Report of EXPERT CONTRACT STECF n. 2583

The expert was asked to act as a 'rapporteur', to provide scientific reports (summaries, inquiries and background information) in preparation of EWG 25-09.

The objective of this ad hoc contract was to update existing stock assessment input files for the stock/s NEP 11 & MUR 5 in order for it to be ready for the assessment runs with the notable inclusion of 2024 relevant data stemming from the 2025 Med & BS DCF Data call.

For the stock/s NEP 11 & MUR 5 given in this ad hoc, the contractor is requested to update the stock assessment input files by:

- **ToR 1.** To compile and provide the most updated information on stock identification and boundaries, length and age composition, growth, maturity, feeding, essential fish habitats including spawning grounds and seasonality as well as natural mortality.
- **ToR 2.** To compile and provide complete sets of annual data on landings and discards as well as the standardized MEDĪTS Index for the longest time series available up to and including 2024, including length frequency distribution over time. To provide a complete and updated stock assessment input file in the format of those used in 2024.

In this document, a brief report of the work done was prepared, however, in attach stock and index objects will be given for both species together with zip folders containing additional informations on data availability, figures, and quality checks on fishery dependent and independent (MEDITS) data.

Striped red mullet in Balearic Islands – MUR in GSA5

Stock identity and boundaries

Mullus surmuletus Linnaeus, 1758 is a demersal mullid widely distributed from western Norway and the English Channel to Senegal (including the Canary Islands), and throughout the Mediterranean and Black Seas; it inhabits rough, sandy and mixed bottoms mainly on the continental shelf, typically between ~5–100 m depth, though deeper records exist in parts of the eastern Mediterranean.

Diet is benthic and carnivorous, it feeds chiefly on small decapod crustaceans, followed by amphipods, polychaetes, and molluscs (Labropoulou *et al.*, 1997; Pavičić *et al.*, 2018).

Compared to its congener *Mullus barbatus*, a greater level of genetic difference was found in some studies, revealing genetic structure also on a medium spatial scale, where the restriction to gene flow could be a result of both biological features and hydrodynamic conditions of the studied region (Hackradt a).

Considering the above, it is reasonable to conduct the stock assessment exclusively within the Balearic Islands. In fact, GSA 5 (Figure 1) has always been identified as a distinct assessment and management unit in the western Mediterranean due to its specific features (Quetglas et al., 2012). These include: (1) the geomorphological separation of the Balearic Islands (GSA 5) from the Iberian Peninsula (GSA 6) by depths of 800–2000 m, acting as a natural barrier to adult demersal exchange; (2) the absence of riverine inputs and submarine canyons in GSA 5 compared to GSA 6, resulting in different trawling grounds and benthic assemblages; (3) consequent differences in trawl-exploited faunal assemblages and in the relative importance of commercial species; (4) limited interaction between demersal fleets in the two areas, with only isolated cases of vessels targeting red shrimp in GSA 5 but landing in GSA 6; (5) substantially lower trawl fishing effort in GSA 5, where the density of vessels is an order of magnitude lower than in adjacent waters.

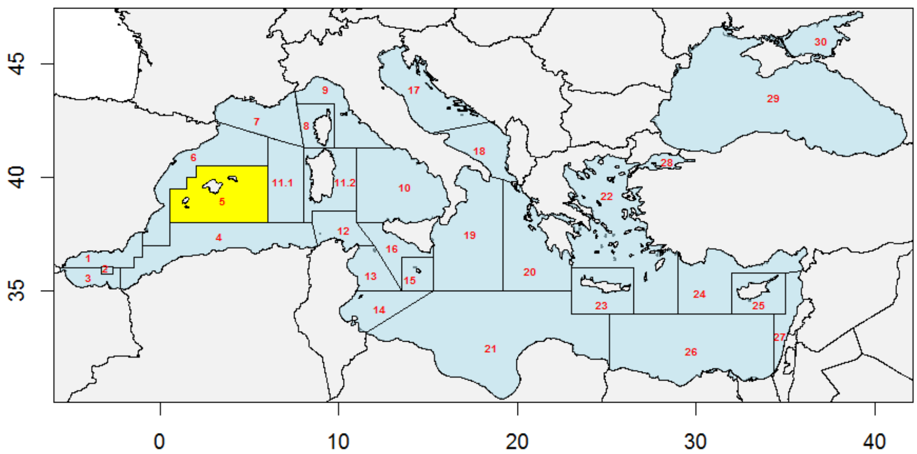

Figure 1. Geographical localization of GSA 5.

Around the Balearic Islands, *M. surmuletus* is a key target of the shelf trawl fishery and part of small-scale net fisheries. Spatially, Balearic shelf concentrations are strongest to the ENE of Mallorca and SE of Menorca, matching the main fishing grounds. Local stock assessments and life-history studies show catches dominated by ages 0–2, a main length mode ~16–20 cm, and recruitment in autumn following a spring spawning season on the continental shelf (GFCM, 2016).

Biological information

For this species, reported spawning generally occurs in late spring–summer in many areas of the Mediterranean range; their larvae and juveniles are pelagic, and recruit to shelf habitats later in the year (Félix-Hackradt *et al.*, 2013). Maximum observed lengths in Mediterranean catches are ~30–35 cm TL, with most fish harvested at 15–22 cm; longevity is often ≤5 years (Mehanna, 2009), and sexes can show slightly different growth trajectories. Length at 50% maturity commonly falls near 13–17 cm of total length (TL), depending on area and sex. These general patterns are consistent across multiple regional studies and species accounts.

Life-history traits and biological parameters estimated in GSA5 are presented in Tables 1 and 2. All the collected information, when available, are presented divided by sex (Female = F, Male = M, or Combined sexes = C), and source. The information on maturity ogive and natural mortality vectors is reported in Tables 3 and 4, respectively. Those data are reported directly by age class and sex combined since they were estimated and developed directly for stock assessment aim.

Table 1: Biological parameters of the Von Bertalanffy Growth curve.

Sex	L_{inf}	K	T_0	Source
F	31.90	0.205	-2.605	Reñones *et al.*, 1995
M	25.54	0.273	-2.450	
C	31.28	0.211	-2.348	
F	34.53	0.1365	-3.8210	Morales-Nin, 1991
M	23.29	0.2882	-3.3250	
C	29.76	0.2376	-2.64	
	40.05	0.164	-1.883	GFCM, 2016*
	33.4	0.43	-0.1	STECF EWG 24-10
	35	0.17	-3.23	DCF-2011
	35	0.19	-2.65	DCF-2012
	35	0.17	-2.84	DCF-2013
	40	0.11	-3.82	DCF-2014
	35	0.182	-2.46	DCF-2015
	32	0.215	-1.76	DCF-2002
	33	0.234	-1.58	DCF-2005
	31.3	0.239	-1.7	DCF-2008
	32	0.169	-3.13	DCF-2016
	35	0.155	-2.29	DCF-2017
	35	0.19	-1.5	DCF-2018
	29	0.322	-0.5	DCF-2019
	29	0.322	-0.5	DCF-2021
	29	0.322	-0.5	DCF-2022
	29	0.322	-0.5	DCF-2023
	29	0.322	-0.5	DCF-2024

*Otolith readings of individuals from the Balearic Islands in the framework of the Spanish National Data Collection Program.

It is worth mentioning that since 2019, even if in 2020 biological sampling was not performed, the growth parameters estimated through the otoliths reading and submitted by the Spanish DCF are consistent over time, and a growing number of individuals have been analyzed, starting from 254 in 2019 up to 787 in 2024.

Table 2: Parameters of the Length-Weight relationship.

Sex	a	b	Source
F	0.00950	3.1091	Reñones *et al.*, 1995
M	0.010453	3.0672	
C	0.009101	3.124	
	0.01600	2.9128	Morales-Nin, 1991
	0.0084	3.118	GFCM, 2016*
	0.0085	3.115	STECF EWG 24-10
	0.00769	3.154	DCF-2011
	0.0046	3.316	DCF-2012
	0.0084	3.127	DCF-2013
	0.0072	3.174	DCF-2014
	0.00956	3.08	DCF-2015
	0.00869	3.104	DCF-2002
	0.00659	3.186	DCF-2005
	0.00628	3.211	DCF-2008
	0.00869	3.104	DCF-2016
	0.01939	2.85	DCF-2017
	0.01746	2.89	DCF-2018
	0.01077	3.04	DCF-2019
	0.01239	3.147	DCF-2021
	0.00874	3.10411	DCF-2022
	0.01052	3.04602	DCF-2023
	0.01066	3.03612	DCF-2024

In general for the species in the area, from literature L_{50} is estimated close to 14–17 cm TL (≈ 1 year of age), with females tending to attain slightly larger asymptotic sizes than males.

Table 3: Maturity ogive by age. For DCF data they are always referring to C.

0	1	2	3	4	5+	Source
0.15	0.39	0.79	0.95	1	1	GFCM, 2016
0	1	1	1	1	1	STECF EWG 24-10
0	0.574	1	1	1	1	DCF-2019
NA	0.027	0.17	0.601	0.917	0.988	DCF-2021
NA	0.409	0.73	0.951	0.981	0.992	DCF-2022
NA	0.465	0.908	0.992	1	0.995	DCF-2023
NA	0	0.908	0.991	1	1	DCF-2024

Natural mortality used operationally in assessments declines with age (e.g., M ≈ 1.0 at age 0, 0.6 at age 1, 0.4 at age 2, then ~0.3 yr^{-1} from age 3+), consistent with fast early life mortality and lower adult M.

In addition to what was already used in the past in the Mediterranean assessment framework for striped red mullet in GSA5, in Table 4 are reported additional natural mortality vectors estimeted through different methods (CnW = Chen Watanabe method, Gis = Gislason method, Cha = Charnarov method) using the Barefoot Ecologist's toolbox available at http://barefootecologist.com.au/shiny_m. As input were given 3 different sets of the Von Bertalanffy Growth curve: (1) the median between all the DCF data, (2) the values from DCF-2021/DCF-2024, (3) the values used in STECF EWG 24-10.

Table 4: Natural mortality vector by age

0	**1**	**2**	**3**	**4**	**5+**	**Source**	
1	0.6	0.4	0.3	0.3	0.3	GFCM, 2016	
1.14	0.86	0.64	0.55	0.50	0.47	STECF EWG 24-10	
1.89	0.86	0.64	0.55	0.50	0.47	CnW in STECF routine using STECF EWG 24-10 paramerers	
0.48	0.38	0.33	0.30	0.27	0.27	CnW	(1)
0.77	0.54	0.42	0.36	0.31	0.30	Gis	
0.73	0.53	0.42	0.36	0.32	0.31	Cha	
0.84	0.58	0.48	0.42	0.39	0.37	CnW	(2)
1.48	0.82	0.59	0.48	0.43	0.43	Gis	
1.36	0.78	0.58	0.48	0.43	0.43	Cha	
1.14	0.72	0.58	0.52	0.48	0.47	CnW	(3)
1.98	0.95	0.67	0.56	0.5	0.48	Gis	
1.86	0.94	0.68	0.57	0.5	0.48	Cha	

Med & BS DCF data

The fishery dependent and independent (MEDITS survey) data submitted for the Med & BS DCF Data call for striped red mullet in GSA5 were checked throug the STECF routines and prepared for updating the stock object.

They were also compared to the last year (2023) submission and no inconsistencies were found.

Fishery dependent data

Official data are presented in the following tables and graphs, both in terms of amount and in demografy.

Main gears targeting the species in the area are GTR and OTB, however few landing data are reported also for other gears.

Discards value are very low.

Table 5: Official landing data in tonnes by year and gear.

Year	FPO	GNS	GTR	LA	LHP	LLS	OTB	SV	Total
2002			25.72				105.96		131.68
2003			19.75				81.87		101.62
2004			28.55				124.40		152.95
2005			35.80				112.71		148.51
2006			35.04				117.84		152.88
2007			8.76				161.30		170.06
2008			8.09				131.07		139.16
2009			5.43				67.54		72.97
2010			8.95				84.20		93.15
2011			14.69				92.67		107.36
2012			14.85				85.51		100.36
2013			18.20				69.68		87.88
2014			16.09				79.26		95.35
2015			15.48				81.12		96.60
2016			13.57				92.89		106.46
2017			9.76				100.15		109.91
2018			10.56				121.84		132.40
2019			12.65				72.89		85.55
2020		1.17	10.17				72.32	0.01	83.69
2021		1.32	7.66		0.03	0.08	69.91	0.01	79.02
2022	0.14	0.89	8.13		0.12	0.04	56.23		65.55
2023	0.00	0.83	7.78	0.01	0.00	0.03	40.66	0.01	49.33
2024	0.00	0.86	4.29		0.02		51.74	0.01	56.92

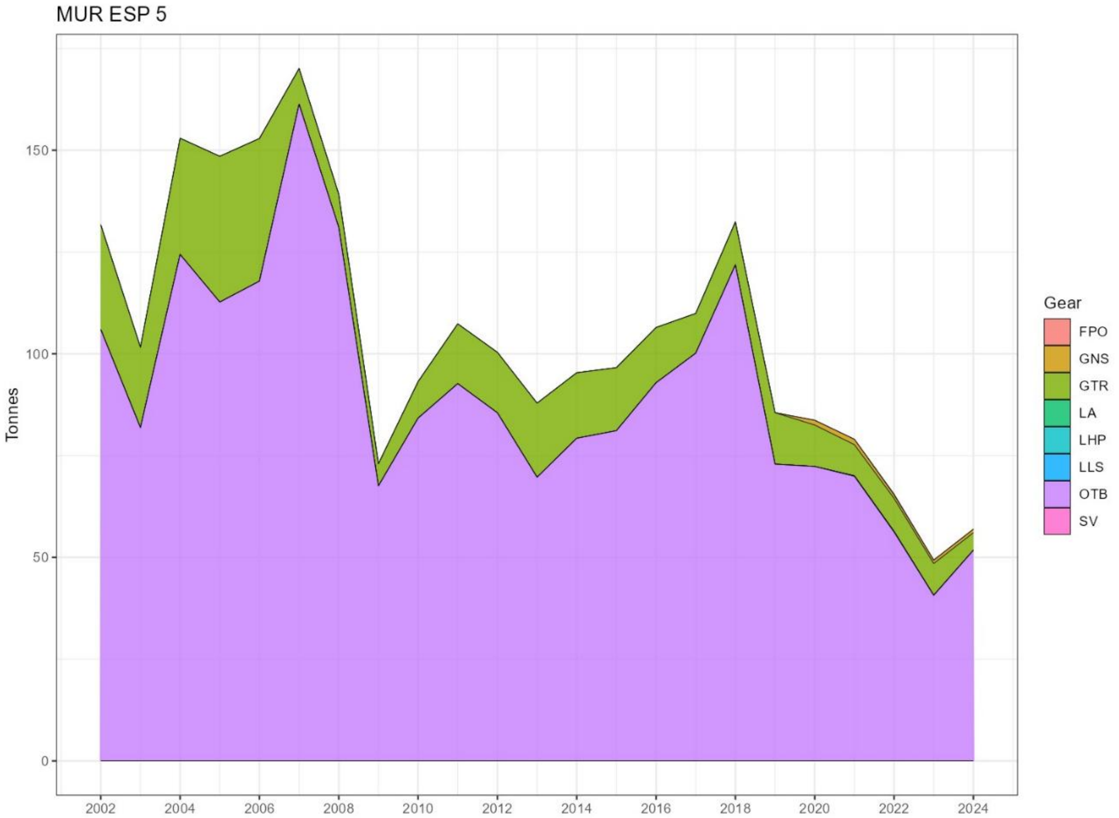

Figure 2: Landing trends by year and gear.

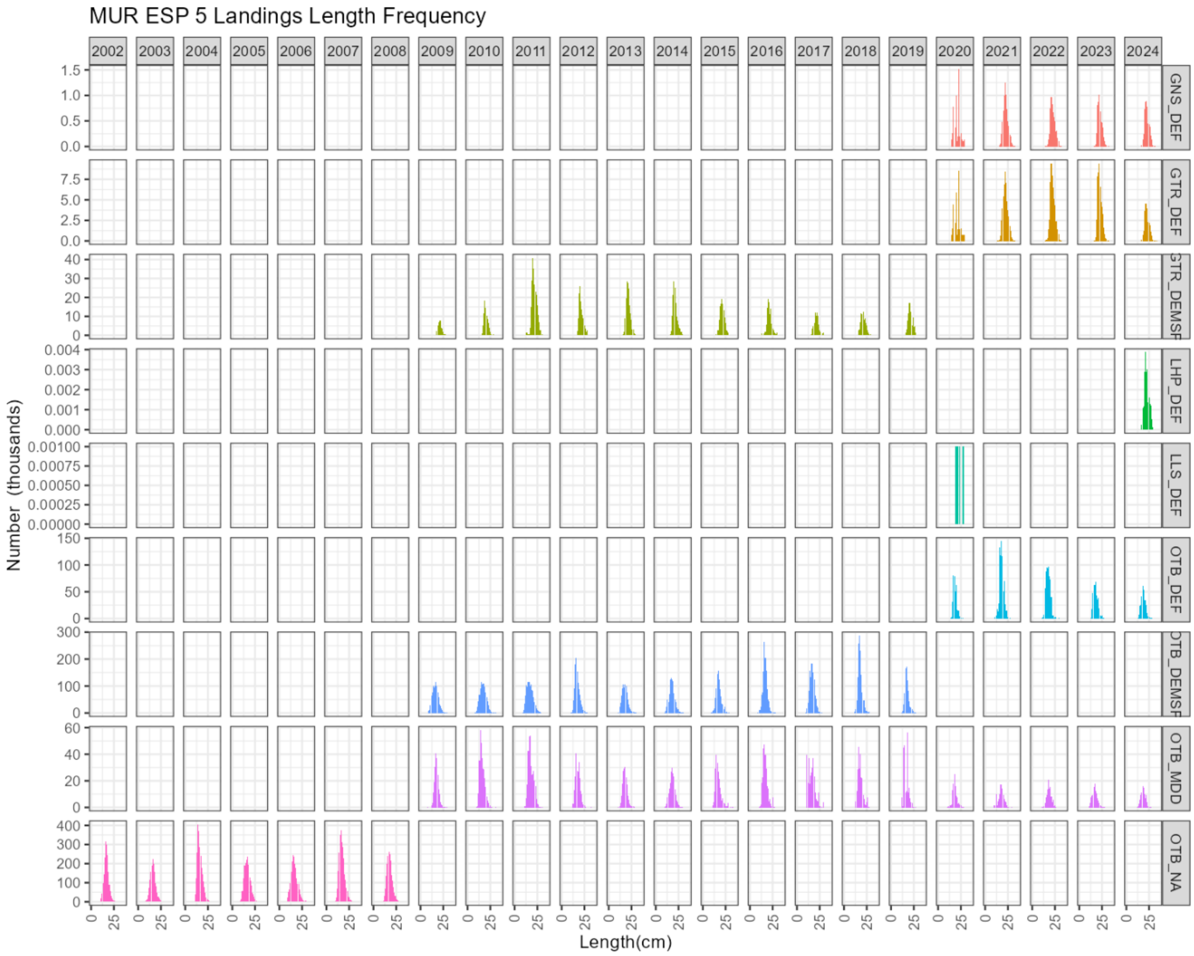

Figure 3: Length Frequency Distributions of landings by year and gear.

Table 6: Official discard data in tonnes by year and gear.

Year	GTR	OTB	Total
2005		0.71	0.71
2007	0		0
2008		0.57	0.57
2009	0.1	0.04	0.14
2010	9.06	0.26	9.32
2011	0	2	2
2012	3.98	5.54	9.52
2013	0.4	0.08	0.48
2014	0.14	2.72	2.86
2015	0	0.15	0.15
2016	0	2.26	2.26
2017		1.48	1.48
2018		0.24	0.24
2019		0	0
2021		0.14	0.14
2022		0	0
2023		0	0
2024		0	0

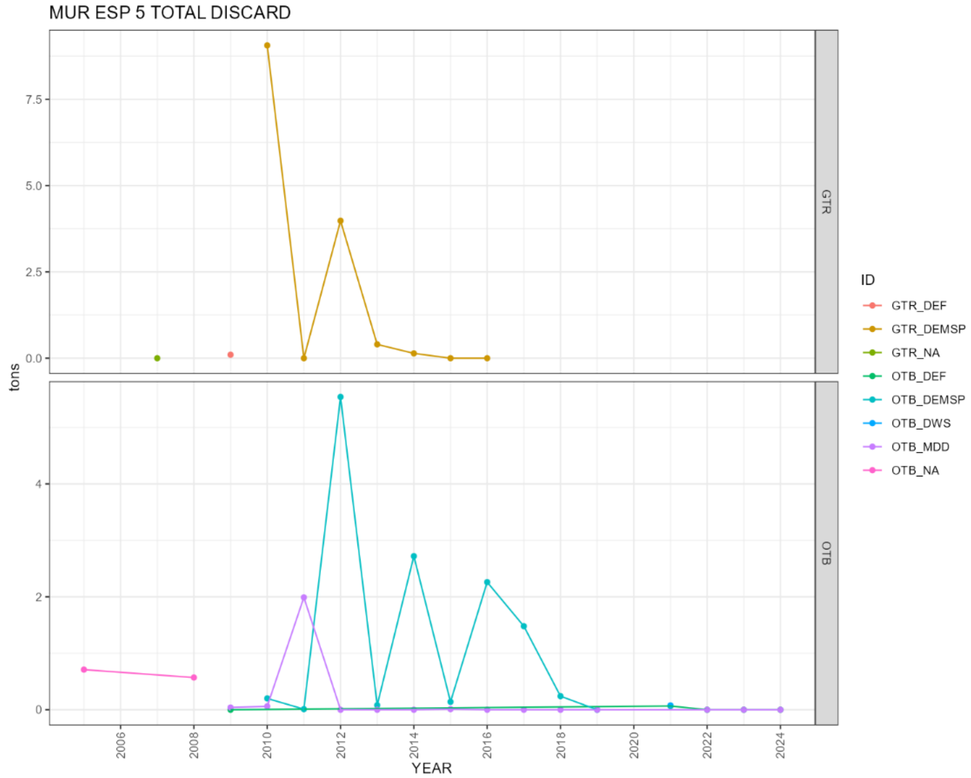

Figure 4: Discard trends by year and gear.

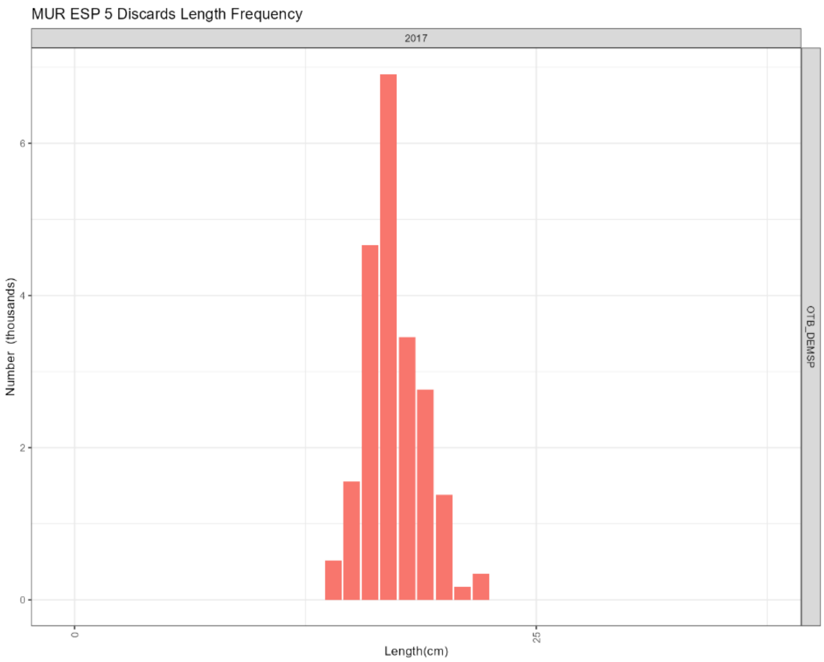

Figure 4: Length Frequency Distributions of discard available only for OTB in 2017.

Fishery independent data – MEDITS survey

The MEDITS survey in GSA5 started in 2007. Prior to this, data collection was limited to very few and variable stations located in the westernmost area, specifically around the Pitiuses Islands (Ibiza and Formentera). Due to the limited spatial coverage and representativeness, data from these earlier years were excluded, as already done in the past.

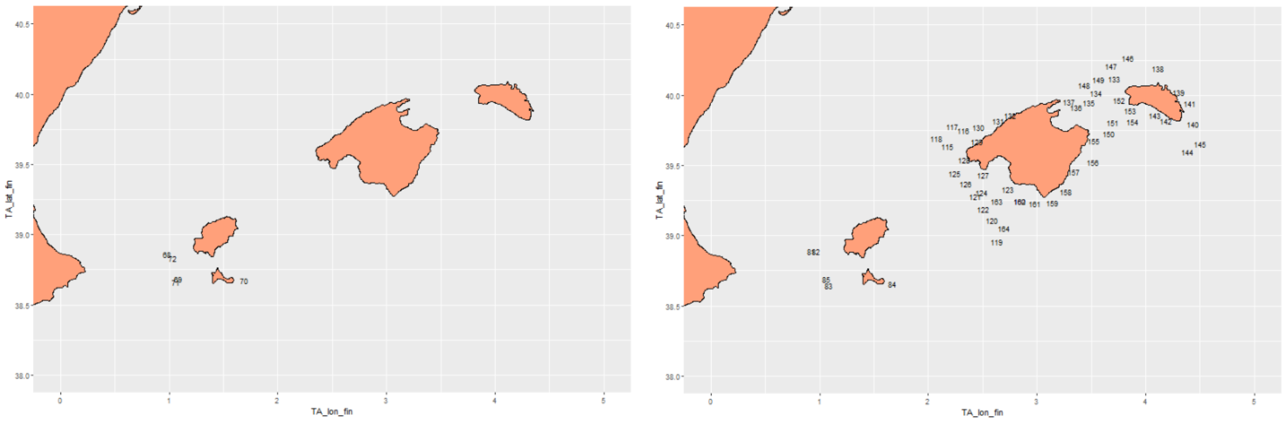

Figure 5: Difference in MEDITS sampling stations between 2006 and 2007 in GSA5.

Mean stratified abundances and biomass per km^2 were estimated following the methodology outlined by Grosslein and Laurec (1982). From the start of the survey until 2020, sampling was restricted to the Mallorca and Menorca islands. Beginning in 2021, the sampling area was extended to include the Ibiza and Formentera islands.

In 2022, the MEDITS Steering Committee recommended that survey indices be calculated separately for the Mallorca-Menorca and Ibiza-Formentera subareas. Accordingly, the abundance index included in the stock object refers exclusively to the Mallorca-Menorca region. However, also the trends including all the islands from 2021 is reported.

MEDITS 2007-2024 for Mallorca and Menorca islands

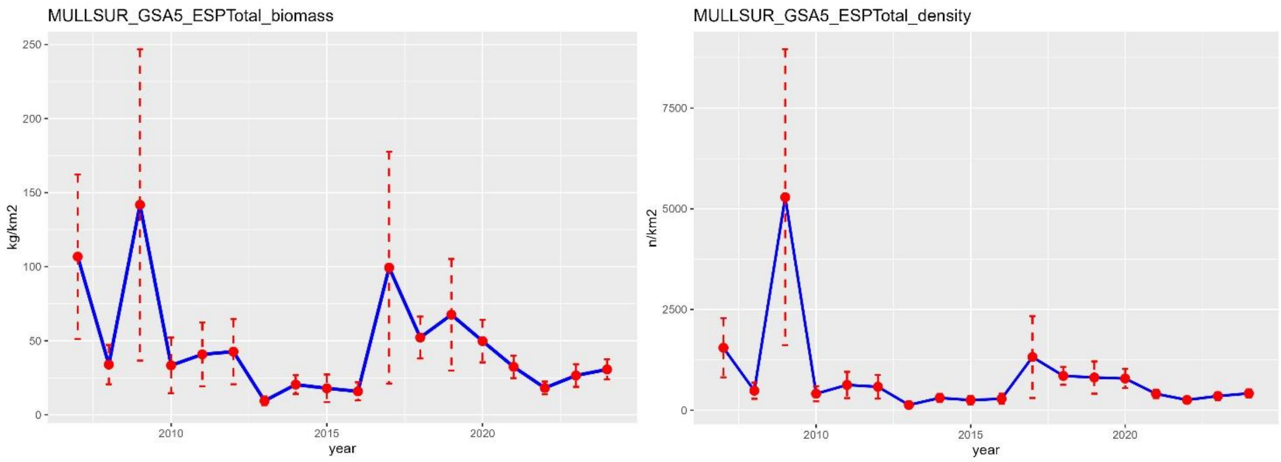

Figure 6: MEDITS index in terms of biomass and density.

Figure 7: MEDITS survey timing.

The huge pick of 2009 and 2020 in the survey indices could be esplained by the fact that the sampling was performed in May, and it was the only case.

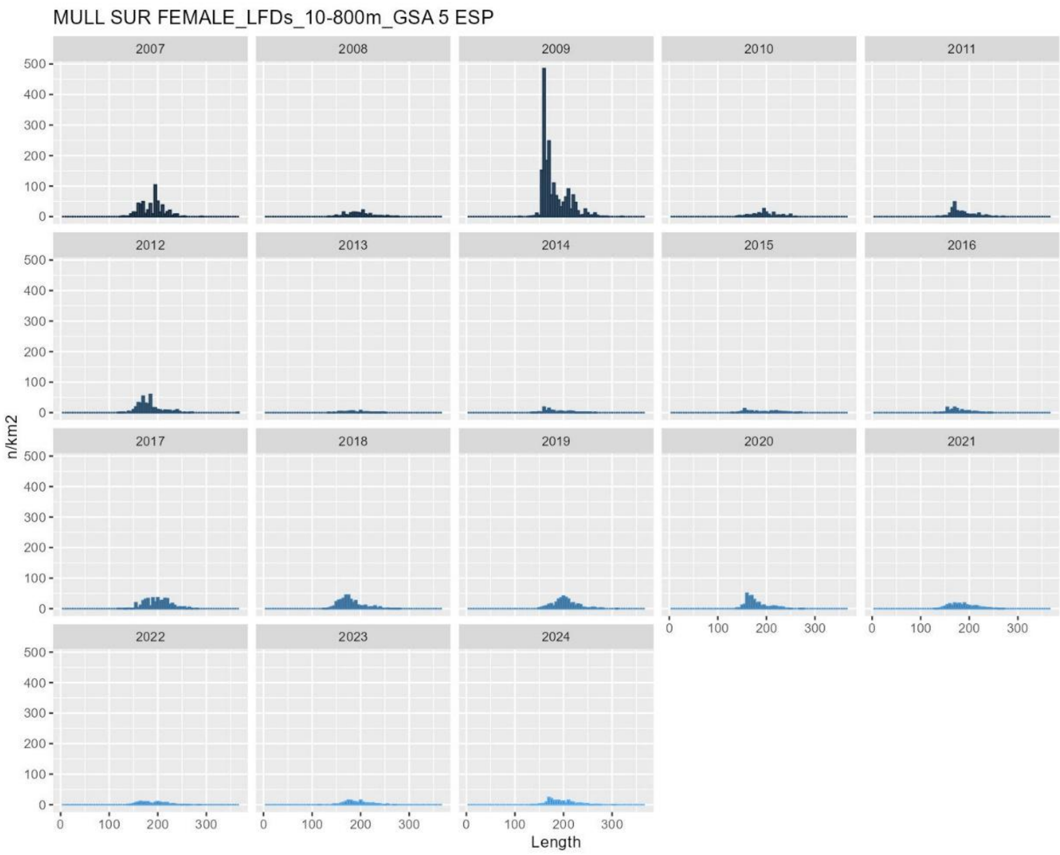

Figure 8: MEDITS LFDs for female individuals.

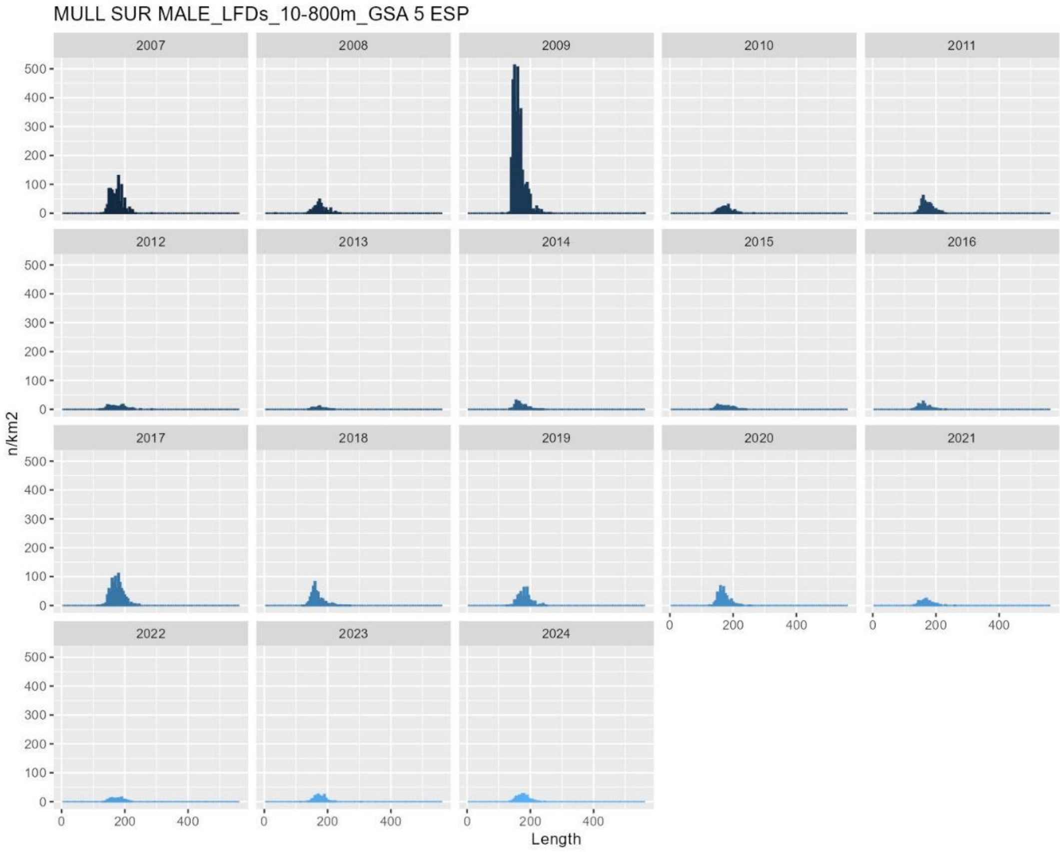

Figure 9: MEDITS LFDs for male individuals.

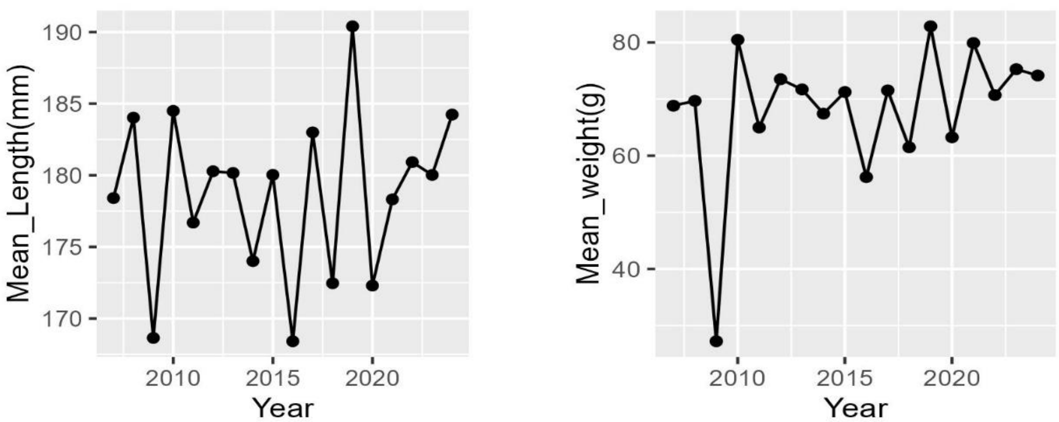

Figure 10: Mean Length and Weight trends across the years.

MEDITS 2021-2024 for the all the islands in GSA5

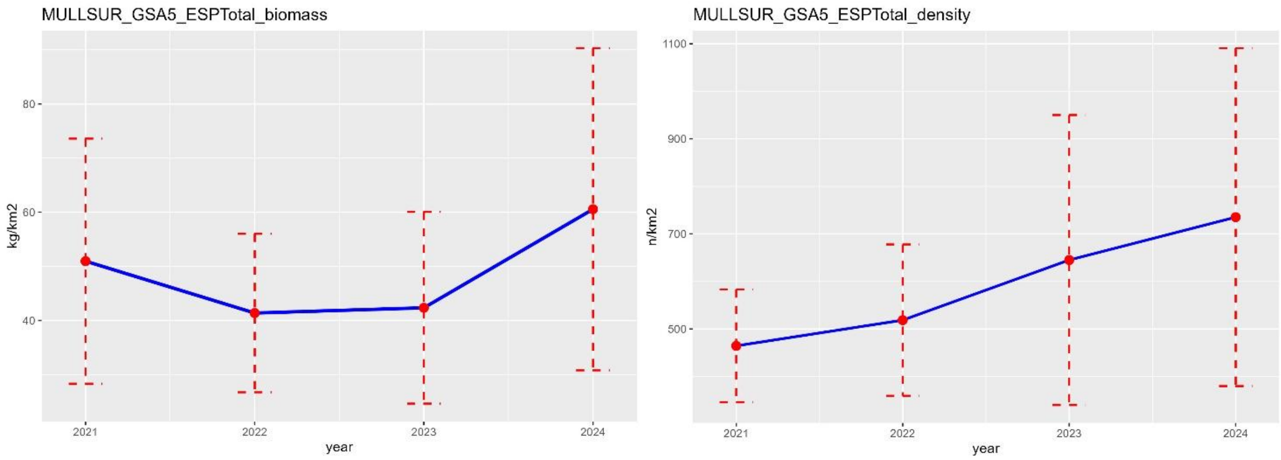

Figure 11: MEDITS index in terms of biomass and density.

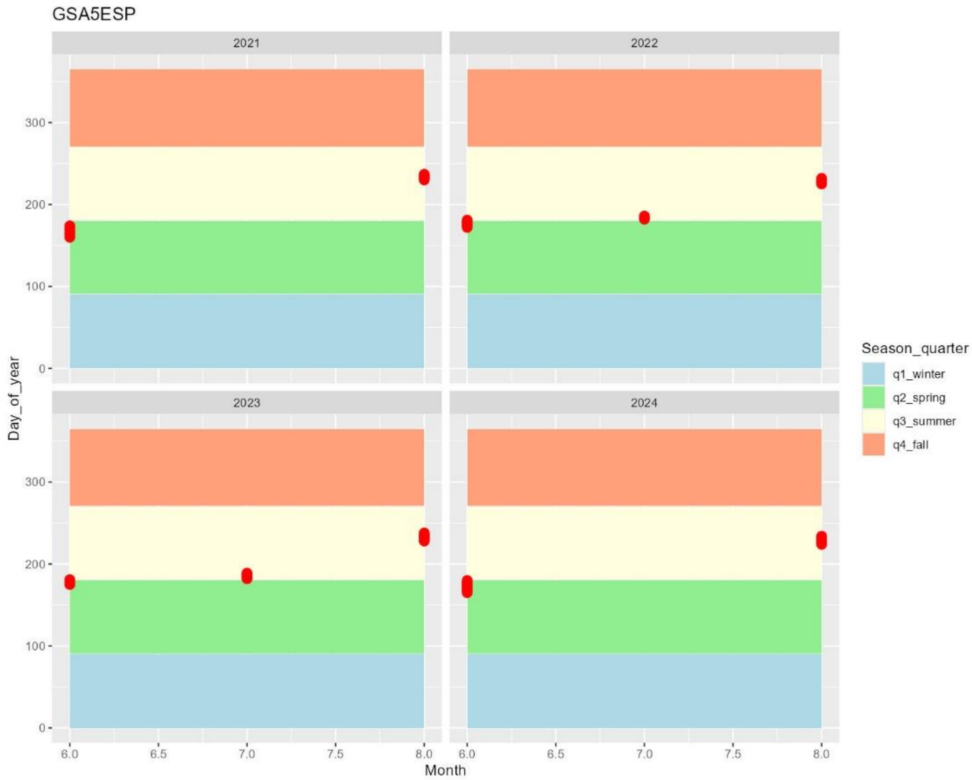

Figure 12: MEDITS survey timing.

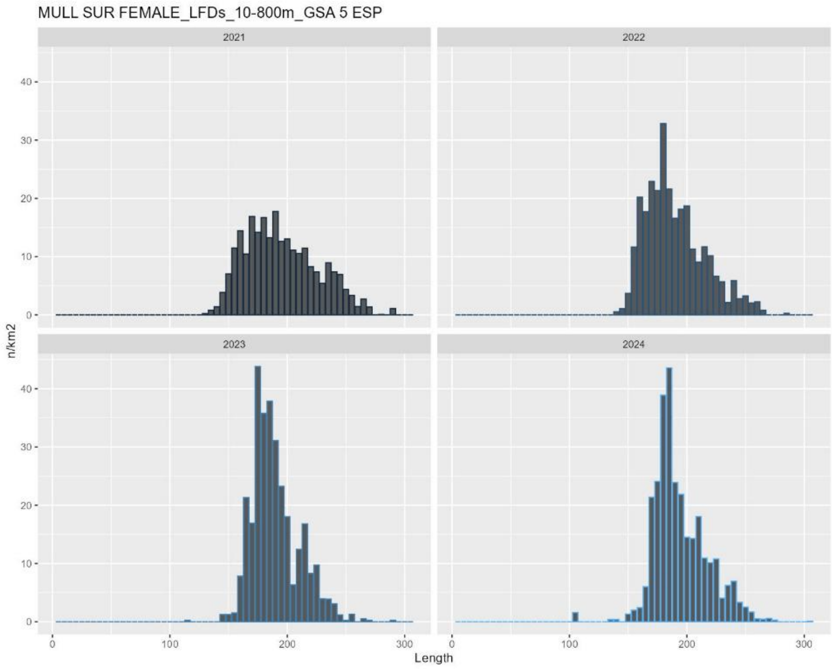

Figure 13: MEDITS LFDs for female individuals.

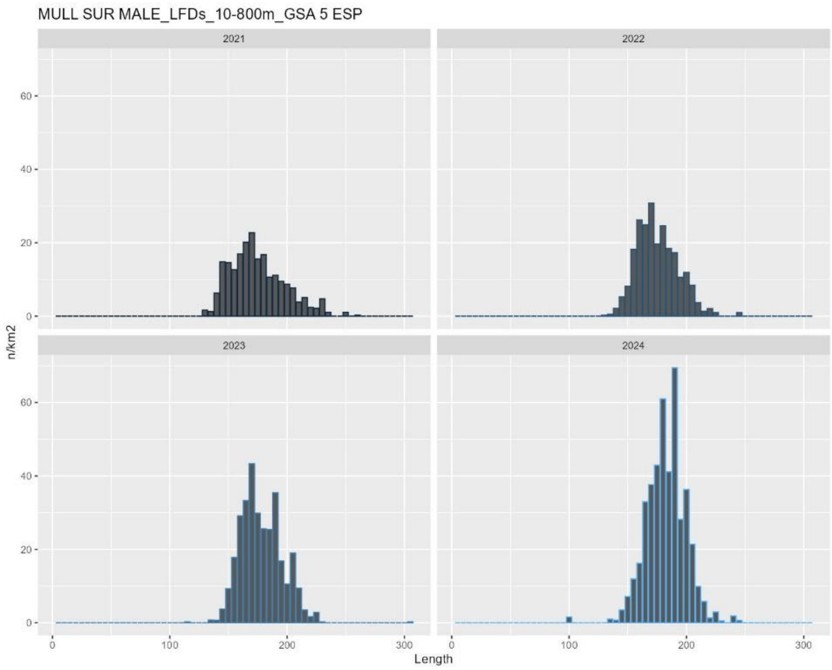

Figure 14: MEDITS LFDs for male individuals.

Stock objects creation

Since different approaches regarding the assumptions on biological parameters, and t0 correction could be made, 6 different stock and index objects were produced. All the specificities are given in the following Table.

The common carachteristics are:

- max_age=5 # Setting max age in slicing #
- spawning <- 0.5 # Setting spwaning period #
- Fbar range 1-3

Table 7: Stock object file names and assumptions.

File name	L_{inf}/K/t_0 a/b	Maturity ogive	Natural mortality vector	t0 correction
MURstk1_not0.Rdata	Median between the parameters in the official DCF data 32.5/ 0.205/-1.73 0.008715/3.104055	Mean of the official DCF data 0.116 0.59 0.886 0.966 0.993 0.998	CnW in the STECF routine 0.557 0.422 0.352 0.310 0.283 0.263	NO
MURstk1_t0corrected.Rdata	//	//	//	YES
MURstk2_not0.Rdata	DCF-2024 data 29/0.322/-0.5 0.01066/3.03612	DCF-2023 data* 0.465 0.908 0.992 1 0.995	CnW in the STECF routine 1.17 0.678 0.52 0.445 0.402 0.377	NO
MURstk2_t0corrected.Rdata	//	//	//	YES
MURstk3_not0.Rdata	As in STECF EWG 2024	As in STECF EWG 2024	As in STECF EWG 2024	NO
MURstk3_t0corrected.Rdata	//	//	//	YES

* Age 0 was not present in the data since 2021. Maybe this could be because of no presence in the DCF samples. Age 1 sample size in recent years is also considered to be very low (2021 = n2, 2022 = n44, 2023 = n23, 2024 = n1). This is why fo this stock object it was prepared a natural mortality vector coming from 2023 DCF official data.

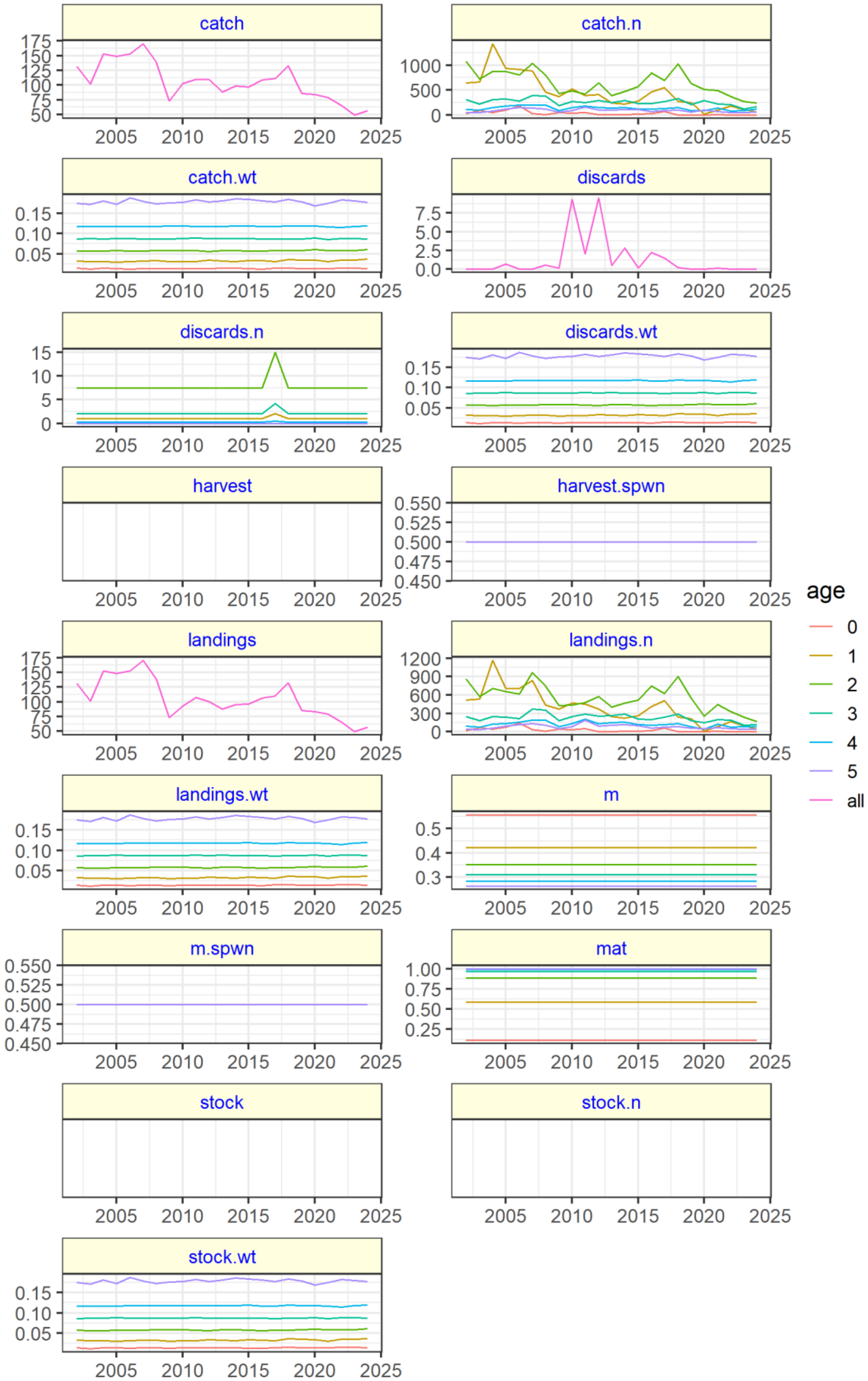

Figure 15: MURstk1_t0corrected.Rdata resume as example.

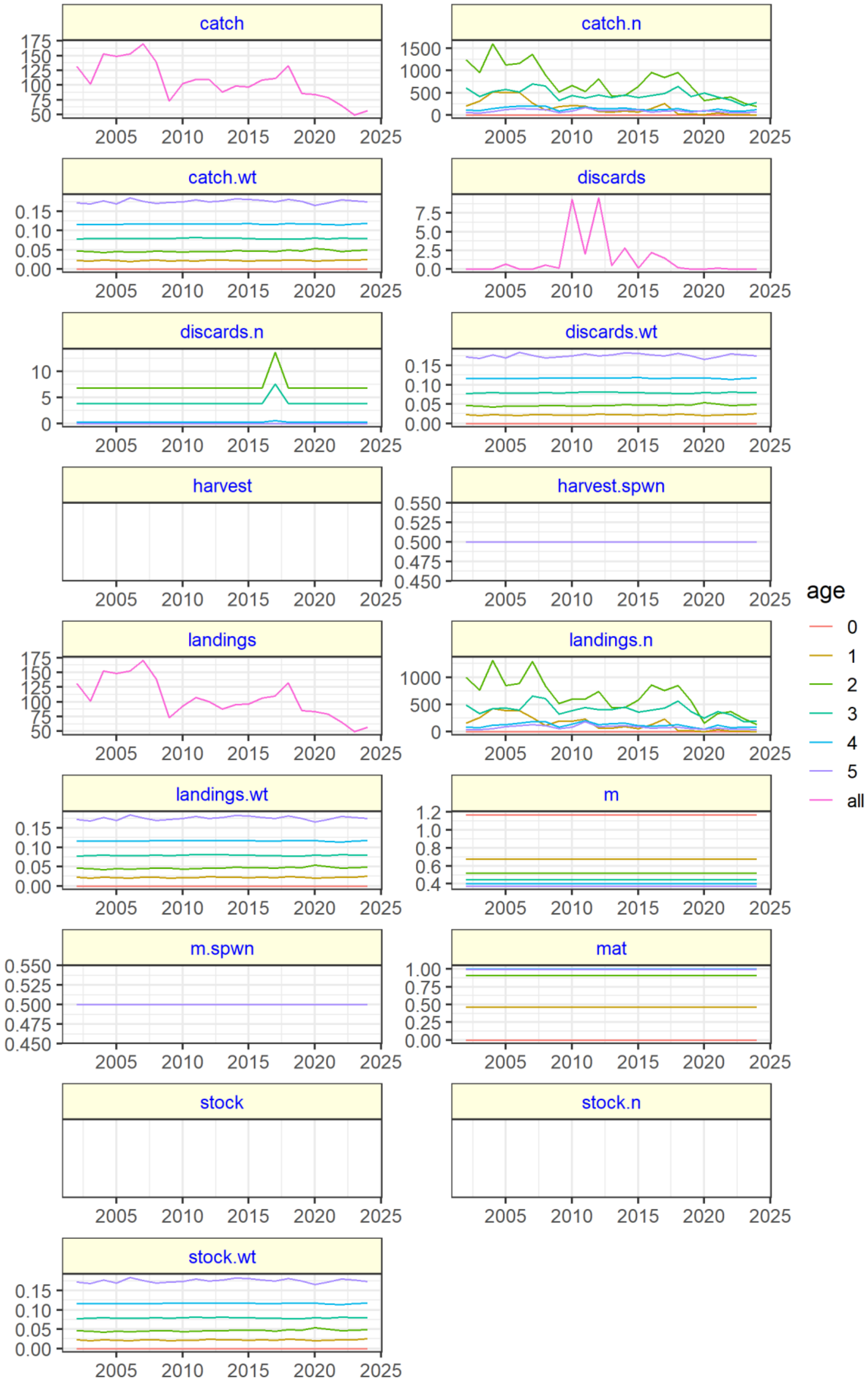

Figure 15: MURstk2_t0corrected.Rdata resume as example.

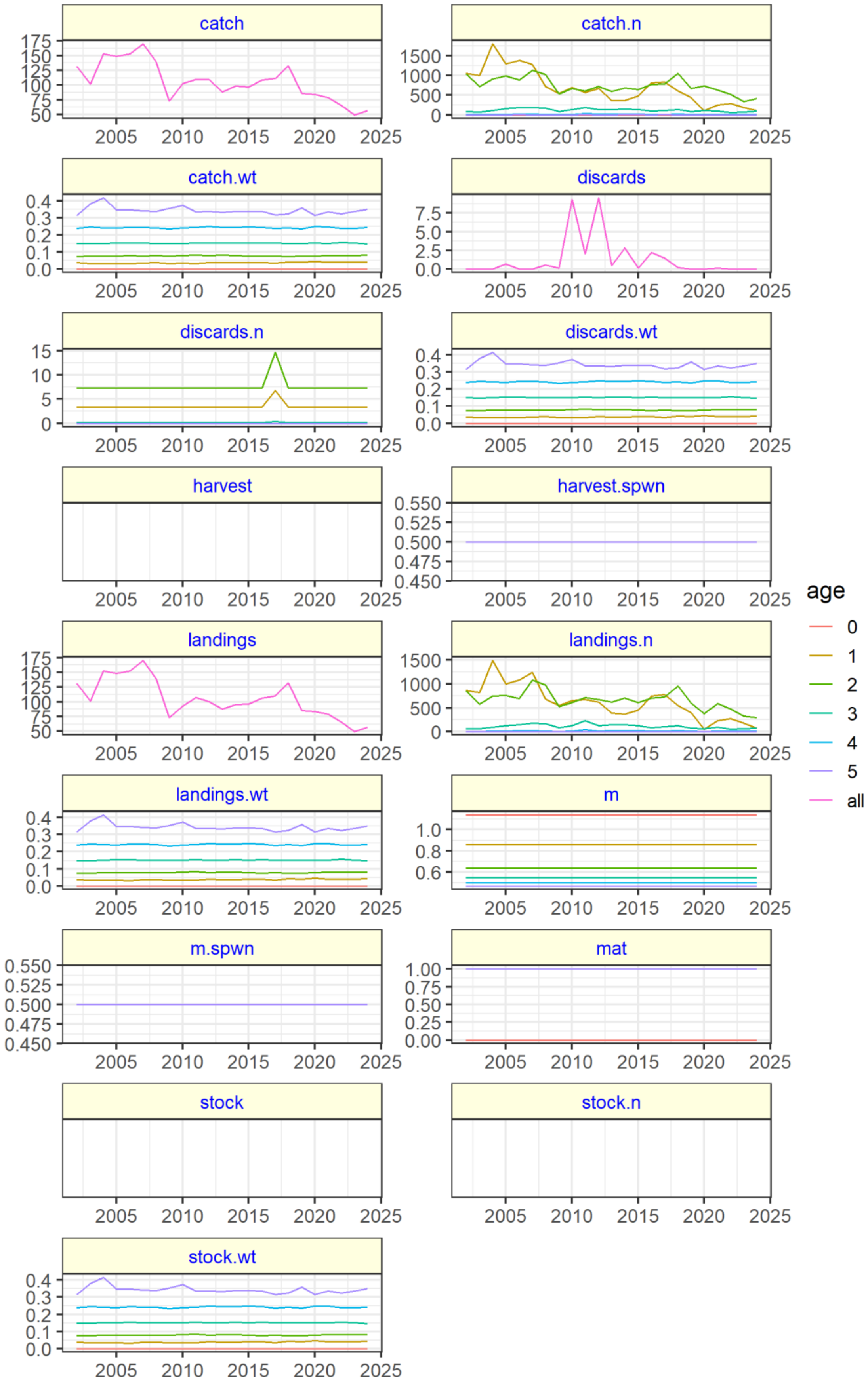

Figure 16: MURstk3_t0corrected.Rdata resume as example.

Norway lobster in Sardinia Island – NEP in GSA11

Stock identity and boundaries

Nephrops norvegicus (Norway lobster) is a demersal crustacean widely distributed in the Northeast Atlantic and throughout the Mediterranean Sea, where it represents one of the most valuable target species for trawl fisheries. It inhabits muddy substrates, typically at depths ranging from 20 to over 800 m, where it constructs and occupies burrows. The species shows strong habitat dependence, as the availability of suitable sediment directly influences its distribution and abundance.

Its biology is characterized by slow growth, late maturation, and marked sexual dimorphism in size and reproductive traits. Feeding behavior is primarily nocturnal, with a diet mainly consisting of benthic invertebrates (polychaetes, echinoderms, and small crustaceans), complemented by opportunistic predation on fish and carrion. In the Mediterranean, *N. norvegicus* populations exhibit considerable spatial heterogeneity, reflecting both environmental conditions and fishing pressure.

In the GSA 11 (Sardinia, Fig. 17), the species is particularly important for local demersal fisheries. Here, populations are mainly concentrated on fine muddy bottoms located on the continental slope, where the ecological conditions favor burrow construction and feeding activity. Studies in this area highlight the commercial relevance of the resource and the need for spatially explicit management measures, given the species' sensitivity to overexploitation and habitat disturbance.

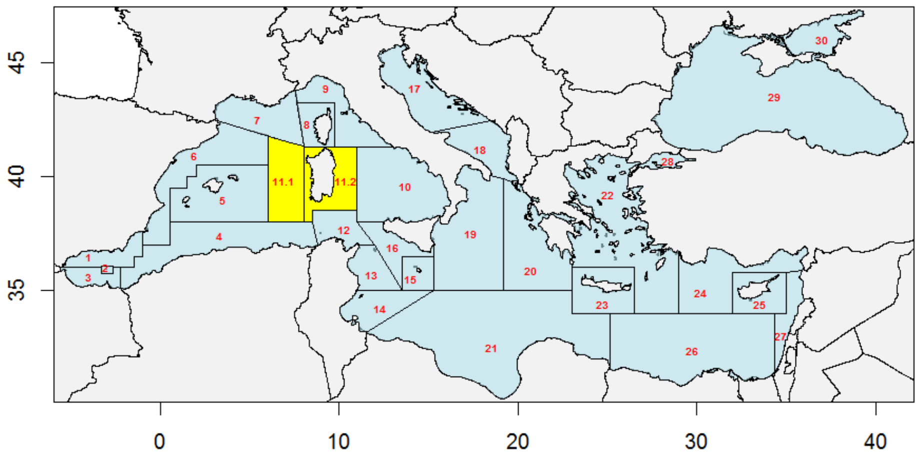

Figure 17. Geographical localization of GSA 11.

Nephrops norvegicus is an inherently sedentary crustacean; individuals construct and reside within semi-permanent burrow systems in muddy substrates, emerging only briefly to forage or mate, and typically exhibiting movements of only a few hundred meters. This constrained dispersal leads to assemblages that are largely self-sustaining and characterized by limited demographic connectivity.

Consequently, global stock assessments—including those in Mediterranean waters—are conducted at finer spatial scales designated as Functional Units (FUs), to reflect the species' localized population structure and manage each area independently (Aguzzi *et al.*, 2022).

As an example, in the Adriatic Sea, identifying and delineating such management subareas has become particularly pressing: integrated hydrodynamic–biological models have revealed the presence of at least three distinct subpopulations with limited connectivity; hence, assessing stocks at the level of these subunits—rather than across broader Geographical Subareas (GSA)—is paramount for accurate and precautionary management. In the GFCM process Adriatic Nephrops is actually assessed in 4 different FU (GFCM, 2025).

However, for assessment purposes the stock of this species has always been assumed as confined within GSA11 boundaries due to the lack of information about the stock structure in the western Mediterranean Sea, as well as the chance to analyze data on a finer scale.

Biological information

Growth pattern in *Nephrops norvegicus* is known to differ between males and females. Males are characterized by slower growth and higher maximum size than females. Sex ratio in relation to the available landings time series (2005 - 2024) is available from DCF for GSA11 with some years missing. Growth parameters reported by DCF are available by sex and from 2016 onward do not change over the years. The *a* and *b* coefficients slightly differ along the reported years.

Life-history traits and biological parameters from the DCF data call are presented in Tables 8 and 9. Growth parameters were retrieved from Mytilineou et al. (1998) since 2016 to 2023, while in 2024 they were estimated through length-frequency analysis using 1981 individuals for females and 2486 for males. The length-weight parameters were always estimated from the samples.

Table 8: Biological parameters of the Von Bertalanffy Growth curve.

Sex	L_{inf}	K	T_0	Source
F	69.4	0.12	-0.64	DCF-2016/2023
M	80.8	0.13	0.07	
F	69.92	0.14	-0.31	DCF-2024
M	74.41	0.19	-0.69	

Table 9: Parameters of the Length-Weight relationship.

Sex	a	b	Source
F	0.0004	3.1204	DCF-2016
M	0.0006	3.0304	
F	0.0007	2.993	DCF-2017
M	0.0006	3.0443	
F	0.0007	2.993	DCF-2018
M	0.0006	3.0443	
F	0.0005	3.07817	DCF-2019
M	0.00063	3.01967	
F	0.00054	3.04698	DCF-2020
M	0.00049	3.08925	
F	0.0005	3.0717	DCF-2021
M	0.0003	3.22069	
F	0.00051	3.05883	DCF-2022
M	0.00046	3.0925	
F	0.00055	3.03904	DCF-2023
M	0.00086	2.9117	
F	0.00108	2.84111	DCF-2024
M	0.00048	3.07871	

Reproductive activity of *Nephrops norvegicus* in the Mediterranean Sea is characterized by a clear annual cycle, with gonadal maturation initiated in spring and summer, and berried females (egg-carrying) predominantly observed during summer and autumn. The size at which 50 % of females reach sexual maturity (L_{50}) in the Central Mediterranean is approximately 30–32 mm carapace length (CL), corresponding to about 5 years of age, while in the Adriatic Sea this value is pretty lower (around 21 mm CL).

Table 10: Maturity ogive by age. For DCF data they are always referring to F (only the last five years have been reported in the table).

0	1	2	3	4	5	6+	Source
NA	NA	0	0.38	0.97	0.98	1	DCF-2020
NA	NA	0	0.07	0.33	0.863	1	DCF-2021
NA	NA	0	0.16	0.68	0.98	1	DCF-2022
NA	NA	0	0.29	0.94	1	1	DCF-2023
NA	NA	NA	0.61	0.93	1	1	DCF-2024

Med & BS DCF data

The fishery dependent and independent (MEDITS survey) data submitted for the Med & BS DCF Data call for striped red mullet in GSA11 were checked throug the STECF routines and prepared for updating the stock object.

They were also compared to the last year (2023) submission and no inconsistencies were found.

Fishery dependent data

Official data are presented in the following tables and graphs, both in terms of amount and in demografy.

Main gears targeting the species in the area are GTR and OTB, however few landing data are reported also for other gears.

Discards value are very low.

Table 11: Official landing data in tonnes by year and gear.

Year	OTB
2005	28.85
2006	42.27
2007	31.33
2008	36.17
2009	44.41
2010	22.77
2011	50.49
2012	50.48
2013	29.76
2014	35.33
2015	21.37
2016	23.91
2017	39.59
2018	78.82
2019	72.02
2020	50.48
2021	48.72
2022	37.32
2023	26.14
2024	34.88

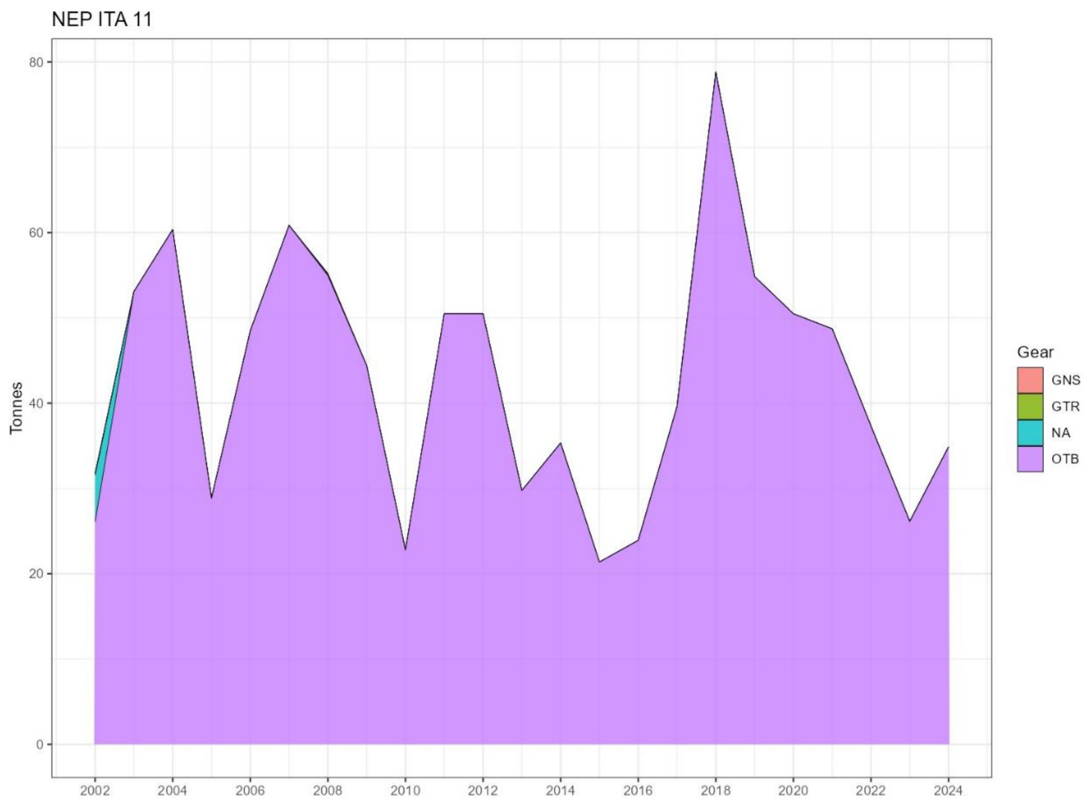

Figure 18. Landing trend by OTB.

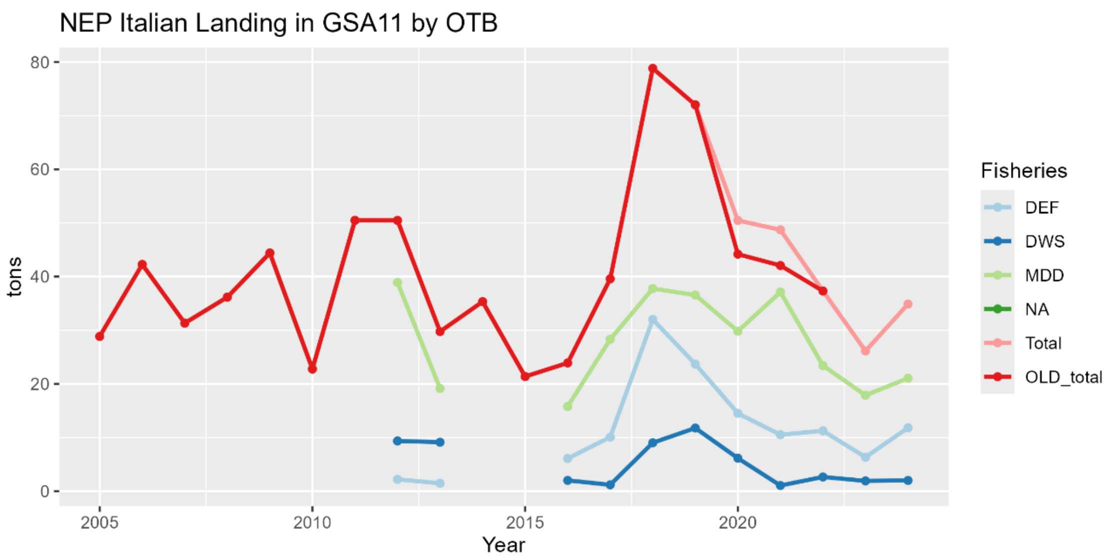

Figure 19. Landing trend by OTB different gears. (OLD_total refers to 2022 data).

Length frequency distributions by year and gear were available through DCF Official data call from the year 2005 onwards.

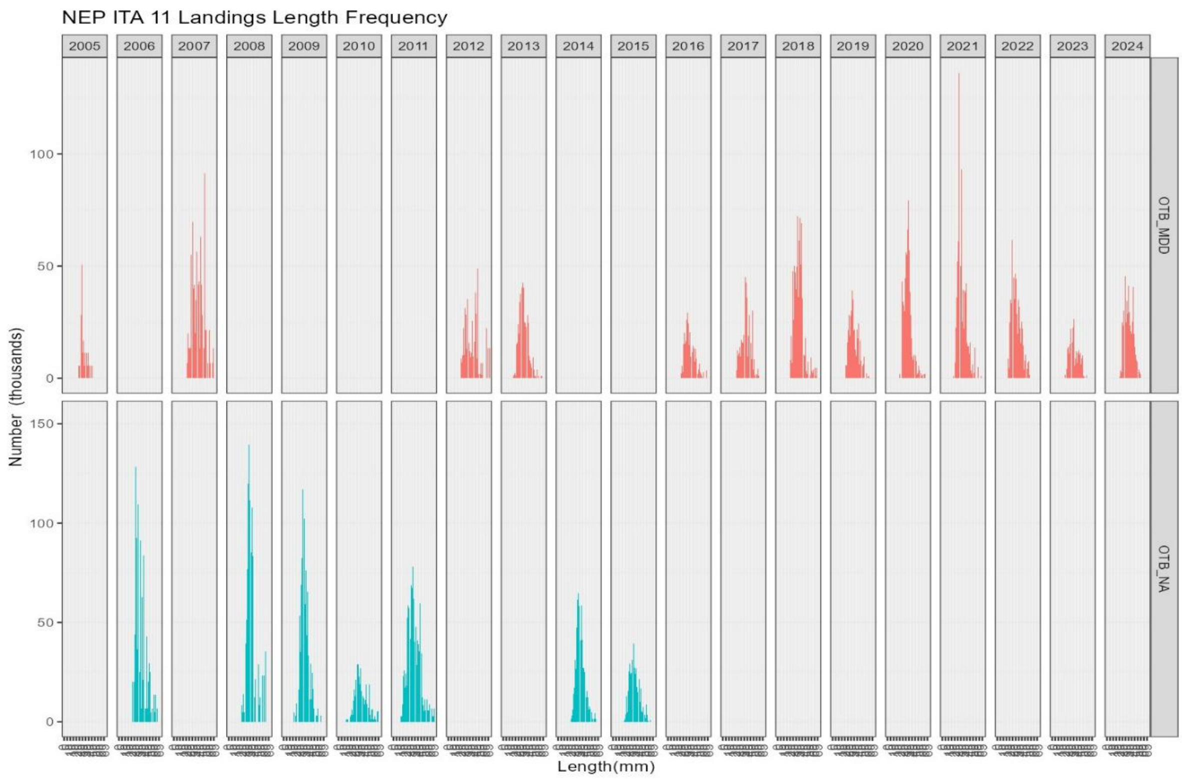

Figure 20. Length frequency distribution of the landings by year and gear in GSA 11.

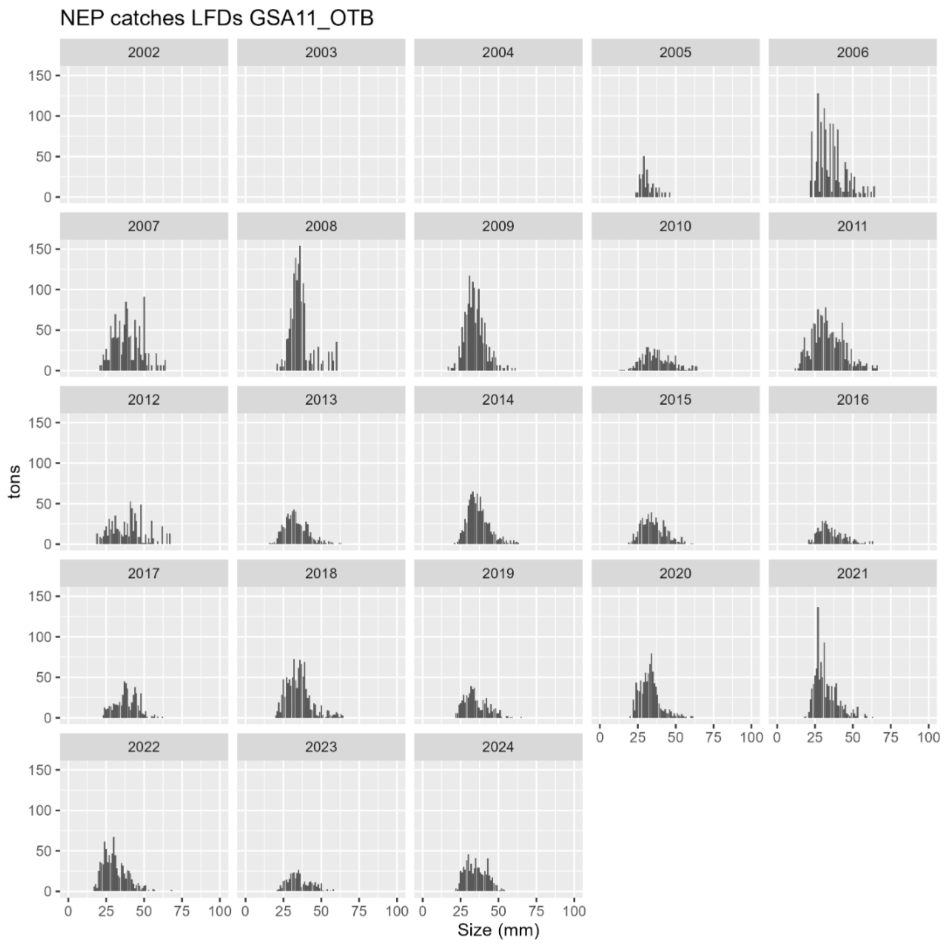

Figure 21. Length frequency distribution of the landings grouped by year.

Discard is reported only for 2022 for a value equal to 0.38 tonnes.

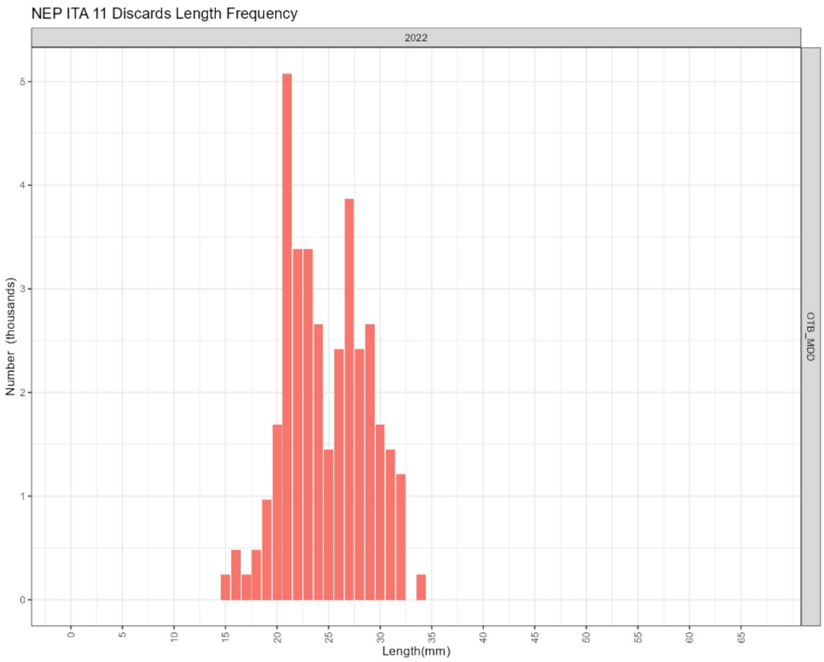

Figure 22. Length frequency distribution of 2022 discard.

Fishery independent data – MEDITS survey

MEDITS survey was not carried out in 2022, so the value in the following figures will appear as zero.

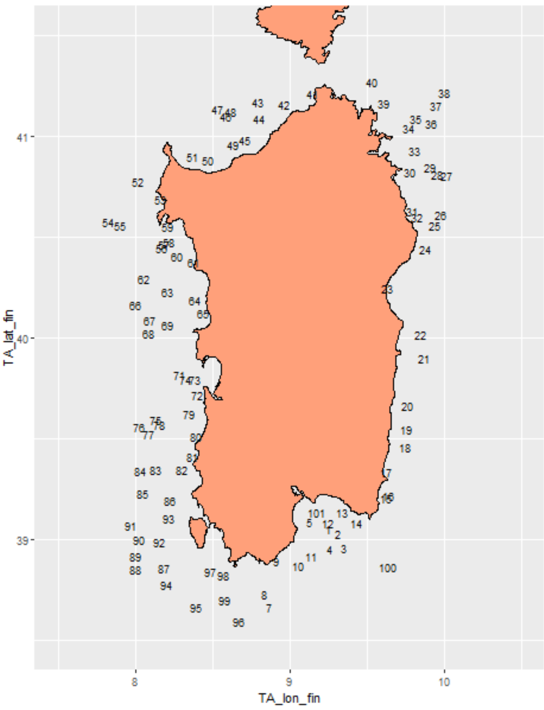

Figure 23. MEDITS sampling locations in 2024.

The MEDITS surveys are carried mainly from May to July. Tables TA, TB, TC were provided according to the MEDITS protocol. Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). In recent years the survey has been carried out later in the year. The abundance and biomass indices for GSA 11 were calculated through stratified means. This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas.

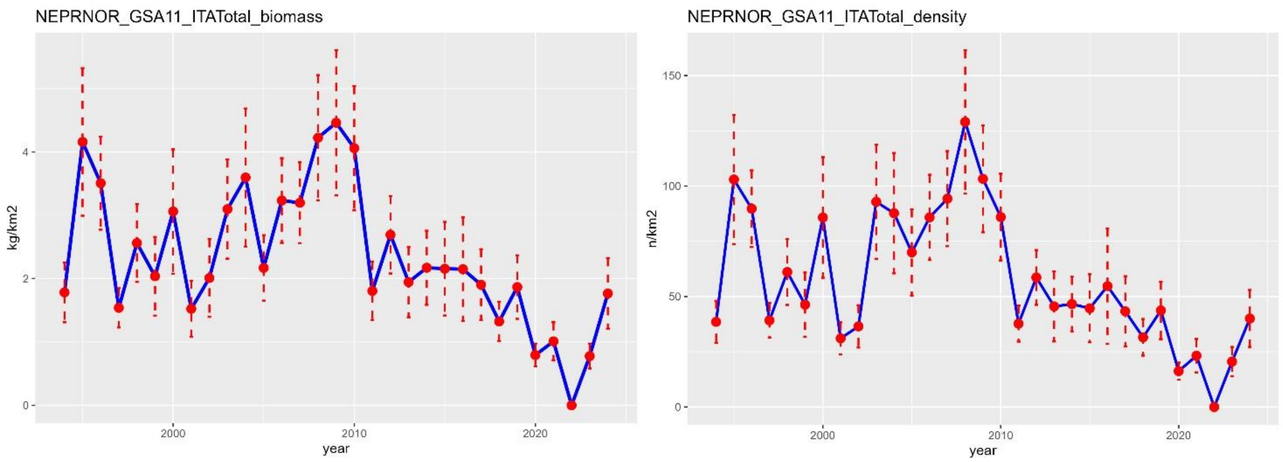

Figure 24: MEDITS index in terms of biomass and density.

Figure 25: MEDITS survey timing.

MEDITS data are available in GSA 11 since 1994. In the period 1994 – 2010 MEDITS indices (Figure 24) show highly fluctuating pattern, ranging between 1.52 (2001) and 4.46 (2009) in terms of biomass (kg/km^2) and 31.1 (2001) and 129 (2008) in terms of density (n/km^2), with an average value for this period of 3.01 kg/km^2 and 75.37 n/km^2. From 2011 onward the stock appears to have been more stable, but with a general decreasing trend both for biomass and densities than decline to the minimum values of the time series in 2023. Observed length frequency distribution for MEDITS data are reported in the following figures by sex.

Figure 26: MEDITS LFDs for female individuals.

Figure 27: MEDITS LFDs for male individuals.

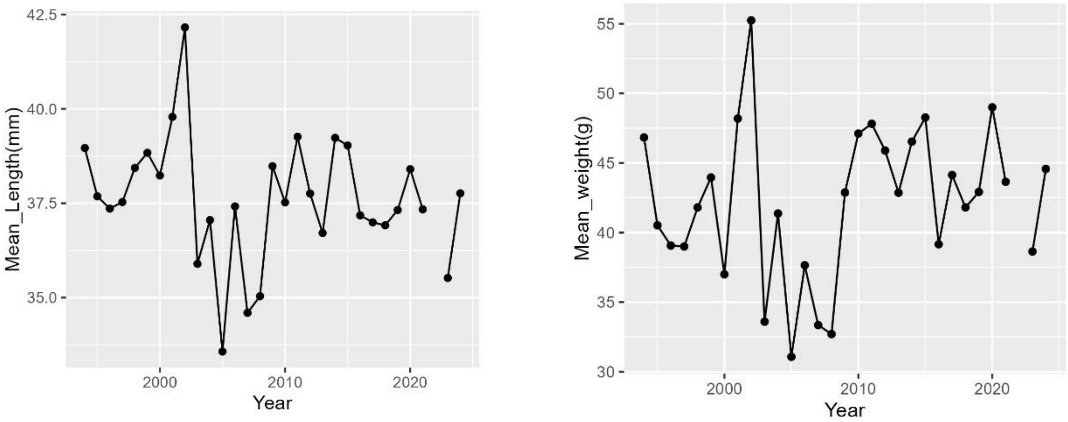

Figure 28: Mean Length and Weight trends across the years.

Stock object creation

Since during STECF EWG 24-10 the assessment for this species was carried out using SPiCT, the stock object was created as a list ready to be used as input to be fitted using the proper model functions.

NEP11_stk.Rdata

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