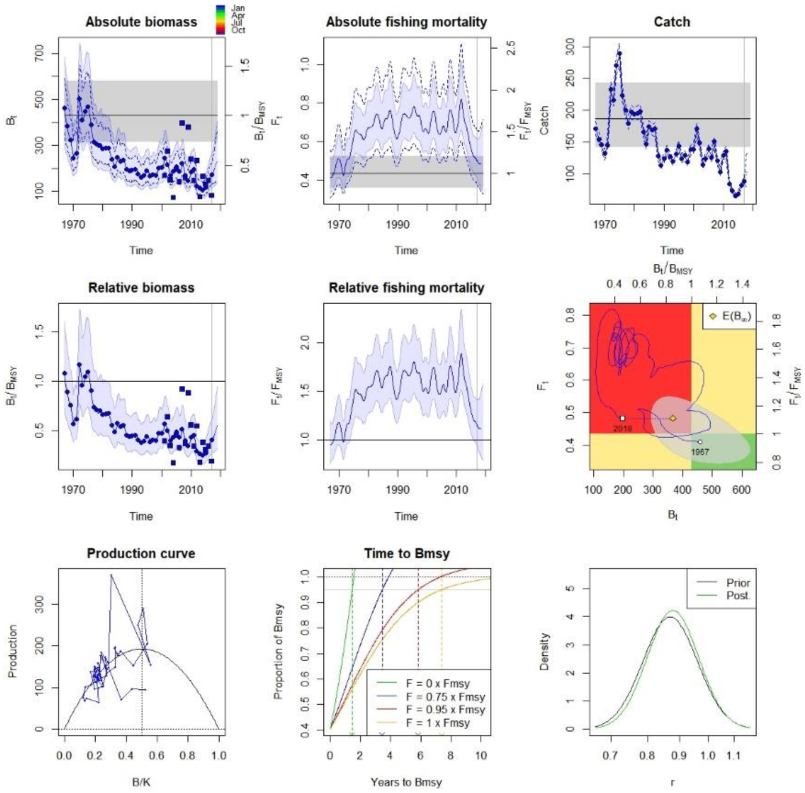

Figure 2.5.2. MUR in GSA 5 - Plot of the main results of the SPiCT assessment.

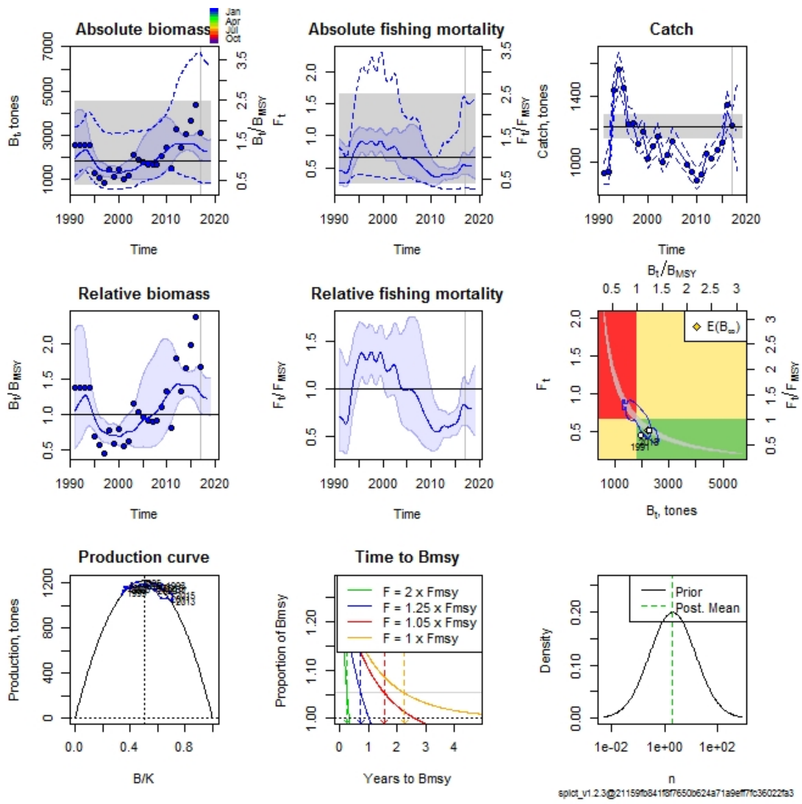

Figure 2.5.3. MUT in GSA 6 - Plot of the main results of the SPiCT assessment.

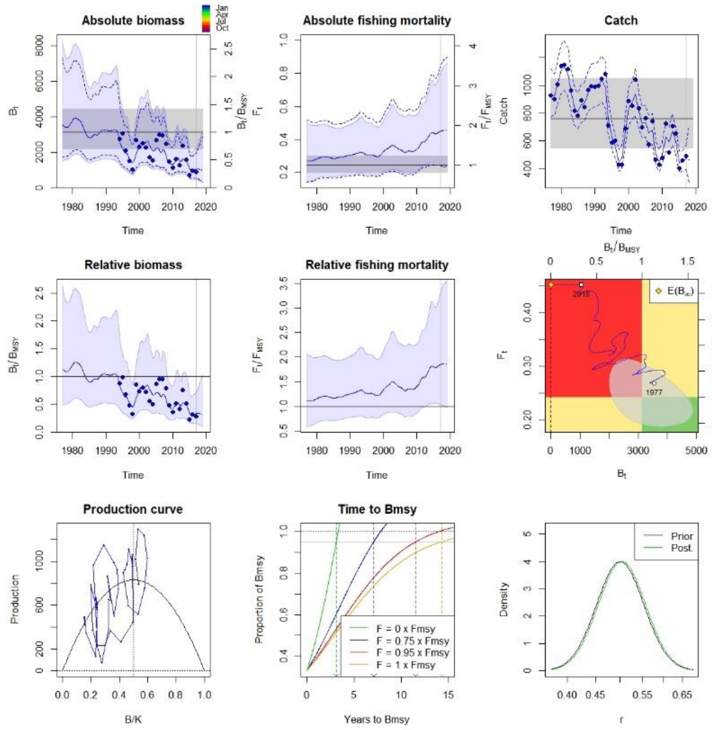

Figure 24. POD in GSA 7 - Plot of the main results of the SPiCT assessment.

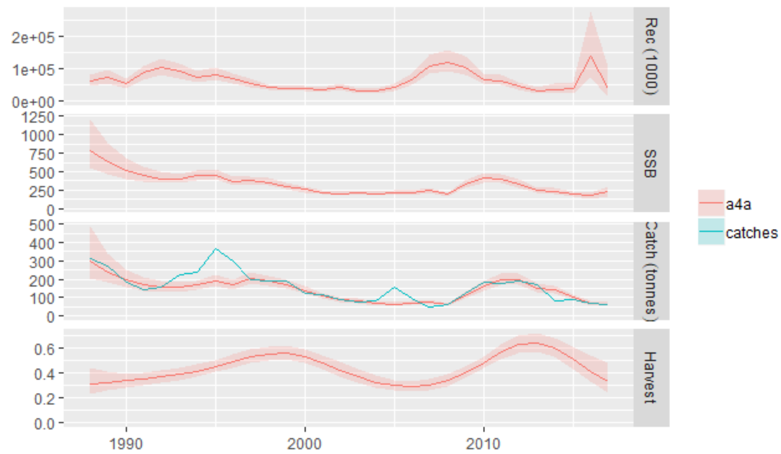

Figure 2.5.5. ARA in GSA 9 – Plot of the main results of the a4a assessment. The catch time series is added in the catch plot (blue line).

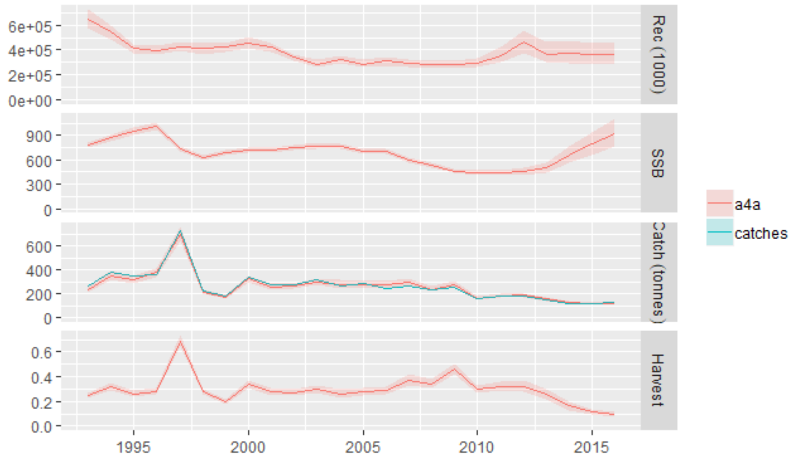

Figure 2.5.6. NEP in GSA 9 – Plot of the main results of the a4a assessment. The catch time series is added in the Catch plot (blue line).

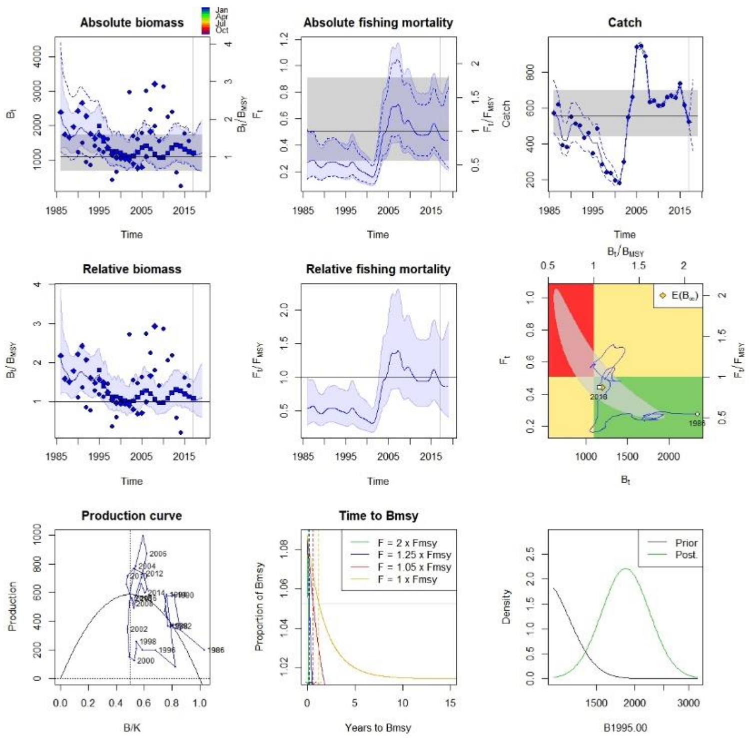

Figure 2.5.7. EOI in GSA 9 - Plot of the main results of the SPiCT assessment.

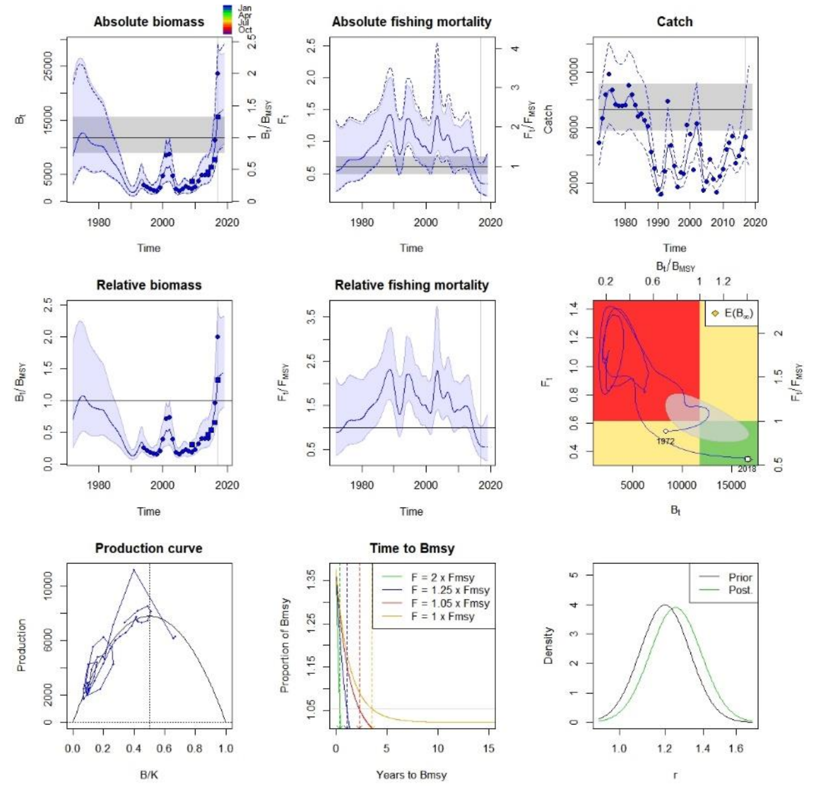

Figure 2.5.8. ANE in GSA 9 - Plot of the main results of the SPiCT assessment.

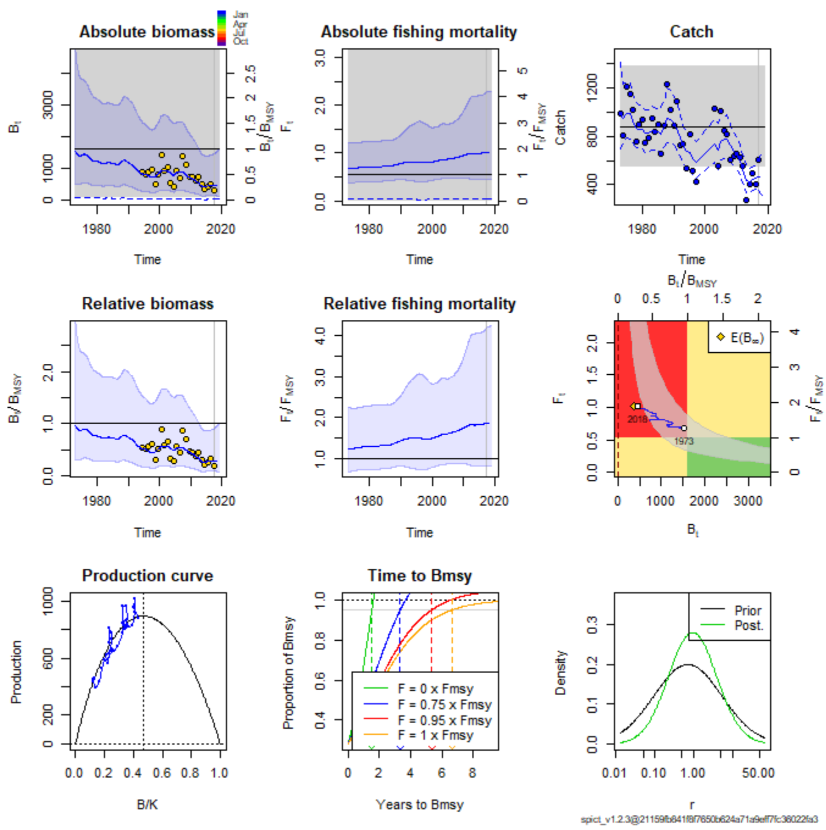

Figure 2.5.9. EDT in GSA 16 - Plot of the main results of the SPiCT assessment.

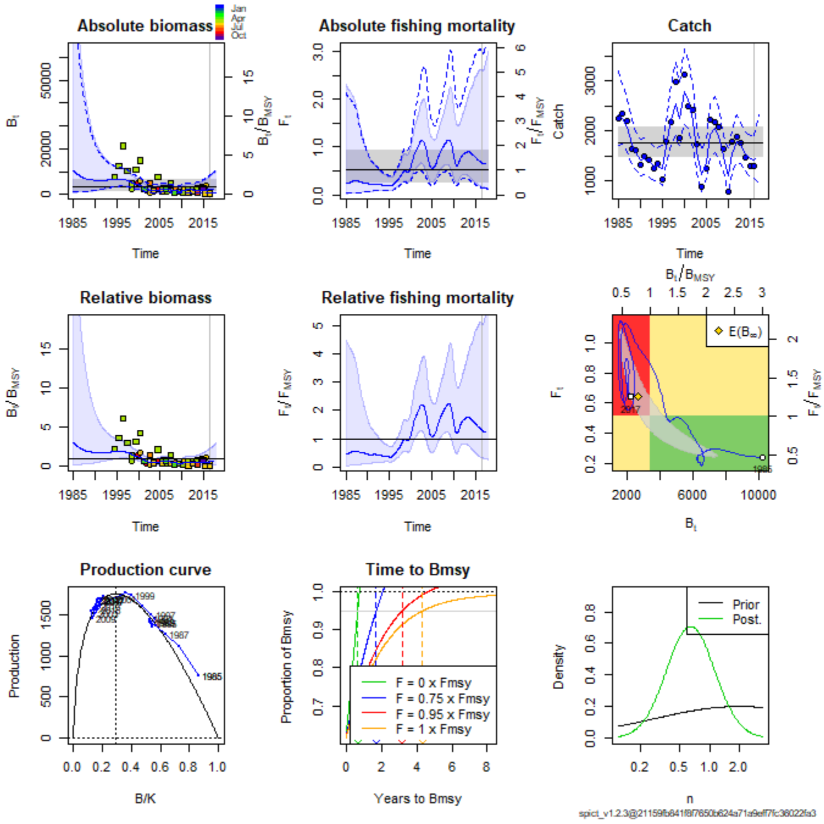

Figure 2.5.10. PIL in GSA 16 - Plot of the main results of the SPiCT assessment.

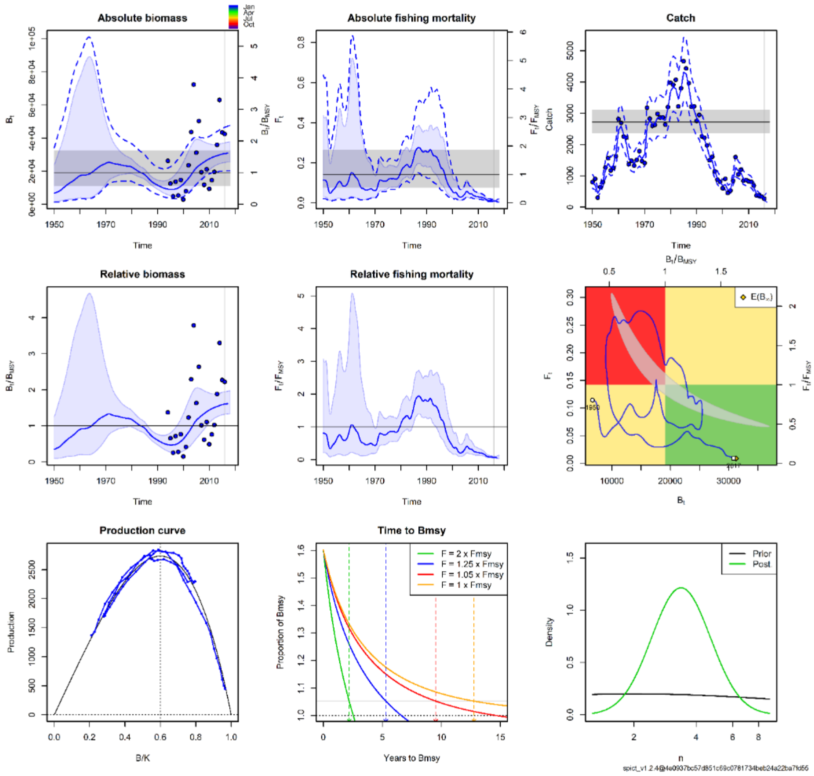

Figure 2.5.11. *Trachurus* spp. in GSA 17 - Plot of the main results of the SPiCT assessment.

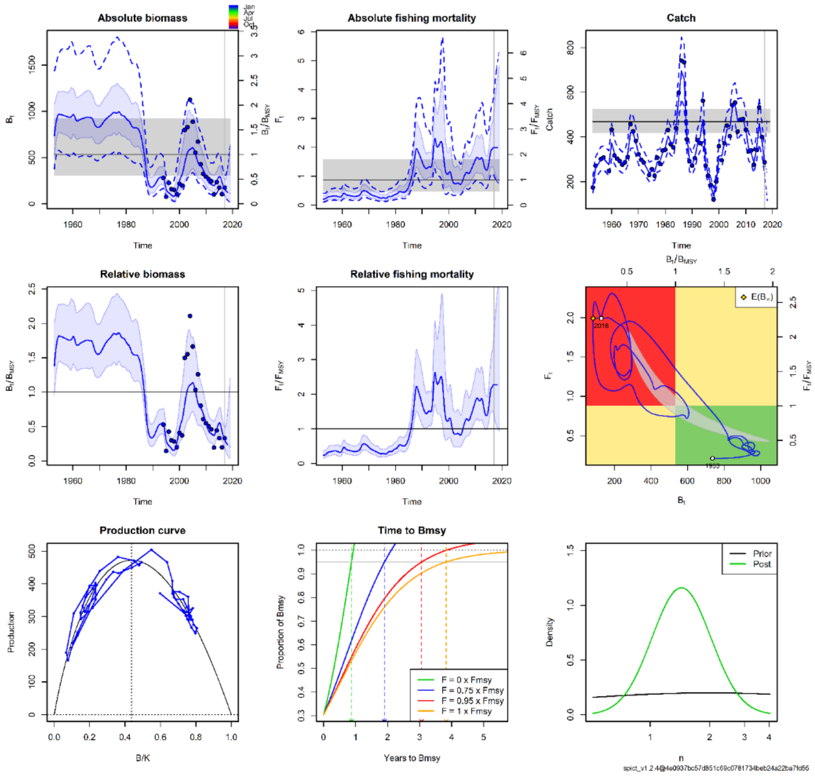

Figure 2.5.12. *Lophius* spp. in Italian GSA 17 - Plot of the main results of the SPiCT assessment.

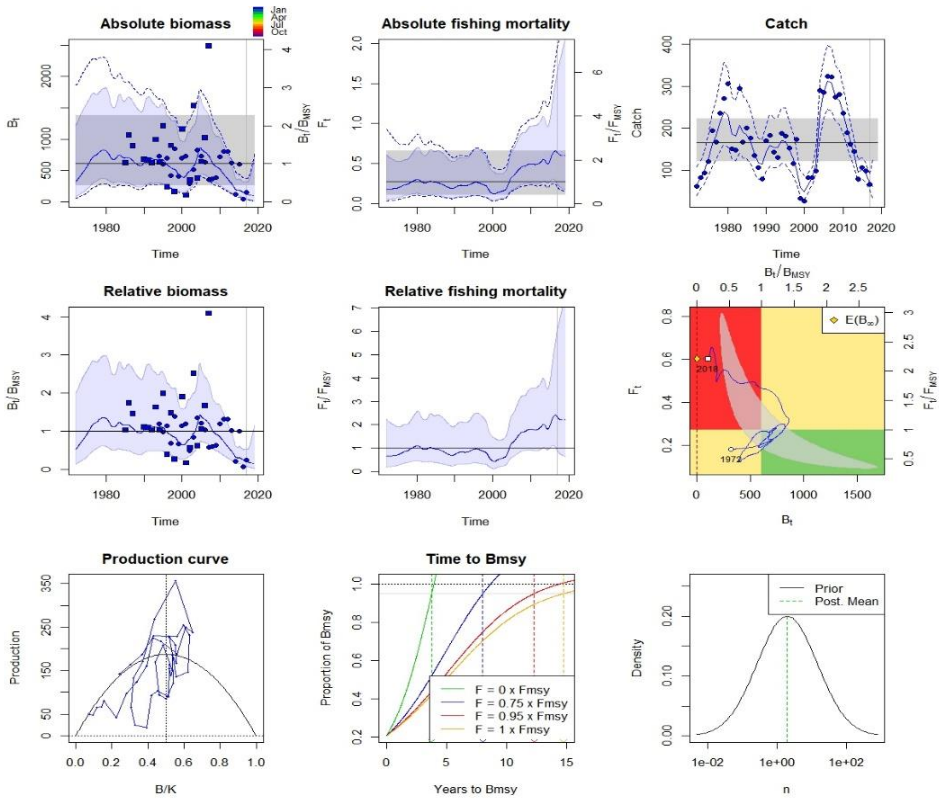

Figure 2.5.13. EOI in GSA 18 - Plot of the main results of the SPiCT assessment.

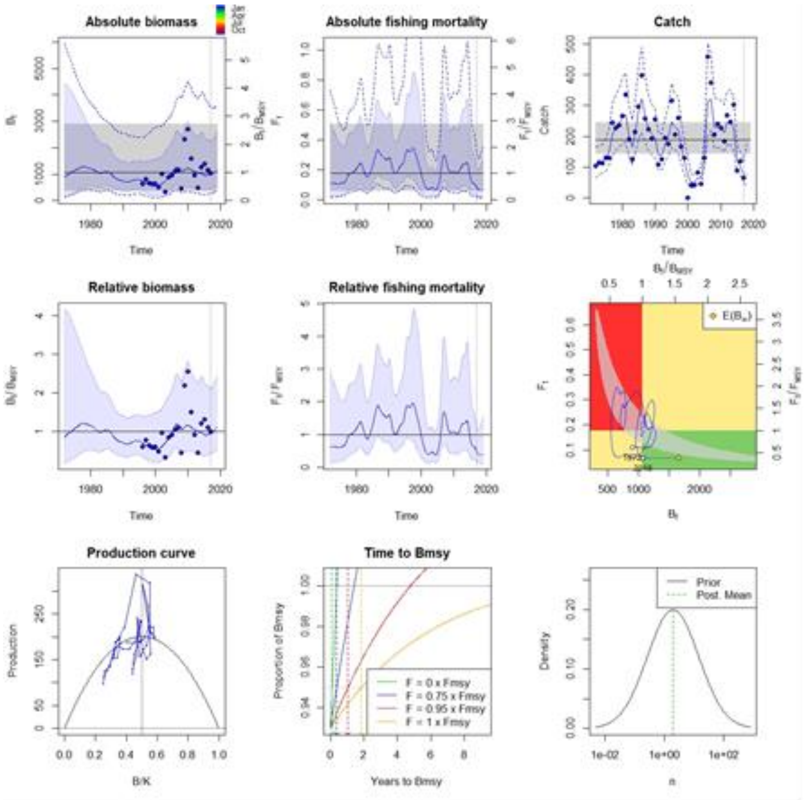

Figure 2.5.14. ARA in GSA 18 - Plot of the main results of the SPiCT assessment.

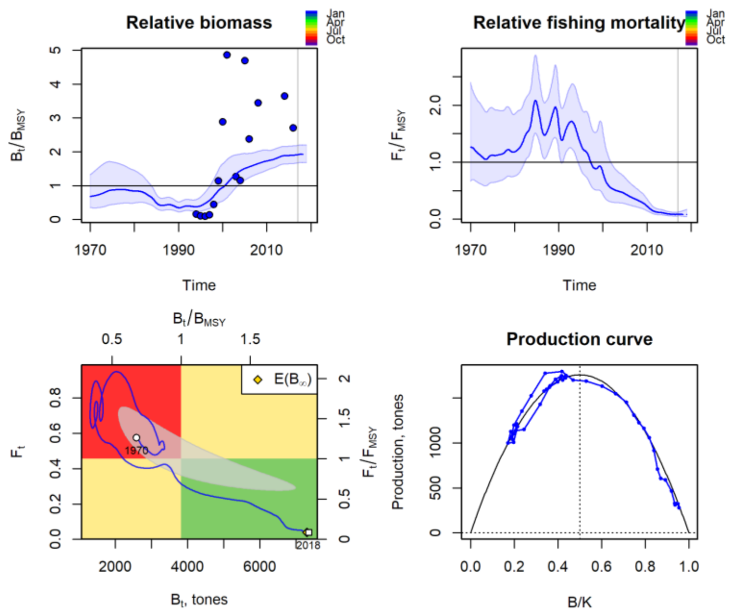

Figure 2.5.15. SPC in GSA 20 – Plot of the main results of the SPiCT assessment.

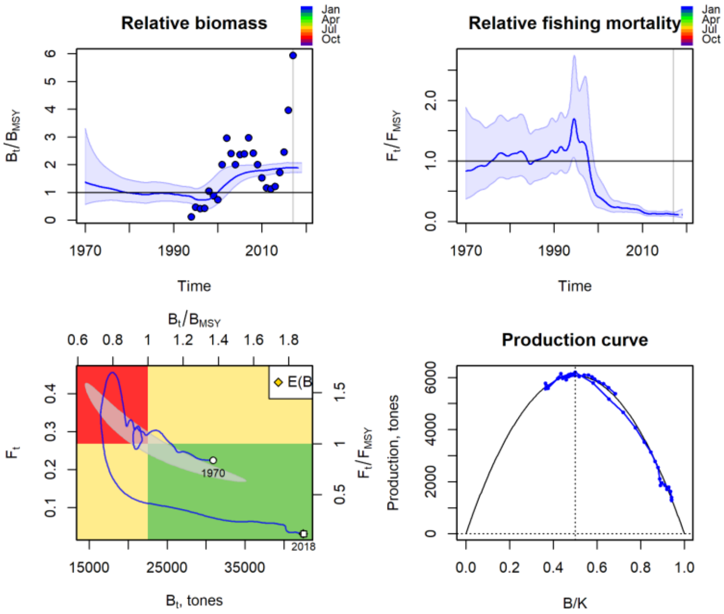

Figure 2.5.16. SPC in GSAs 22-23 – Plot of the main results of the SPiCT assessment.

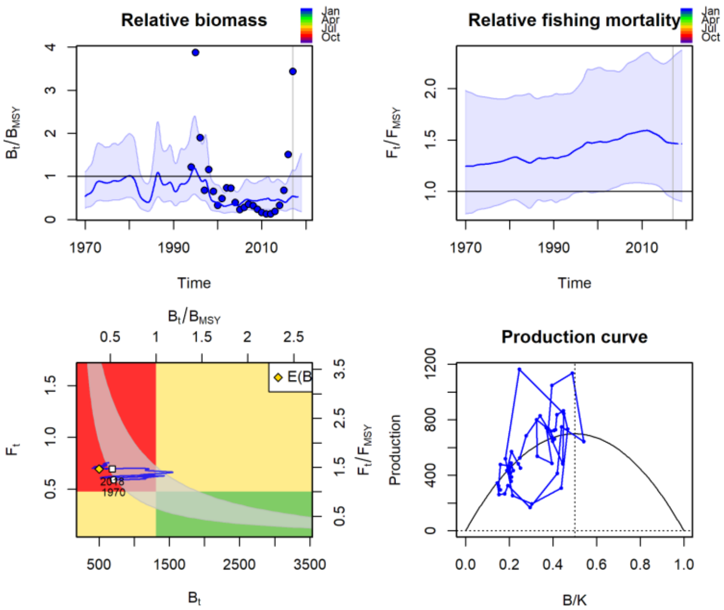

Figure 2.5.17. PAC in GSA 22 – Plot of the main results of the SPiCT assessment.

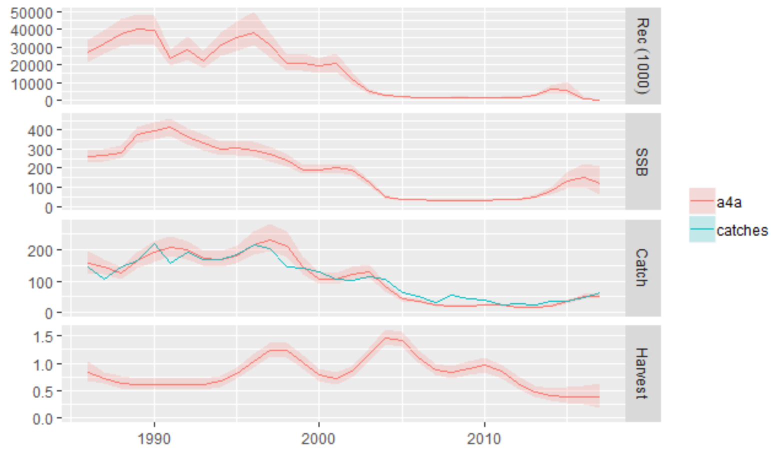

Figure 3a. MUR in GSA 25 – Plot of the main results of the main results of the a4a assessment. The catch time series are added in the Catch plot (blue line).

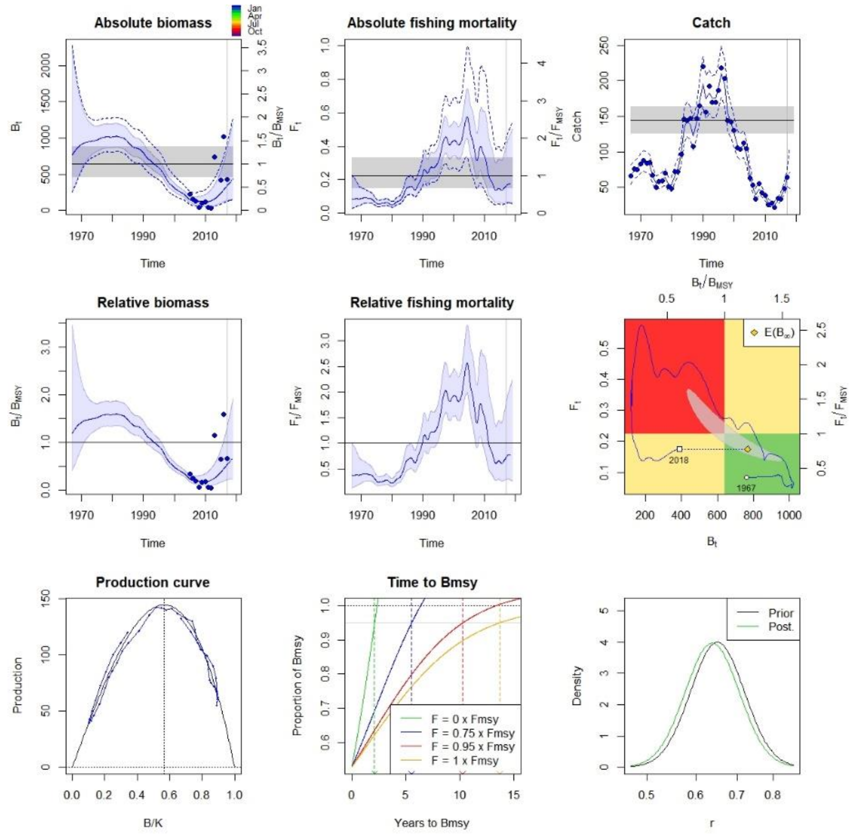

Figure 4b. MUR in GSA 25 – Plot of the main results of the main results of the SPiCT assessment.

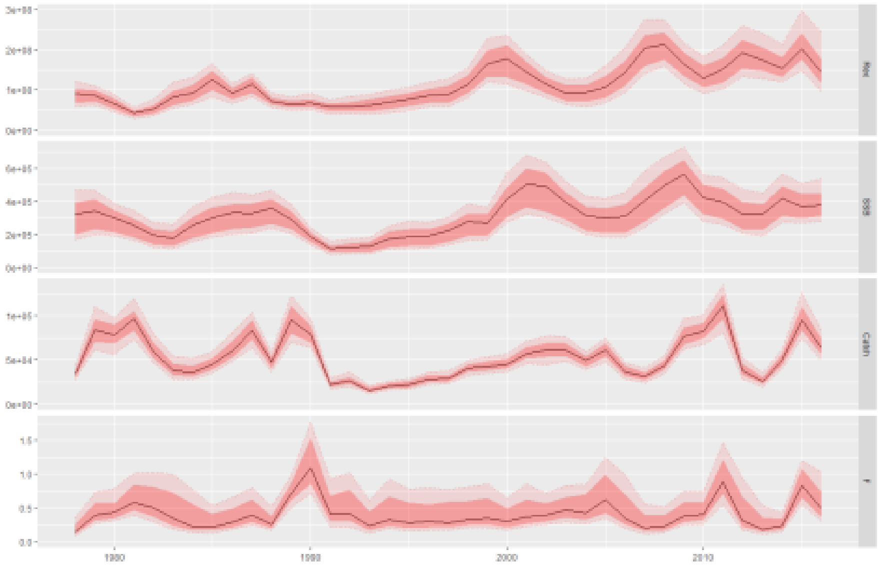

Figure 2.5.19. SPR in GSA 29 - Plot of the main results of the a4a assessment.

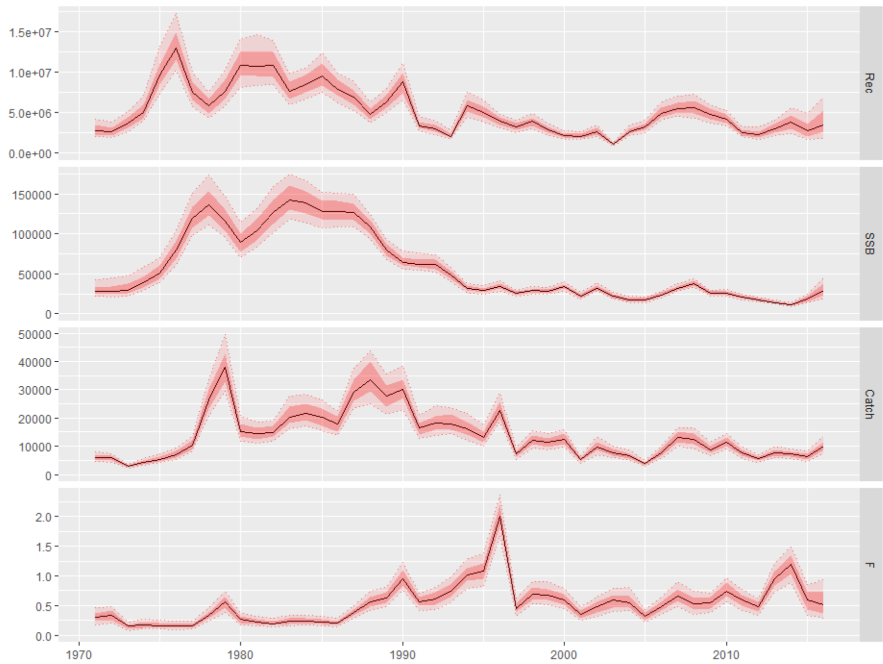

Figure 2.5.20. WHG in GSA 29 - Plot of the main results of the a4a assessment.

The summary of the results of the 20 stock assessments performed under WP4 is presented in Table 2.5.3. Most of the stocks evaluated within this project were assessed for the first time. For the stocks for which an evaluation was already carried out, this project offered the possibility of improving the robustness of the assessment using historical data.
Despite Table 2.5.3 is providing the results of the assessments, this must be intended as a preliminary advice. All the assessment should be further scrutinized and revised by the relevant fora (e.g. STECF and GFCM working groups on stock assessment) before being used to provide scientific advice.
Taking it into due considerations, we are here summarizing the results of the stock assessments performed under the RECFISH project: 8 stocks resulted in over-exploitation,

11 resulted sustainably exploited, and for only one stock (*Mullus surmuletus in GSA 25*) two stock assessments were carried out resulting in contrasting results, even though the general reduction of fishing mortality is confirmed by the two approaches.
In general, stock assessments performed by WP4 using the historical data collected under the RECFISH project provided a more optimistic figure of the status of the stocks in the Mediterranean and Black Sea. This can be a result of the higher contrast in the time series due to the inclusion of old data when catches were usually higher than in the recent years. In any case, the results should be further scrutinized in the relevant working groups to better evaluate and investigate this hypothesis.

Table 4 Summary of the stock assessment results.

GSAs	Species	Time span	Method used	Current values	Reference points	F_{curr}/F_{MSY}	Stock status
01, 03, 04	*Parapenaeus longirostris*	1970 - 2017	SPiCT	F_{curr} = 0.15	F_{MSY} = 0.98	0.15	Sustainably exploited, with high biomass
05	*Mullus surmuletus*	1967 - 2017	SPiCT	F_{curr} = 0.49	F_{MSY} = 0.43	1.15	In overexploitation
06	*Mullus barbatus*	1991 - 2017	SPiCT	F_{curr} = 0.55	F_{MSY} = 0.66	0.83	Sustainably exploited, with high biomass
07	*Trisopterus capelanus*	1977 - 2016	SPiCT	F_{curr} = 0.45	F_{MSY} = 0.24	1.87	In overexploitation
09	*Aristeus antennatus*	1988 - 2017	a4a	F_{curr} = 0.26	F_{MSY} = 0.37	0.70	Sustainably exploited
09	*Nephrops norvegicus*	1994 - 2016	a4a	F_{curr} = 0.10	F_{MSY} = 0.15	0.67	Sustainably exploited
09	*Eledone cirrhosa*	1985 - 2017	SPiCT	F_{curr} = 0.44	F_{MSY} = 0.51	0.87	Sustainably exploited, with high biomass
09	*Engraulis encrasicolus*	1972 - 2017	SPiCT	F_{curr} = 0.36	F_{MSY} = 0.62	0.58	Sustainably exploited, with high biomass
10	*Eledone cirrhosa*	1972 - 2017	SPiCT	F_{curr} = 0.66	F_{MSY} = 0.3	2.2	In overexploitation
16	*Eledone moschata*	1972 - 2017	SPiCT	F_{curr} = 1.03	F_{MSY} = 0.55	1.87	In overexploitation
16	*Sardina pilchardus*	1985 - 2016	SPiCT	F_{curr} = 0.66	F_{MSY} = 0.51	1.29	In overexploitation
17	*Trachurus* spp.	1956 - 2017	SPiCT	F_{curr} = 0.01	F_{MSY} = 0.14	0.06	Sustainably exploited
17	*Lophius* spp.	1953 - 2017	SPiCT	F_{curr} = 2.00	F_{MSY} = 0.88	2.28	In overexploitation
18	*Aristeus antennatus*	1972 - 2017	SPiCT	F_{curr} = 0.07	F_{MSY} = 0.18	0.38	Sustainably exploited
20	*Spicara smaris*	1990 - 2017	SPiCT	F_{curr} = 0.04	F_{MSY} = 0.46	0.08	Sustainably exploited, with high biomass
22 - 23	*Spicara smaris*	1995 - 2017	SPiCT	F_{curr} = 0.03	F_{MSY} = 0.27	0.12	Sustainably exploited, with high biomass

22	*Pagellus erythrinus*	1994 - 2017	SPiCT	F_{curr} = 0.70	F_{MSY} = 0.47	1.50	In overexploitation
25	*Mullus surmuletus*	1986 – 2017 (a4a)	a4a	F_{curr} = 0.37	F_{MSY} = 0.22	1.68	In overexploitation
		1967 – 2017 (SPiCT)	SPiCT	F_{curr} = 0.17	F_{MSY} = 0.22	0.78	Sustainably exploited, with high biomass
29	*Sprattus sprattus*	1978 - 2016	a4a	F_{curr} = 0.48	F_{MSY} = 0.64	0.75	Sustainably exploited
29	*Merlangius merlangus*	1971 - 2016	a4a	F_{curr} = 0.53	F_{MSY} = 0.47	1.13	In overexploitation

End-users and working groups on stock assessment recommended standardizing survey indices, at least when scientific surveys are carried out in breach of standard protocols (e.g. in different times of the year) (GFCM, 2017). Under the framework of the RECFISH project, the use of standardized survey data was investigated and tested, and did not provide significant improvement in the assessment model fitting and diagnostics. In contrast, it was found difficult to run surplus production models using standardized surveys as tuning information. At the same time, statistical catch-at-age assessments resulted in poor fitting and model diagnostics using standardized LFDs for the whole time series of surveys, such as in the a4a assessments of Norway lobster and blue and red shrimp in GSA 9.

Also the use of old surveys, such as the Predvodnik (1963-1971, Adriatic Sea), in the stock assessment models should be better evaluated. Under the RECFISH project, we have tried to include it into the assessment of two stocks in the Adriatic Sea (GSA 17), without achieving acceptable results.

Although further investigation is needed to better understand these aspects, the experience gained under the RECFISH project seems to suggest using standardized survey data (including LFDs) not for the full time series of survey, but just for those specific years when the survey was conducted in breach of standard protocols (e.g. in different times of the year), or to fill the gaps in the case a survey was not conducted in some years.

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22.4. Project execution, milestones and deliverables

The project will be finalized in 18 months, from the 22nd December 2017 to June 2019. The completion of each WP/Task along with the respective milestones and deliverables (Tables 4.1 and 4.2) has been achieved. The Draft Final Report (D0.3) was submitted at month 16 (April 2019) according to the new project schedule (amended after the approval of the 2-months extension). This document represents the Final Report (D0.4).

Table 4.1. List of milestones (*number of milestone with delivery date and responsible person and affiliation*).

Milestone	Milestone name	Date	WP/Task	Responsible	Partner/s	Comments
M0.1	1st Plenary meeting	Jan 18	0	Ligas	CIBM	Completed
M0.2	Data sharing agreement	Feb 18	0	Spedicato	COISPA	Completed
M0.3	Kick-off meeting	Mar 18	0	Ligas	CIBM	Completed
M0.4	2nd Plenary Meeting	July 18	0	Ligas	CIBM	Completed by web conference
M0.5	Progress meeting	Sep 18	0	Ligas	CIBM	Completed
M0.6	3rd Plenary Meeting	Feb 19	0	Ligas	CIBM	Completed
M0.7	Final meeting	May 19	0	Ligas	CIBM	
M1.1	Completion of data collection	Dec 18	1	Sartor/Raykov	CIBM/IO-BAS	Completed
M2.1	Completion of data collection (WP1)	Dec 18	2	Solidoro/Tserpes	OGS/HCMR	Completed
M3.1	Database structure definition	Oct 18	3	Kavadas/Facchini	HCMR/COISPA	Completed
M3.2	Completion of the database	Apr 19	3	Kavadas/Facchini	HCMR/COISPA	Completed
M4.1	Stock assessment working group	Feb 19	4	Angelini/Daskalov	CNR/IBER-BAS	Completed

Table 4.2. List of deliverables *(number of deliverable with delivery date with responsible person and affiliation)*.

Deliverable	Deliverable name	WP/Task	Partner/s	Responsible	Date	Comments
D0.1	Inception Report	0	CIBM	Ligas	Feb 18	Completed
D0.2	Interim Report	0	CIBM	Ligas	Aug 18	Completed
D0.3	Draft Final report	0	CIBM	Ligas	Apr 19	Completed
D0.4	Final Report	0	CIBM	Ligas	Jul 19	Completed
D1.1	Fisheries historical data in the Mediterranean	1.1	CIBM/OGS	Sartor/Fortibuoni	Jan 19	Completed
D1.2	Fisheries historical data in the Black Sea	1.2	NIMRD/IO-BAS	Totoiu/Yankova	Jan 19	Completed
D2.1	Validation of fisheries historical data	2.1	OGS/IBER-BAS	Libralato/Panayotova	Feb 19	Completed
D2.2	Standardization of CPUEs	2.2	COISPA/HCMR	Bitetto/Tserpes	Feb 19	Completed
D3.1	Database and user manual	3	HCMR/COISPA	Kavadas/Facchini	Feb 19	Completed
D3.2	Completed database	3	HCMR/COISPA	Kavadas/Facchini	Apr 19	Completed
D4.1	Draft Report of the stock assessment working group	4	CNR/IBER-BAS	Angelini/Daskalov	Mar 19	Completed
D4.2	Final Report of the stock assessment working group	4	CNR/IBER-BAS	Angelini/Daskalov	Jul 19	Completed

23.5. Final products and project legacy

Final versions of all the deliverables produced during the RECFISH project are available as annexes to this report. Furthermore, they are stored on the project sharepoint (https://cloudfs.hcmr.gr/index.php/s/1C3fqVKaFuLLAhb/authenticate).

The project sharepoint is also hosting the final database, produced in cooperation by WP1 and WP3, and all the scripts and input data used for the analyses performed under Task 2.1, Task 2.2 and WP4. The R scripts and input data used for the analyses performed under Task 2.1, Task 2.2 and WP4 will be also stored into a GitHub repository (https://github.com/aleligas/RECFISH).

The products of the RECFISH project will serve and support future stock assessment activities. The database will be used to gather historical data to be included in stock assessments. The script developed by Task 2.1 will be used to check the quality of historical data. Besides working on the RECFISH database format, it can be easily applied to other databases and formats. The scripts developed by Task 2.2 will represent the methodological basis for the standardization of survey indices and LFDs of stocks which were not investigated by the RECFISH project. The input data and the scripts of the stock assessments performed under WP4 will be further scrutinized and refined under the relevant working groups (i.e. STECF and GFCM) on stock assessment.

24. Annex I. Minutes of the First Plenary Meeting

First Plenary Meeting, 25th-26th January 2018
Pisa, Grand Hotel Bonanno

Welcome and Introductions

The meeting was opened by the coordinator of the project RECFISH, Alessandro Ligas, who welcomed the participants and ask them to introduce themselves and their role in the project. Then, the group adopted the agenda. Paolo Sartor provided the group with some domestic information.

Presentation of the project RECFISH

Maria Teresa Spedicato, scientific coordinator of the Framework, gave a presentation on the objectives of the Framework under the Tender EASME/EMFF/032 and the composition of the consortium. Among the different aspects of the Framework, she pointed out that she contacted the Contracting Authority regarding the possibility of activating horizontal services, as was done under the previous framework MAREA.

The needing of a data sharing agreement taking into account aspects such as data access until the completion of the project, confidentiality and security was remarked, taking into account WP0 commitments of the RECFISH project. A detailed proposal will be circulated by the specific project coordinator.

The objectives and workplan of the project RECFISH and the Work Packages (WP) were presented by the coordinator and the WP leaders.

Discussion – Scientific and technical aspects

During the plenary discussion following the presentations, the group addressed several scientific and technical aspects related to the implementation of the project:

- The group agreed in preparing a list of possible candidate stocks for the validation and standardization of time series, and for the assessments. The group stressed the importance of identifying priorities since the first phases of work, due to the tight schedule for the implementation of the project. To this purpose, Alessandro Ligas presented the table for the identification of candidate stocks to be included as an annex to the Inception Report. The group agreed on the format of the table, that will be circulated among partners in the next days for collecting proposals by the experts of the different areas/stocks, together with the Draft Inception Report and the minutes of this meeting (that will also be an annex to the Inception report). The number of proposed stocks should exceed the one in the contract (20 assessments and 40 standardised CPUEs) to cope with possible problematic issues in the data of some time series.
- A list of the available data will be circulated by Paolo Sartor, WP1 Leader; each partner shall fill the table listing the data they intend to provide, specifying metadata characteristics.
- As regards WP2, it was agreed to focus the attention to the landings time series that will be used for stock assessment under the project RECFISH. Likewise for the CPUEs (40 CPUEs mainly from demersal trawl surveys to be standardized). It was also agreed to flag the landings and time series of other variables for validation purposes.
- It was also agreed to anticipate the start of WP2 at month 3, instead of month 4, in order to allow a longer work in parallel between WPs 1, 2, and 3.
- Technological creeping parameters to be applied to landings and commercial CPUEs will be borrowed from those available in literature.
- As concerns WP3, the group agreed in using an Excel template file (following the format used by the EVOMED project) to store temporarily the data collected under WP1. The final database will be built using the open source software PostgresSQL. The database will be hosted on the HCMR server, and access rights will be guaranteed to WP leaders and other staff according to the different tasks (uploading, downloading, etc.). These aspects will be considered in the Data Sharing Agreement.
- It was agreed that each partner will be responsible of checking the quality of the scientific trawl survey data they will provide by means of using the RoME routine (Bitetto et al., 2017; downloadable from: www.coispa.it).
- The coordinator will circulate among the partners a draft leaflet of the project to present the objectives of the project RECFISH; this leaflet could be used to introduce the project to scientists and institutes of non-EU countries who might be interested in providing historical data. To this end, the coordinator remarked the availability of the FAO Regional Projects to act as facilitators in contacting non-EU scientists and institutes.

Points to be discussed/clarified with the CA:

- Possibility of broadening the assessment methods (e.g. 2-stage biomass models, CMSY, etc.) depending on data availability, including methods already used for assessing some stocks in the case of re-assessment with longer time series of data and the co-occurrence of different gears/fisheries, with different exploitation patterns (e.g. SS3).

- Comments/suggestions on the spatial aggregation to be used in each case study area.
- Priority on the type of data to be stored in the database (validated information only, or all the information collected among the partners, including the one that could not be validated due to time constraints, limitations in data collection methods, etc.

The meeting closed on the 26th January at 13.00.

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25. Annex II. Minutes of the Final Plenary Meeting

Final Plenary meeting, 28th February 2019, CoNISMa HQ, Piazzale Flaminio 9, Rome

Minutes of the meeting, 09.00-13.15

Mr Ligas, Specific Contract 01 (SC01) coordinator, presented the progressing of the activities of the project and the work packages. He presented the progress in the data collection performed under WP1 and the structure of the common template for the temporary storage of the data prepared in cooperation with WP3. This template will represent the basis for the final database that will be produced under WP3.

Mr Panzeri presented the methodologies that were developed under Task 2.1 for the quality check and validation of landings data, and showed the draft of the deliverable D2.1.

Mrs Bitetto presented the methodologies developed under Task 2.2 for the standardization of survey indices and LFDs, and showed the results of the analyses carried out so far, including a list of the species/stocks considered for the analyses under Task 2.2.

Mr Kavadas presented the structure of the RECFISH database, as well as the sharepoint for the temporary storage of all the scripts and input data used by Task 2.1, Task 2.2 and WP4.

Finally, Ms Angelini presented the outcomes of the WP4 workshop on stock assessment. She also provided a draft for the preparation of the workshop report (Deliverable D4.1).

Administrative aspects

Mr Nieto congratulated with the coordinator and all the partners for the progressing of the activities of the specific contract RECFISH, and informed on the approval of the 2-months extension of the project deadline.

Mrs Laggini provided the participants with information on administrative aspects. She informed that the invoices for the 30% interim payment.

The meeting closed at 13.15.

List of participants

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26. Annex III. Minutes of the Kick-off Meeting

Kick-off meeting, 28th March 2018, DG MARE (99 Rue Joseph II, 1049 - Brussels), room J99 03/SDR1 "AQUARIUM", 10.30-13.15

Welcome and Introductions

The meeting was attended by EASME, DG MARE and the coordinator of the project RECFISH.

Presentation of the project RECFISH

Mr Ligas, project coordinator, presented the structure of the project and the work packages. The discussion during the meeting identified some issues that are expected to be better detailed in the revision of the Inception Report. The following points were discussed:

- EASME and DG MARE invited the project coordinator to revise the risk assessment associated to data availability and suitability in the Inception Report. In particular, EASME and DG MARE highlighted a major gap in the preliminary list of available data due to the lack of information from the EU western Mediterranean (Spain). This was considered very unsatisfactory, and may represent a major threat to the successful implementation of the project. EASME and DG MARE invited the project coordinator to take immediate actions to fill this gap.
- EASME and DG MARE acknowledged positively the information regarding the availability of data from Tunisia and Turkey, and highlighted the need of progressing further in the activity of seeking for fisheries historical data from non-EU countries.
- EASME and DG MARE requested more flexibility in terms of data collection. Although acknowledging the completion of WP1 by month 10 of the project (October 2018), they ask for the possibility of populating the database with possible “new” historical data that may be made available to the project after that date. Being the finalization of the database foreseen by February 2019, the coordinator accepted the request.

Furthermore, the following aspects were discussed:

- Concerning the database, EASME and DG MARE will check with their IT technicians for particular needs in terms of database structure and format. The CA will inform the project consortium as soon as possible on this aspect.
- EASME requested the project coordinator to draft a declaration on the pre-existing rights on the historical data that will be used to populate the database. The declaration will be signed by all the partners. The property of the data will remain to the partners.
- Mr Osio (DG MARE) will circulate a list of reports of projects and sampling activities performed in non-EU waters that could represent a possible source of data and information.
- Mr Ligas, will contact the FAO Regional Projects to seek their support in further exploring the existence of fisheries historical data in non-EU Mediterranean countries.

Administrative aspects

The Project Coordinator is expected to submit the minutes of the kick off meeting in a week from the meeting and the revised Inception Report in 10 working days, where all comments by EASME and DG MARE are to be addressed.

All correspondence between the Project Consortium and the Contracting Authority should be addressed to Mr Adolfo Merino Buisac (adolfo.merino-buisac@ec.europa.eu) and Mr Giacomo Chato Osio (giacomo-chato.osio@ec.europa.eu).

The meeting closed at 13.15.

List of participants

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27. Annex IV. Minutes of the Progress Meeting

Progress meeting, 27th September 2018, EASME (COV2, Place Rogier 16 - Brussels), 09.45-13.15

Welcome and Introductions

The meeting was attended by EASME and DG MARE (hereafter the Contracting Authority, CA), and the beneficiaries of the project RECFISH.

Presentation of the progress of the activities of the project RECFISH

Mr Ligas, Specific Contract 01 (SC01) coordinator, presented the progressing of the activities of the project and the work packages. He presented the progress in the data collection performed under WP1 and the structure of the common template for the temporary storage of the data prepared in cooperation with WP3. This template will represent the basis for the final database that will be produced under WP3. Mr Raykov presented the collection of historical data in the Black Sea (Task 1.2). Mr Ligas showed the methodologies that were developed under WP2 (Task 2.1) for the quality check and validation of landings data. Mrs Spedicato presented the methodologies developed under Task 2.2 for the standardization of survey indices and LFDs. Finally, Ms Angelini presented the activities of WP4, that just started.

The following points were also discussed:

- Mrs Spedicato, scientific coordinator of the Framework Contract (FWC), informed the CA that a Data Sharing Agreement (DSA) has been finalized and circulated among the FWC partners (and sub-contractors) for the signature; the DSA is dealing with data access, data use and sharing policy, data confidentiality. The deadline to receive the DSA duly signed is the 30th September 2018. The FWC coordinator will inform the CA on any possible issues with the signature of the DSA.
- Furthermore, she pointed out that no horizontal services have been activated so far under the FWC, contrary to what has been done under the previous framework (MARE2009_05_Lot1, MAREA). This implies that activities involving the partners cannot go beyond the specific projects activated so far with the involved partners and the related administrative aspects. Thus more wide coordination activities regarding all the partners and for example common IT services cannot be undertaken. The CA acknowledged this point, but informed that for the time being no horizontal services are envisaged under this FWC due to budget restrictions.
- The FWC coordinator and the SC01 coordinator pointed out that receiving the comments on the Draft Interim Report before the meeting could have allowed the beneficiaries addressing the possible issues in advance, anyhow the beneficiary will do its best to address the received comments in due time.
- The CA acknowledged positively the information regarding the availability of data from Tunisia and Turkey, and highlighted the need of progressing further in the activity of seeking for fisheries historical data from non-EU countries by means of revising the available literature (both scientific publications and grey literature).
- The CA highlighted that no progress has been achieved in tackling the gap due to the lack of information from the EU western Mediterranean (Spain). This was considered unsatisfactory. Thus the CA invited the project coordinator to make a further attempt to fill this gap, considering the current availability of the DSA.
- Although acknowledging the completion of WP1 by month 10 of the project (October 2018), the CA asked for the possibility of populating the database with possible “new” historical data that may be made available to the project after that date.
- The CA asked for an updated list of possible candidate stocks to be submitted for their consultation and comments.
- Concerning WP4, the CA agreed with the possibility of performing a higher number of stock assessments based on production models than the initial proposal; at the same time, he acknowledged the possibility of performing the assessment of stocks routinely assessed by GFCM and STECF working groups in the case a longer time series of data could provide more robust results.
- The CA asked for the possibility of working on the Black Sea surveys data in order to convert them into the Medits format (TA, TB, TC).
- A new and updated Data Call will be launched to request EU DCR/DCF data up to 2017.
- The CA will circulate a list of reports and publications from non-EU countries that could represent a possible source of data and information. The attendants of the Consortium agreed that this will be a very useful input to increment the database of WP1.
- The attendants also discussed for a need of the specific contract for a 2-months extension, especially considering the need of a new data call and the population of the data base in WP1. According to the CA, in principle, there should be not impediments to grant such prorogation.

Administrative aspects
The draft minutes of the Progress meeting will be submitted in a week from the meeting, while the revised Interim Report in 10 working days, where all comments by CA are to be addressed.

The meeting closed at 13.15.

List of participants

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28. Annex V. Minutes of the Final Meeting

Final meeting, 13th June 2019, EASME (COV2, Place Rogier 16 - Brussels), 10.00-13.15

Welcome and Introductions
The meeting was attended by EASME and DG MARE officers and members of the RECFISH consortium.
Presentation of the project RECFISH
Mr Ligas, project coordinator, presented the structure of the project and the work packages. Mr Libralato and Mr Panzeri presented the activities performed under Task 2.1, while Mrs Bitetto showed the work and analyses carried out under Task 2.2. Mr Kavadas provided a presentation (via Skype) on the structure and features of the RECFISH database. Mr. Osio and Mr Nieto Conde congratulated and acknowledged the excellent work done during the implementation of the RECFISH project. Nonetheless, some aspects were highlighted during the discussion that require a revision in order to improve the quality of the results. The following points were discussed:

- The Final Report (Deliverable D0.4) must contain an Executive Summary in French and Spanish. The main findings and outcomes of the project, as well as some new results and assessments, should be clearly highlighted in both the Executive summary and the main text of the report; a list of acronyms should be also provided;
- As regards WP1, it was remarked the importance of mentioning in the Final Report the major issue due to the lack of Spanish data (except Catalonia);
- As concerns Task 2.1, a paragraph describing and commenting the results of the analyses performed and their usefulness for stock assessment should be added in the Final Report; the report should be enriched with the plots showing additional results for some exemplificative case studies; summary tables aimed at better informing on the consistency and validation of the data included into the database;
- Concerning Task 2.2, it was requested to add in each case study a table showing the outputs of the model selection procedure; furthermore, a better harmonization in terms of the plots and outputs must be achieved. Uncertainty boundaries must be included in the plots showing the comparison between observed and predicted time series;
- Some standardizations must be revised, as the results are showing some unresolved issues. Some of them, not used in any assessment, can be possibly withdrawn, as at the moment 43 stocks were considered for standardization (55 time series in total, compared to the 40 requested by the ToRs);
- The use of the variable "year" as a factor or as a spline and its effect on the stock assessment should be further investigated; some standardization procedures using "years" as a spline provided very smoothed time series may have affected the fitting of the assessment models, especially in the case of SPiCT;
- It was also requested to better explain the use of the sampling intensity (number of hauls) as a "dummy variable in some of the case studies, and to further investigate its use to improve some of the standardization (e.g., in GSA 16);
- As concerns stock assessment (WP4), it was requested to investigate the use of the GRUND survey data in the assessment of EDT in GSA 16; it was requested to include Croatian landing data (from official FAO sources) and "old" surveys data in the two assessment performed in GSA 17 (namely *Lophius* spp. and *Trachurus* spp.); the assessment of *M. surmuletus* in GSA 5 must be re-run using MEDITS survey data as tuning, and it was also requested to better explain the use of the LPUE in the stock assessment of EOI in GSA9.
- It was requested to highlight the assessments that are considered not robust and could be improved in future investigations; at the same time, it is important to explain the decisions in selecting only one GSA for the majority of stock assessment performed.

Administrative aspects
The draft minutes of the Final meeting will be submitted in 5 working days.

The meeting closed at 13.15.

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Stefanos Kavadas (HCMR, WP3 Leader) participated via Skype to present the RECFISH database features.

The following Annexes are embedded as separate files into the Final Report

29. Annex VI. Deliverable D1.1

RECFISH D1.1.docx

30. Annex VII. Deliverable D1.2

RECFISH D1.2.docx

31. Annex VIII. Deliverable D2.1

RECFISH D2.1.docx

32. Annex IX. Deliverable D2.2

RECFISH D2.2.docx

33. Annex X. Deliverable D3.1

RECFISH D3.1.docx

34. Annex XI. Deliverable D4.2

RECFISH D4.2.docx

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