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Spatial and temporal trend in the abundance and distribution of gurnards (Pisces: Triglidae) in the northern Mediterranean Sea

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Summary: In this study we investigated the spatio-temporal distribution of gurnards (8 species of Triglidae and one species of Peristediidae) in the northern Mediterranean Sea using 22 years of MEDITS bottom trawl survey data (1994-2015). Gurnards showed significant differences in terms of abundance, dominance and composition among geographical sub-areas and ecoregions, with the highest relative biomass (BI_y) being found in Malta, eastern Corsica, the Balearic Islands and the eastern Ionian Sea. The lowest gurnards BI_y were observed in the highly exploited areas of the western Mediterranean and the Adriatic Sea, where the largest number of species with a negative linear trend in BI_y was also found. The temporal trends in species abundances highlighted a general decrease for the coastal species (*C. lucerna, C. lastoviza, C. obscurus*) as compared with the species inhabiting the deep continental shelf and slope (*T. lyra, P. cataphractum*). The results provide for the first time an overview of the spatiotemporal trend in the abundance of gurnards over the wide spatial scale of the northern Mediterranean Sea, also suggesting the possible use of these species as indicators for monitoring the impact of fishing pressure on demersal fish assemblages.

Keywords: Triglidae; Mediterranean Sea; trawl by-catch; MEDITS; fishing pressure.

Abundancia y distribución de los gurnardos en el norte del Mediterráneo

Resumen: En este estudio hemos investigado la distribución espacio-temporal de los gurnardos (8 especies de Triglidae y 1 especie de Peristediidae) en el norte del Mediterráneo usando 22 años de datos de la campaña de pesca de arrastre ME-

DITS (1994-2015). Los gurnardos mostraron diferencias significativas en la abundancia, dominancia y composición entre las distintas sub-areas geográficas (GSAs) y las ecoregiones, encontrándose las mayores biomasas relativas (BI_y) en Malta, el este de Córcega, las Islas Baleares y el oeste del mar Jónico. Por otro lado, los menores valores de BI_y fueron observados en las áreas más explotadas del oeste del Mediterráneo y del Mar Adriático, donde también se observó el mayor número de especies con una tendencia lineal negativa en relación a BI_y. La tendencia temporal en la abundancia de especies evidenció una disminución general en las especies costeras (*C. lucerna, C. lastoviza, C. obscurus)* respecto a las especies que habitan la profunda plataforma y pendiente continentales (*T. lyra, P. cataphractum*). Los resultados proporcionan por primera vez una visión general de las tendencias espacio-temporales en la abundancia de los gurnardos en la amplia escala espacial del norte del Mediterráneo, sugiriendo también la posibilidad de usar estas especies como indicadores para monitorear el impacto de la presión de pesca sobre los ensamblajes de peces demersales.

Palabras clave: Triglidae; mar Mediterráneo; captura accesoria de pesca de arrastre; MEDITS; presión de pesca.

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INTRODUCTION

The Triglidae (or gurnards) is a large family of fish of the order Scorpaeniformes, which comprises 8 genera and 125 species dwelling in tropical and temperate marine areas (Richards and Jones 2002). In the Mediterranean Sea, the family is represented by 4 genera (*Eutrigla, Trigla, Chelidonichthys* and *Lepidotrigla*) and 8 species (*E. gurnardus, T. lyra, C. lucerna, C. cuculus, C. obscurus, C. lastoviza, L. cavillone* and *L. dieuzeidei*). These fish are an important component of demersal assemblages in terms of biomass in both the eastern and western Mediterranean basins (Jukic-Peladic et al. 2001, Labropoulou and Papaconstantinou 2004, Massuti and Reñones 2005). Several studies have focused on the life-history traits of these species, such as growth (Papaconstantinou 1981, 1984, Colloca et al. 2003) and spawning (Papaconstantinou 1983, Vallisneri et al. 2011, 2012), feeding (Colloca et al. 1994, Morte et al. 1997, Terrats et al. 2000), as well as on other aspects related to the trophic and habitat partitioning among species (Serena et al. 1990, Tsimenides et al. 1992, Colloca et al. 2010). From an ecological perspective, the 8 gurnard species, along with the closely related African armoured searobin, *Peristedion cataphractum*, play similar roles in the trophic web, feeding mainly on epibenthic crustaceans (Colloca et al. 1994). Interspecific competition for food is reduced by species segregation across gradients of prey size and habitat type (Morte et al. 1997, Colloca et al. 2010, Montanini et al. 2017).

The commercial importance of the Mediterranean gurnards is not negligible. Indeed, the largest-sized species such as *C. lucerna*, *T. lyra*, *E. gurnardus*, *C. cuculus* and *C. lastoviza* are a valuable by-catch of demersal fisheries of many Mediterranean sectors (Ordines et al. 2014). Although the impact of fishing on the gurnard populations has rarely been examined, Ordines et al. (2014) pointed out that some commercially important gurnards, such as *C. lastoviza* and *C. cuculus,* have also been affected by the overall overexploitation of commercial stocks in the Mediterranean (Colloca et al. 2013, Cardinale et al. 2017). As a result, their levels of overexploitation are similar to, or even higher than, those detected for some of the most important target species such as hake and red mullet (Ordines et al. 2014). As has been demonstrated for the North Atlantic, the trends in the by-catch species (including gurnards), are quite similar to those of the principal target species, showing high exploitation rates and declining stock biomasses during the late 20th century (Cook and Heath 2018).

In the present study we investigated the abundance and distribution of 9 gurnard species over a large spatial scale covering the northern Mediterranean Sea that corresponds to EU waters. The main objective of the study was to elucidate the temporal and spatial variations in species abundances across the northern Mediterranean and to discuss the possible role of fisheries in the observed pattern.

MATERIALS AND METHODS

Survey data

The study was carried out in the framework of the international Mediterranean bottom trawl survey (MEDITS) in the northern Mediterranean using data from 1994 to 2015. The survey incorporated 17 out of the 27 geographical subareas (GSAs) into which the entire Mediterranean has been subdivided and 6 ecoregions (Spalding et al. 2007) from the northern Alboran Sea to Cyprus (Fig. 1). The gurnard data come from 23941 hauls carried out during daytime, mainly from spring to early summer (May-July) at depths of 10 to 800 m. In GSAs 5, 15 and 25, time series were shorter or incomplete, and in GSAs 20, 22, 23 and 25 some years were missing. The sampling procedure was standardized according to a common protocol (Bertrand et al. 2002, Anonymous 2017). For each of the nine species considered, a relative biomass index by haul (BI_h) was calculated as the total

Fig. 1. – Map of the study area showing FAO geographical sub-areas (GSAs) and 6 marine ecoregions (Spalding 2007).

biomass of the specimens caught per square kilometre (kg km^{-2}). A matrix of 9×23941 BI_h values was therefore obtained.

Temporal and spatial trends in relative biomass

BI_h values were averaged by year, GSA and ecoregion (Spalding et al. 2007) to get annual mean species biomass (BI_y) values. The temporal trend in BI_y was first calculated for the whole assemblage (i.e. the nine gurnard species pooled together), separately for the continental shelf (0-200 m) and the slope (200-800 m). A more detailed analysis was carried out for each single species at the ecoregion and GSA level to investigate temporal and geographical differences in species abundance. BI_y values of a given species in each GSA and ecoregion were calculated for the depth range where 90% of the positive hauls for that species was found (Fig. 2). This was also done in order to eliminate the outliers in the depth distributions and possible errors linked to species misidentification.

The data from the northern Adriatic (GSA 17) were analysed separately for the west (GSA 17a) and east (GSA 17b) side to account for differences due to fishing pressure and/or differences in the environmental characteristics between these two areas.

The proportional rate of change in BI_y was calculated between the first and the last 3 years (i.e. 1994-96 and 2013-15) in GSAs 1, 6, 7, 8, 9, 10, 11, 16, 17a, 17b, 18, 19, 20, 22 and 23. In the case of GSAs 5 15 and 25, where the MEDITS time series is shorter, the change in BI_y was estimated between 2007-09 and 2013-15 (GSA 5), and 2005-07 and 2013-15 (GSAs 15 and 25).

The non-parametric LOESS smoother was used to find a curve of best fit of species BI_y in each GSA and ecoregion over time without assuming that the data must fit to a specific distribution shape (Cleveland et al. 1992). When a significant linear trend in species relative biomass occurred over time, this was indicated either in the GSAs or in the ecoregions. Results were finally summarized using the "traffic light" representation.

Species dominance was explored in each ecoregion by means of k-dominance curves produced using the R package *BiodiversityR* (Kindt and Coe 2005).

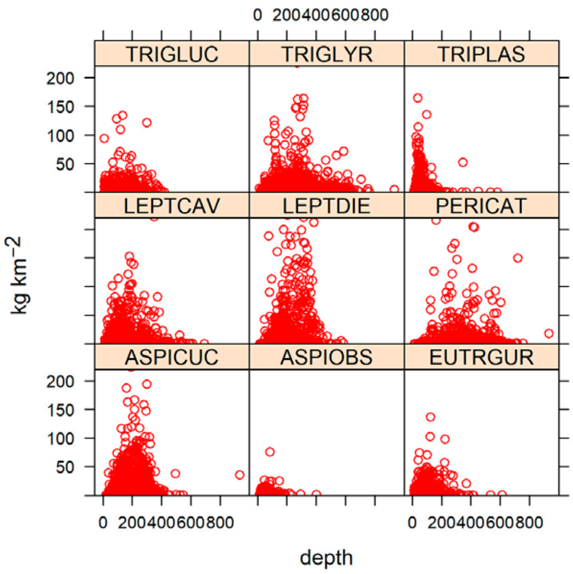

Fig. 2. – Depth distribution of the 9 species of Mediterranean gurnards. Species CPUE (kg km^{-2}) per haul are plotted for all GSAs combined. TRIGLUC, *Chelidonichthys lucerna*; TRIGLYR, *Trigla lyra*; EUTRGUR, *Eutrigla gurnardus*; ASPICUC, *Chelidonichthys cuculus;* ASPIOBS, *Chelidonichthys obscurus*; LEPICAV, *Lepidotrigla cavillone*; LEPIDIE, *Lepidotrigla dieuzeidei*; TRIPLAS, *Chelidonichthys lastoviza*; PERICAT, *Peristedion cataphractum.*

RESULTS

Geographical pattern in gurnard composition

There were clear differences in gurnard composition among Mediterranean ecoregions (Fig. 3). The species guilds appeared similar in the Ionian Sea (ION) and the western Mediterranean, where the most abundant species was *C. cuculus*, accounting

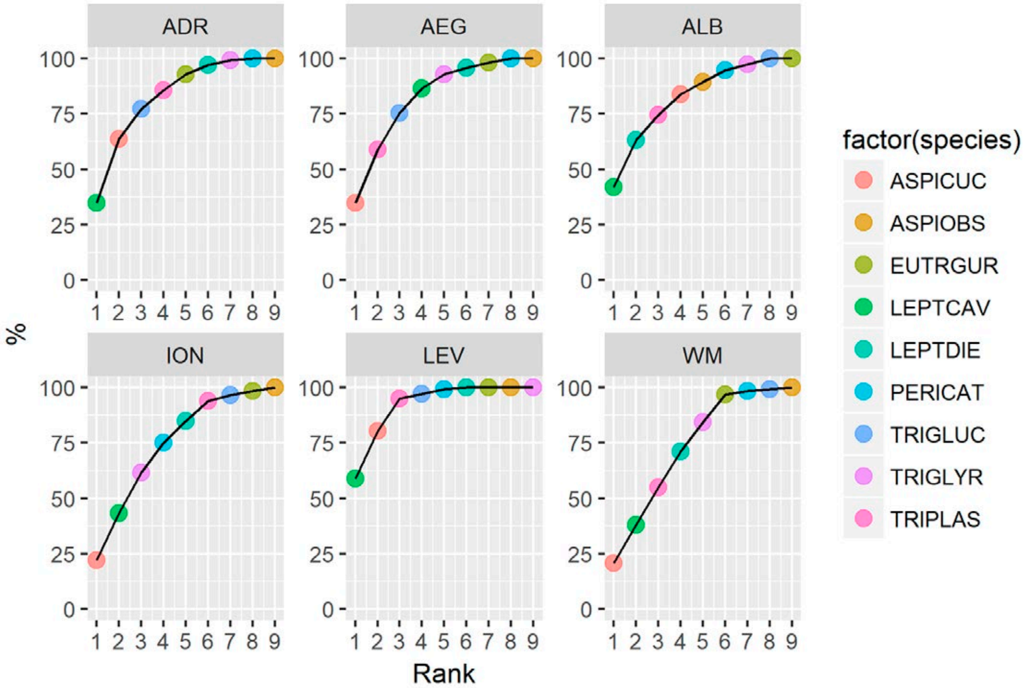

Fig. 3. – Species rank-accumulation (k-dominance) curves of gurnards in the six Mediterranean ecoregions. ADR, Adriatic Sea; ALB, Alboran Sea; AEG, Aegean Sea; ION, Ionian Sea; LEV, Levantine Sea; WM, western Mediterranean. Species code as in Figure 2.

for about 25% of the observed relative biomass, also accounting for more than 80% combined with four other species (*L. cavillone, L. dieuzeidei, C. lastoviza, T. lyra*). In the Adriatic Sea (ADR), the guild was dominated by *L. cavillone* and *C. cuculus*, accounting together for more than 60% of the species biomass, while in the Alboran Sea the dominant species were the two *Lepidotrigla*. A very different pattern arose in the Levantine (Cyprus, GSA 25), where three species (*L. cavillone, C. cuculus* and *C. lastoviza*) accounted for more than 90% of the relative biomass. Finally, in the Aegean region, *C. cuculus, C. lastoviza* and *C. lucerna* accounted for about 75% of the total biomass.

Trends in the overall gurnard abundance

Gurnards were generally more abundant on the continental shelf (0-200 m, Table 1) than on the slope (200-800 m, Table 2). The highest gurnard biomass index (BI_y) was found on the shelves of Malta (GSA 15, 112.2 kg km^{-2}) and the Balearic Islands (GSA 5, 86.4 kg km^{-2}) during the period 2013-2015 and on the shelves of the eastern Ionian Sea (GSA 20, 71.3 kg km^{-2}) during the period 2004-2008. The lowest values appeared on the Italian side of the northern Adriatic (GSA 17a, 3.9 kg km^{-2}), the Alboran Sea (GSA 1, 6.2 kg km^{-2}) and the west coasts of Italy (GSA 9, 9.5 kg km^{-2} and GSA 10, 5.1 kg km^{-2}) (Table 1).

Table 1. – Mean MEDITS biomass index (BI_y: kg km^{-2}) of gurnards (all species pooled) on the continental shelf (0-200 m) per GSA and year from 1994 to 2015. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	2.1	4.5	2.8	2.3	7.9	8.9	3.9	5.1	3.3	1.6	8.1	5.8	28.7	21.7	6.3	7.7	0.4	10.9	2.4	2.6	10.9	5.2	
5														129.7	54.3	69.8	116.7	134.8	120.9	62.8	141.0	55.6	
6	9.2	17.0	6.2	7.8	16.1	9.2	13.4	13.1	4.1	5.1	8.9	10.4	15.8	18.5	4.9	12.8	14.4	23.0	9.4	18.5	17.7	18.0	66.8
7	79.6	146.0	101.9	42.1	43.9	80.2	59.5	69.0	70.3	54.7	41.8	39.1	54.4	55.3	72.4	65.0	49.7	40.6	53.9	77.3	28.0	27.0	–59.6
8	26.1	39.9	46.6	62.1	23.8	50.6	25.4	29.5		25.6	20.4	32.2	38.1	39.2	54.5	52.2	29.9	42.6	56.2	58.3	41.1	38.9	
9	12.9	15.3	17.7	17.0	18.3	16.0	15.1	10.7	12.3	35.6	17.1	10.0	6.3	11.8	13.1	14.0	18.6	12.4	8.6	9.5	9.8	9.2	
10	11.4	16.7	15.5	8.5	17.1	11.9	14.3	14.6	12.1	15.5	4.3	9.6	9.9	13.8	4.9	13.4	11.1	12.5	12.1	6.0	7.0	2.2	–65.1
11	39.7	28.5	35.9	34.5	39.4	65.4	26.6	85.6	38.0	60.1	33.7	57.4	45.0	86.4	24.6	43.5	40.0	43.8	47.0	17.1	15.8	29.7	
15												45.7	88.8	83.8	127.4	95.9	51.7	97.8	75.0	75.3	166.4	94.8	
16	7.9	41.2	20.4	32.6	19.0	13.3	26.7	16.8	33.7	36.4	40.6	47.1	47.5	46.0	59.3	60.1	67.3	32.1	31.3	41.6	46.9	32.5	74.0
17a	3.3	3.2	6.1	3.7	2.2	18.3	10.1	5.4	13.9	6.1	6.2	8.0	7.1	3.8	4.3	2.1	3.3	3.4	2.9	2.6	4.9	4.2	
17b			26.2	14.0	11.7		27.6	13.7	40.7	24.0	33.3	27.4	20.7	23.0	29.8	28.3	20.9	8.7	18.0	12.7	10.1	20.5	
18	2.7	3.4	2.8	2.8	3.4	19.9	8.3	19.9	26.4	8.2	10.2	26.4	10.7	10.3	13.9	17.0	21.7	15.0	22.4	9.0	8.6	1.6	
19	8.5	5.0	2.5	0.6	4.4	3.0	3.7	2.9	31.0	11.9	29.8	13.4	8.7	5.8	10.9	4.5	5.3	6.6	20.4	16.4	14.1	7.2	
20	8.7	13.2	69.9	33.9	39.4	27.1	30.0	40.7		45.1	48.4	114.9	65.9		56.0						21.8		
22	41.7	29.4	31.9	27.3	27.4	30.1	44.8	29.1		60.7	43.7	51.3	30.4		43.6						30.2		
23	20.6	29.6	28.4	19.6	42.7	41.0	14.7	21.2		54.7	22.2	23.2	15.1		41.1						15.1		
25												12.3	14.4	22.0	10.7	12.0	6.5	10.4	15.7	43.3		26.2	

Table 2. – Mean MEDITS biomass index (BI_y: kg km^{-2}) of gurnards (all species pooled) on the continental slope (200-800 m) per GSA and year from 1994 to 2015. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.4	0.2	0.0	0.1	0.3	
5														25.9	33.3	35.4	25.5	27.6	23.9	29.7	16.3	15.4	–35.1
6	0.2	0.5	1.1	0.5	0.2	0.0	6.9	3.5	1.0	0.3	0.7	1.4	4.8	2.9	1.7	3.4	0.6	5.1	1.8	1.4	1.9	5.0	
7	8.0	58.5	44.8	30.8	27.5	62.8	63.4	44.3	26.4	51.8	39.3	44.4	27.0	31.4	32.0	67.1	46.8	57.3	50.1	19.6	55.4	62.3	
8	38.1	41.9	37.7	26.9	37.1	32.6	10.7	37.1		20.3	32.4	28.3	48.6	47.3	26.0	19.2	23.9	23.5	13.5	16.5	25.6	21.2	–46.3
9	0.9	2.0	1.4	1.1	0.9	0.3	1.1	0.6	1.0	1.1	1.8	1.1	1.2	0.7	0.8	6.3	1.8	1.2	4.2	4.2	2.3	1.8	88.0
10	0.7	1.2	1.8	1.7	4.8	1.5	3.5	0.8	1.5	3.1	3.0	6.0	4.4	2.0	4.4	4.9	5.4	3.2	3.7	5.1	2.1	1.5	136.0
11	12.2	9.5	33.0	14.8	19.6	10.5	10.2	22.8	28.4	10.3	4.5	14.3	2.3	12.5	3.2	7.3	4.6	6.2	8.9	4.4	1.8	9.7	–63.9
15												58.6	27.3	1.3	40.3	36.8	36.5	65.7	49.9	24.3	23.9	36.7	
16	6.0	1.3	4.8	0.4	1.3	0.7	0.4	2.1	4.0	9.8	2.1	6.9	6.1	10.7	16.8	24.5	4.7	5.8	5.9	4.1	1.1	4.7	
17a	0.0	0.1	2.4	2.0	3.7	13.3	3.9	0.4	21.1	13.0	5.8	0.9	1.2	2.5	3.9	1.1	4.4	0.4	0.1	1.1	8.6	2.0	
17b			2.2	11.3	1.1		112.4	20.8	1.7	1.4	0.6	1.6	5.7	3.2	0.0	0.4	15.1	0.3	5.9	1.4	6.1	4.7	
18	5.7	6.6	9.5	1.2	0.9	29.5	4.8	4.1	14.6	3.4	14.1	7.3	2.6	15.7	8.5	12.3	2.7	2.1	5.1	2.7	4.2	2.9	
19	0.0	0.1	0.2	0.3	0.0	0.1	0.3	0.9	0.2	0.5	0.7	0.2	0.9	0.7	0.2	0.3	0.4	2.2	0.4	1.8	0.4	0.9	875.6
20	12.6	0.0	8.1	1.1	7.8	25.0	14.7	24.4		52.1	39.6	39.0	34.0		41.8						15.2		448.3
22	6.7	8.5	10.2	8.1	14.3	21.9	17.9	9.7		28.9	25.8	19.8	16.0		29.9						8.1		
23	8.9	0.4	14.0	13.8	24.7	28.8	16.9	28.7		40.5	31.0	27.5	18.1		14.8						9.2		
25												17.0	33.9	19.0	11.3	21.5	14.7	9.7	14.3	8.7		30.1	

The shelf areas where a significant negative linear trend in BI_y was found were the Gulf of Lions (GSAs 7, r^2=0.27, p<0.01) and the southern Tyrrhenian Sea (r^2=0.28, p<0.01) while the trend was positive in northern Spain (GSAs 6, r^2=0.30, p<0.05) and south of Sicily (GSA 16, r^2=0.30, p<0.01) (Fig. 4A).

The highest mean BI_y values of gurnards on the continental slope in the last three years of the time series were found in the Gulf of Lions (45.8 kg km^{-2}), Maltese waters (28.3 kg km^{-2}) and the eastern Ionian Sea (38.6 kg km^{-2} in 2004-2008). For the same period, the lowest relative biomass (BI_y <3.0 kg km^{-2}) occurred in the Alboran, western Ionian, northern Tyrrhenian and Ligurian seas, as well as on the Italian side of GSA 17. Gurnard BI_y increased linearly over time in the Tyrrhenian and Ligurian seas [GSA 9 (r^2=0.19, p<0.05) and GSA 10 (r^2=0.14, p<0.05] and in the Ionian Sea [GSA 19 (r^2=0.27, p<0.01) and GSA 20 (r^2=0.26, p<0.05]. A linear decrease occurred in the Balearic Islands (r^2=0.44, p<0.05), eastern Corsica (r^2=0.18, p<0.05) and Sardinia (r^2=0.29, p<0.05) (Fig. 4B).

Temporal trends in species abundance

Lepidotrigla cavillone

The large-scaled gurnard was mostly distributed on the outer shelf between 36 and 187 m depth. It displayed an almost linear decrease in relative biomass in the western Mediterranean (r^2=0.38, p<0.01) and in the Aegean ecoregion (r^2=0.49, p<0.01), while it increased in the Ionian ecoregion (r^2=0.27, p<0.01) (Fig. 5).

At the GSA level a positive linear trend was found in the south of Sicily (r^2=0.27, p<0.01), where there was a 224% increase in BI_y in 2013-2015 compared with the beginning of MEDITS, and in eastern Corsica (GSA 8, +109%: r^2=0.22, p<0.05). The trend was significantly decreasing in the Gulf of Lions (–69%: r^2=0.48, p<0.01), in the southern Tyrrhenian (–75%; r^2=0.17, p<0.05) and northwestern Adriatic seas (–63%: r^2=0.18, p<0.05) (Fig. 5B; Appendix 1). During the period 2013-2015 the highest relative species abundances occurred in Cyprus (26.7 kg km^{-2}), Maltese waters (26.2 kg km^{-2}) and eastern Corsica (GSA 8: 23.0 kg km^{-2}). High BI_y was also found in the eastern Ionian Sea (36 kg km^{-2}) during the

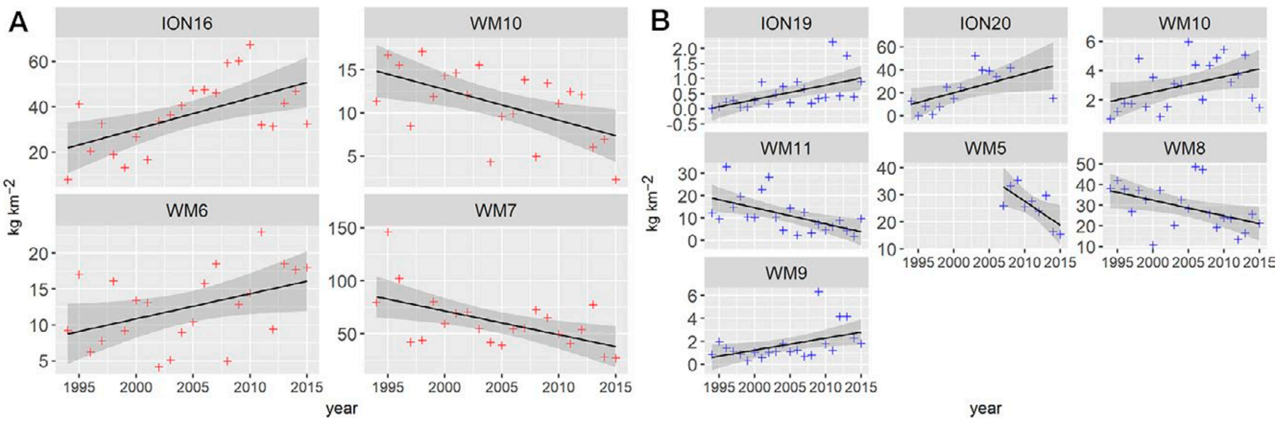

Fig. 4. – All gurnards pooled. GSAs showing a significant linear temporal trend in MEDITS relative biomass index (kg km^{-2}) on the continental shelf (A, 0-200 m) and slope (B, 200-800 m). GSA codes: 10, southern and central Tyrrhenian Sea; 16, south of Sicily; 6, northern Spain; 7, Gulf of Lions; 11, Sardinia; 19, western Ionian Sea; 20, eastern Ionian Sea; 5, Balearic Island; 8, Corsica; 9, Ligurian Sea and northern Tyrrhenian Sea.

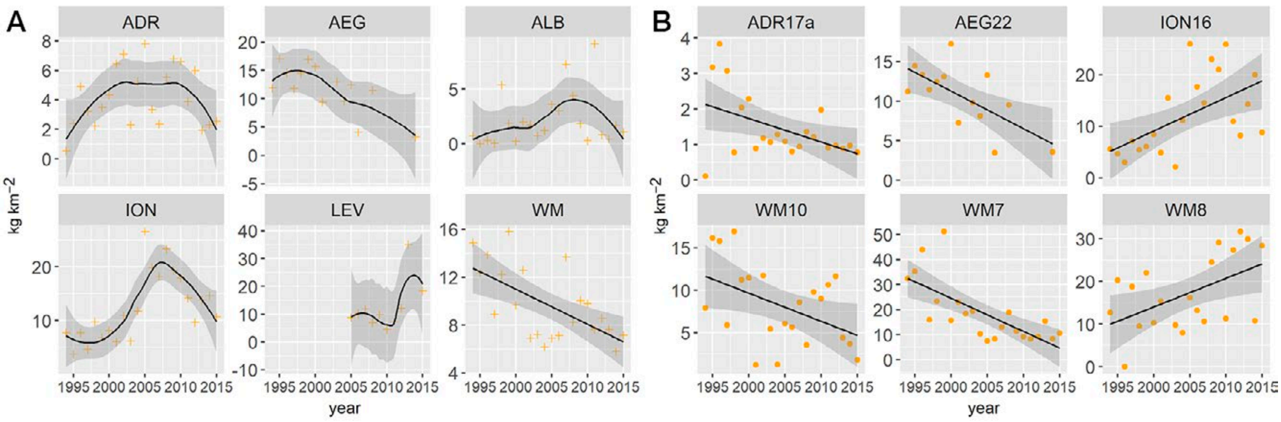

Fig. 5. – *Lepidotrigla cavillone*. Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 10, southern and central Tyrrhenian Sea; 16, south of Sicily; 17a, NW Adriatic Sea; 22, Aegean Sea; 7, Gulf of Lions; 8, eastern Corsica.

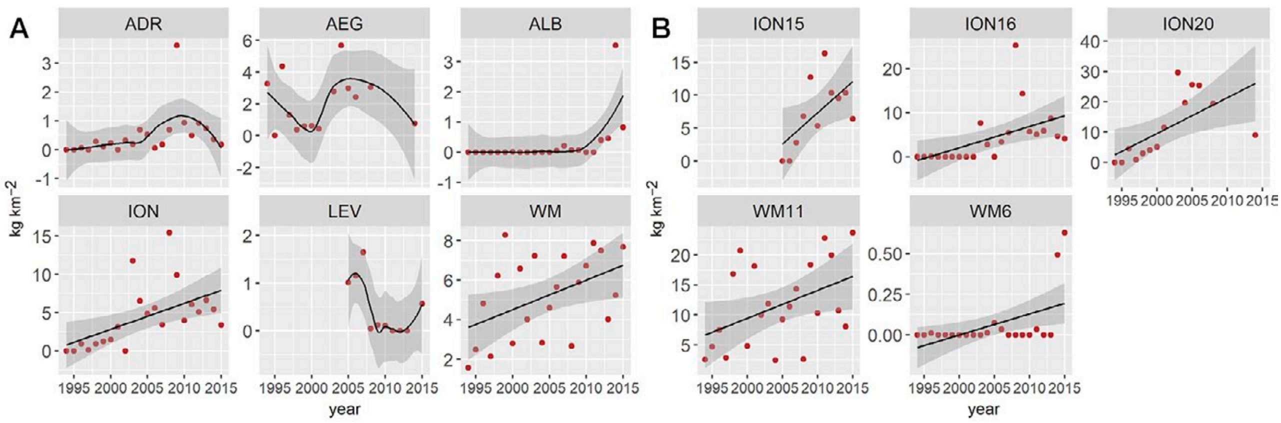

Fig. 6. – *Lepidotrigla dieuzeidei*. Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 11, Sardinia; 15, Malta; 16, south of Sicily; 20, eastern Ionian Sea; 6, northern Spain.

period 2004-2008 (Appendix 1). By contrast, very low abundances (BI_y <1.5 kg km^{-2}) were found in the western sector of the Adriatic Sea and in the western Ionian and Alboran seas.

Lepidotrigla dieuzeidei

The bulk of the MEDITS catch of spiny gurnard was obtained at depths ranging from 70 to 360 m, with the highest abundances in 2013-2015 found in eastern Corsica (25.7 kg km^{-2}), Sardinia (14.2 kg km^{-2}), the Balearic Islands (10.0 kg km^{-2}), the eastern Ionian Sea (9.0 kg km^{-2}) and Malta (8.8 kg km^{-2}, Appendix 2). The species showed a significant increasing trend in the western Mediterranean (r^2=0.21, $p<0.05$) and Ionian ecoregions (r^2=0.25, $p<0.05$) during the study period (Fig. 6A). A significant linear trend was found in Sardinia (r^2=0.15, $p<0.05$), the Ionian GSAs 15 (r^2=0.30, $p<0.05$), 16 (r^2=0.23, $p<0.05$) and 20 (r^2=0.34, $p<0.05$) and northernern Spain (r^2=0.22, $p<0.05$) (Fig. 6B). The species was absent from GSAs 19 and 23, with records also lacking in several other GSAs, especially during the first MEDITS period (1994-2000, Appendix 2), possibly due to misidentifications and confusion with the congeneric *L. cavillone*.

Lepidotrigla spp.

Appendix 3 shows the abundances and trends in the relative biomass of the two *Lepidotrigla* species combined for the 26-360 m depth range, where more than 90% of the positive hauls for the two species were found. The resulting pattern is not very different from the one observed for the large-scaled gurnard, which was more abundant than the spiny gurnard in most of the GSAs. The main differences were a significant increase in the Alboran Sea (+918% in BI_y), mostly due to the occurrence of the spiny gurnard in the catch of the last three years, and a decrease in the Aegean Sea (–55.1% in BI_y).

Chelidonichtys cuculus

Red gurnard was mostly distributed between 60 and 270 m, where it achieved the highest relative abundance in the period 2013-2015 in the Balearic Islands (43.8 kg km^{-2}), south of Sicily (19.8 kg km^{-2}), Malta (13.2 kg km^{-2}) and the Aegean Sea (GSA 22: 11.5 kg km^{-2}, Appendix 4). A positive trend (r^2=0.46, $p<0.01$) was found in the Ionian ecoregion, with a strong increasing trend in the western Ionian Seas (+1039%, r^2=0.34, $p<0.01$) (Fig. 7A

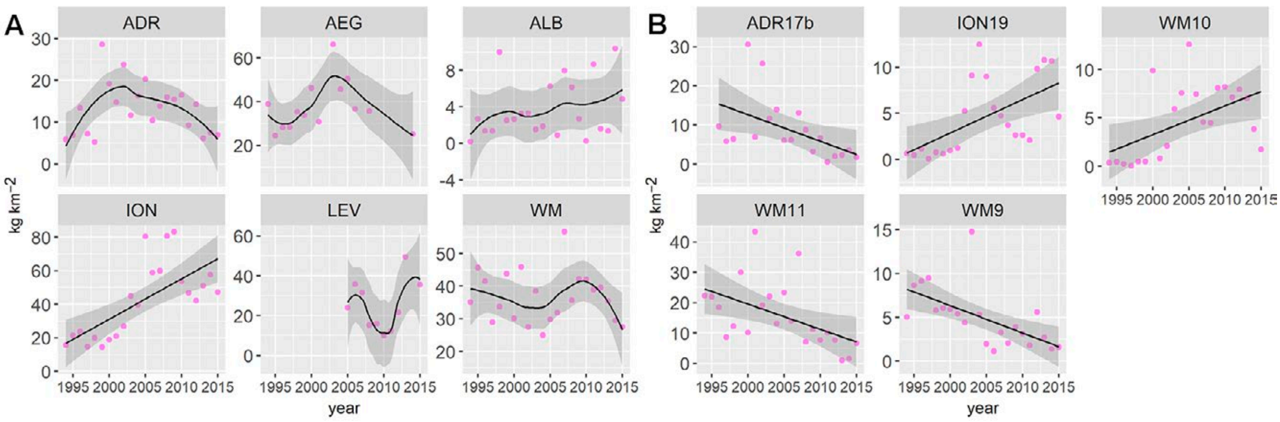

Fig. 7. – *Chelidonichthys cuculus*. Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 10, southern and central Tyrrhenian Sea; 11, Sardinia; 17b, NE Adriatic Sea; 19, western Ionian Sea; 9, Ligurian Sea and northern Tyrrhenian Sea.

and Appendix 4). In the western Mediterranean, the BI_y fluctuated from 1994 with a contrasted spatial pattern: a sharply increasing trend in the southern Tyrrhenian (+1102%, r^2=0.22, $p<0.05$) and a decreasing trend in the northern Tyrrhenian and Ligurian Seas (–75.0%, r^2=0.34, $p<0.01$) and in Sardinia (–85%, r^2=0.21, $p<0.05$) (Fig. 7). In the Adriatic Sea the species was much more abundant on the east side, where, however, it declined significantly from the 1990s (–73.7%, r^2=0.21, $p<0.05$) (Fig. 7B, Appendix 4).

Chelidonichthys obscurus

The longfin gurnard is a shelf species, mostly occurring between 20 and 120 m depth. It was absent in the Adriatic and Levantine ecoregions, occurring sporadically at a very low relative biomass in the Aegean Sea (Fig. 8A). The temporal trend showed a significant decrease in the western Mediterranean (r^2=0.21, $p<0.05$, Fig. 8A) where a linear reduction appeared in GSAs 6 (–88%: r^2=0.13, $p<0.05$) and 7 (–96%, r^2=0.21, $p<0.05$, Fig. 8B). The highest recent (2013-2015) BI_y was found in southern Sicily (1.3 kg km^{-2}), where, however, the species abundance decreased linearly (r^2=0.14, $p<0.05$), and in Sardinia (0.9 kg km^{-2}) (Fig. 8B, Appendix 5). The only area where the species increased linearly through time was the eastern Ionian Sea (r^2=0.23, $p<0.05$, Fig. 8B).

Eutrigla gurnardus

The grey gurnard was more abundant on the continental shelf (30-165 m) of the western Mediterranean region and particularly in the Gulf of Lions. In this area the species was several times more abundant (19.4 kg km^{-2}) than elsewhere. In the other ecoregions (Fig. 9A), it was found at a very low relative abundance and it was absent from the Alboran and southern Tyrrhenian seas, Crete and Cyprus (Fig. 9B and Appendix 6). A significant and positive linear trend in BI_y was found in the Ionian region (r^2=0.48, $p<0.01$) and specifically in Malta (+58.8%, r^2=0.21, $p<0.05$) and south of Sicily (+11000%, r^2=0.34, $p<0.01$, Fig. 9B).

Chelidonichthys lucerna

The tub gurnard is also a shelf species, mainly distributed between 15 and 175 m depth. It was significantly decreasing on the continental shelf of the western Mediterranean (r^2=0.48, $p<0.01$) and specifi-

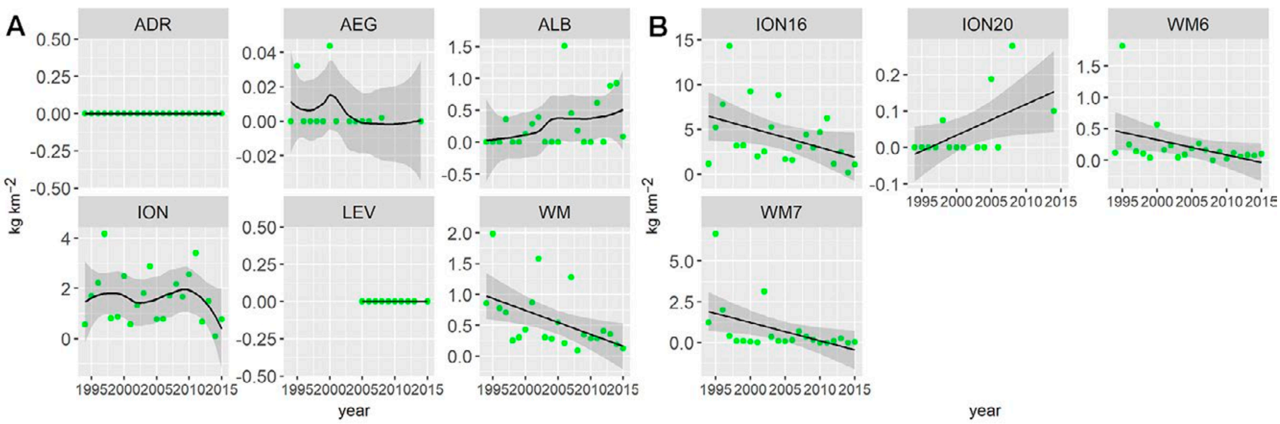

Fig. 8. – *Chelidonichthys obscurus*. Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 16, south of Sicily; 20, eastern Ionian Sea; 6, northern Spain; 7, Gulf of Lions.

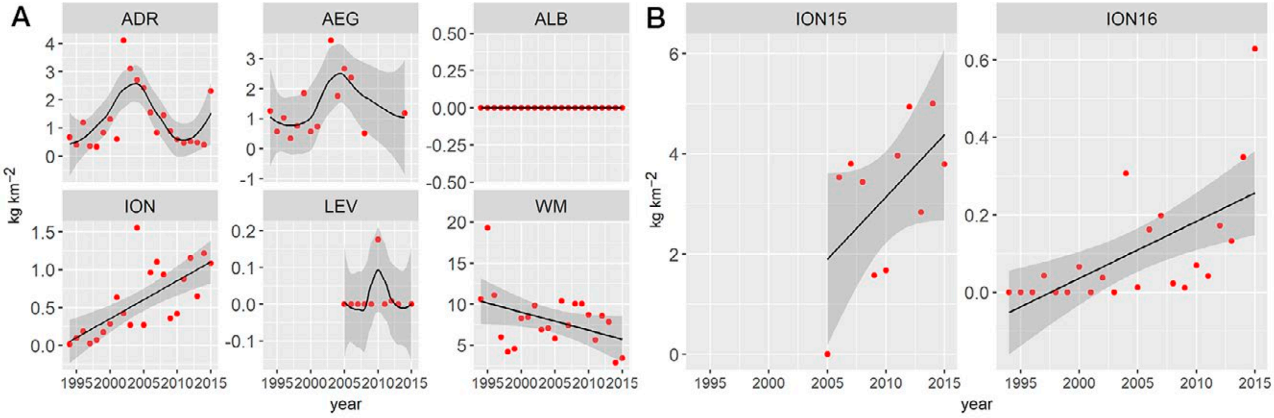

Fig. 9. – *Eutrigla gurnardus*. Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 15, Malta, 16, south of Sicily.

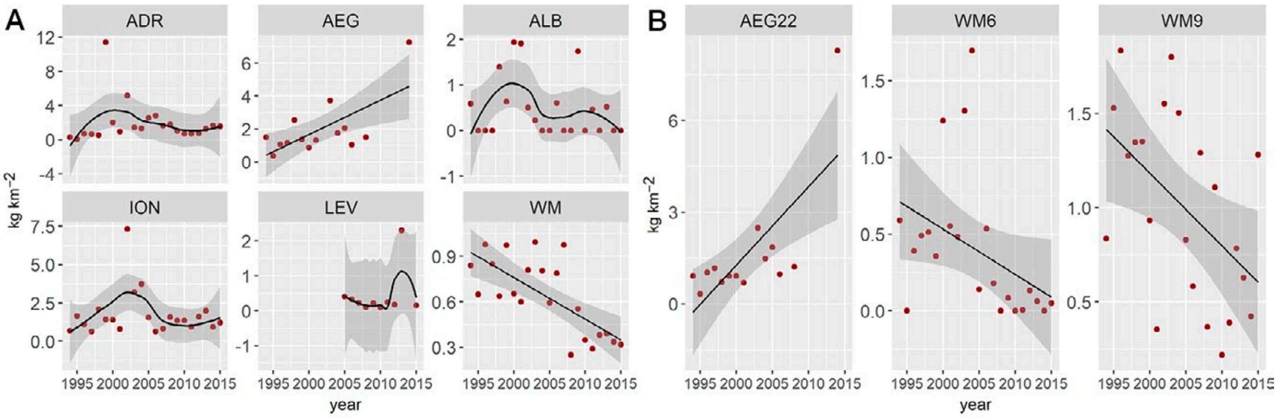

Fig. 10. – *Chelidonichthys lucerna*. Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 22, Aegean Sea; 6, northern Spain; 9, Ligurian Sea and northern Tyrrhenian Sea.

cally in the GSAs 6 (r^2=0.13, p<0.05) and 9 (r^2=0.22, p<0.05), while an increasing trend was observed in the GSA 22, in the Aegean Sea (r^2=0.41, p<0.01) (Fig. 10). In the other regions the species fluctuated at low abundance levels without any clear temporal trend (Appendix 7). In 2013-2015 the highest BI_y was obtained on the continental shelf of the Aegean Sea (8.3 kg km^{-2} in 2014) and the western Ionian Sea (GSA 19: 2.8 kg km^{-2}, Appendix 7).

Trigla lyra

The piper gurnard is typically distributed on the continental slope, with the highest BI_y values found in the Gulf of Lions (33.6 kg km^{-2}), Malta (31.1 km^{-2}) and Balearic waters (23.3 kg km^{-2}) during the period 2013-2015 (Appendix 8). The species showed an increasing trend in the western Mediterranean (r^2=0.49, p<0.01) and Ionian (r^2=0.50, p<0.01) ecoregions (Fig. 11A). In the first area, BI_y values increased in the northern Tyrrhenian and Ligurian seas (r^2=0.13, p<0.05), while they decreased in eastern Corsica (r^2=0.26, p<0.01). In the Ionian area the species increased in the Strait of Sicily in GSAs 15 (r^2=0.25, p<0.05) and 16 (r^2=0.17, p<0.05), and in the western Ionian Sea (r^2=0.17, p<0.05, Fig. 11B).

Chelidonichthys lastoviza

The streaked gurnard was mostly caught between 25 and 120 m depth, with the highest BI_y found in Malta (59.3 kg km^{-2}) and the Balearic Island (34.5 kg km^{-2}) in 2013-2015. The species was also abundant in the Aegean Sea in GSA 22 (Appendix 9). It showed an increasing trend in the western Mediterranean (r^2=0.29, p<0.05) and the Ionian ecoregions (r^2=0.18, p<0.05, Fig. 12A). The species showed wide temporal fluctuations in BI_y, with significant positive linear trends in GSAs 6 (r^2=0.29, p<0.01) and 23 (r^2=0.60, p<0.01). A negative trend was found in GSAs 7 (r^2=0.29, p<0.01), 10 (r^2=0.45, p<0.01) and 16 (r^2=0.23, p<0.05), and on both the west (r^2=0.25, p<0.01) and east side (r^2=0.21, p<0.01) of the northern Adriatic Sea (Fig. 12B).

Peristedion cataphractum

The African armoured searobin was mostly present on the continental slope below 200 m, with 90% of the positive hauls being found between 115 and 550 m depth. It reached by far the highest BI_y in Maltese waters (27.3 kg km^{-2} in 2013-2015), being generally more than ten times less abundant in all the other GSAs except GSA 20 in 1994-98 (12.2 kg km^{-2}, Appendix

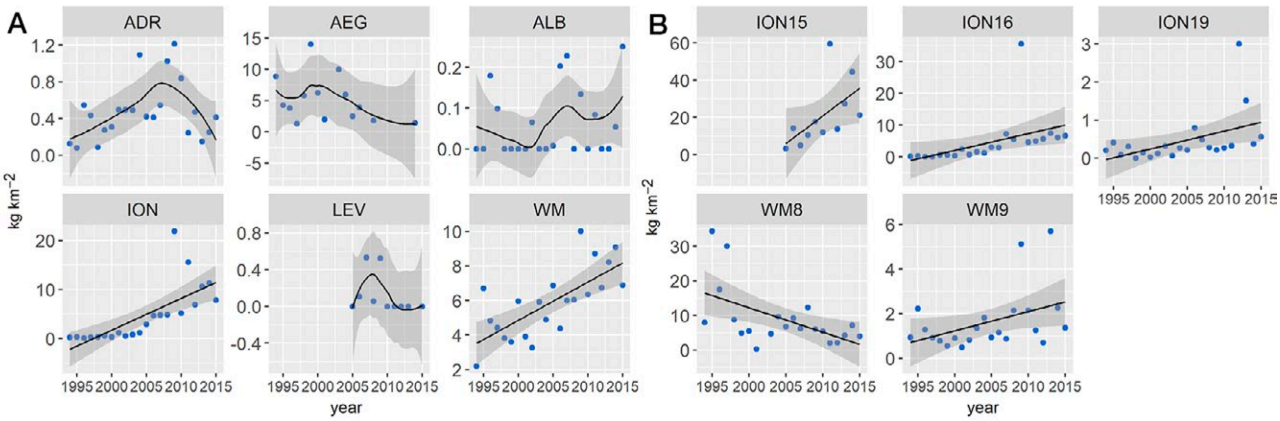

Fig. 11. – *Trigla lyra.* Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 15, Malta; 16, south of Sicily; 19, western Ionian Sea; 8, eastern Corsica; 9, Ligurian Sea and northern Tyrrhenian Sea.

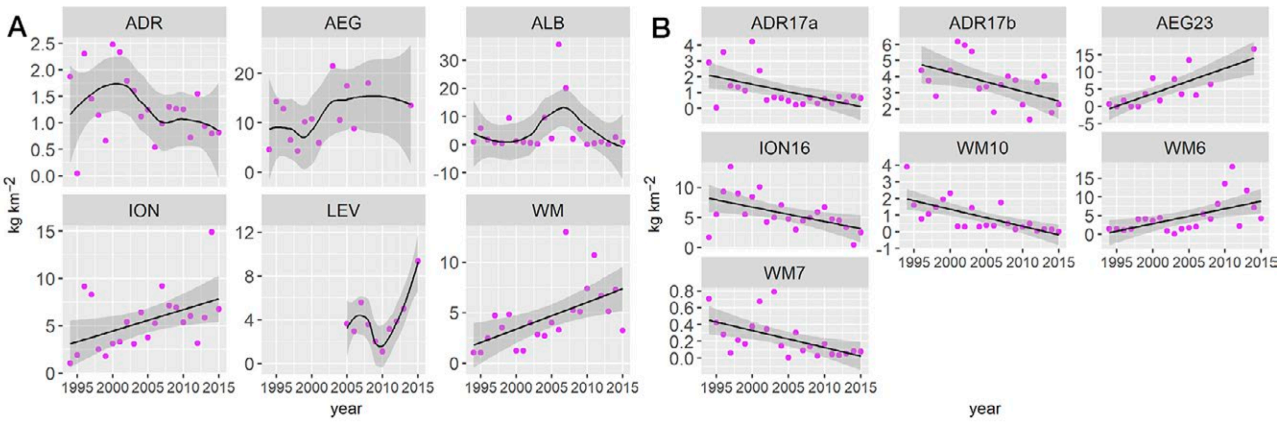

Fig 12. – *Chelidonichthys lastoviza.* Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 10, southern and central Tyrrhenian Sea; 16, south of Sicily; 17a, NW Adriatic Sea; 17b, NE Adriatic Sea; 23, Crete; 6, northern Spain; 7, Gulf of Lions.

10). The species showed a linear increasing trend in the Adriatic (r^2=0.69, p<0.01), Ionian (r^2=0.48, p<0.01) and Levantine (r^2=0.35, p<0.05) ecoregions and a decreasing trend in the western Mediterranean (r^2=0.47, p<0.01, Fig. 13A). A positive trend was found in the Adriatic (GSA 17a: r^2=0.20, p<0.05 and 18: r^2=0.77, p<0.01), south of Sicily (r^2=0.16, p<0.05) and the western Ionian Sea (r^2=0.16, p<0.05), while a significant linear decrease was observed in Sardinia (r^2=0.46, p<0.01, Fig. 13B).

DISCUSSION

This study provides an overview of the status of gurnards in the northern Mediterranean Sea using 22 years of MEDITS bottom trawl survey data. Gurnards

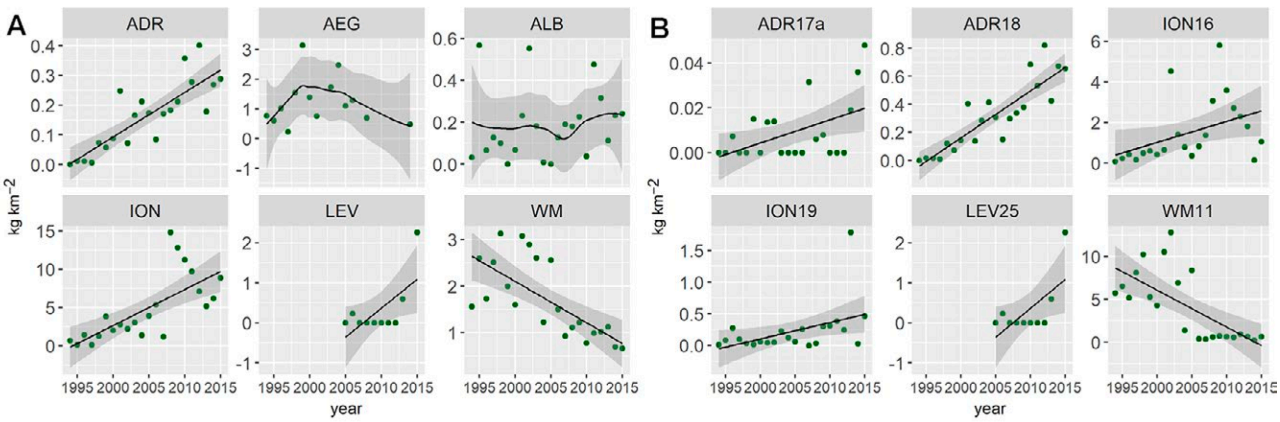

Fig. 13. – *Peristedion cataphractum.* Mean and 95% confidence intervals of the MEDITS relative biomass index (kg km^{-2}) in the Mediterranean ecoregions (A) and geographical sub-areas (GSAs, B) where a significant linear trend was found. GSA codes: 11, Sardinia; 16, south of Sicily; 17a, NW Adriatic Sea; 18, southern Adriatic Sea; 19, western Ionian Sea; 25, Cyprus.

are an important component of demersal assemblages in Mediterranean ecoregions, inhabiting soft and detrital bottoms from the shallower portion of the continental shelf to the upper slope. Some of them, such as *C. lucerna*, *T. lyra*, *C. cuculus, C. lastoviza* and *E. gurnardus*, can be important commercial species for the demersal fisheries. The other species mainly constitute commercial or non-commercial trawling by-catch. Results of our study highlighted important differences among Mediterranean ecoregions and sub-areas (GSAs) in terms of species composition and dominance, which are probably related to the different biogeographic affinity of the species. The majority of the Mediterranean gurnards have a sub-tropical affinity, with only *C. cuculus, C. obscurus* and *E. gurnardus* being temperate species (http://www.fishbase.org). In particular, the Ionian and western Mediterranean ecoregions appeared very similar in the structure of the gurnard species guild, with *C. cuculus* being the most abundant species, followed by five others (*L. cavillone, L. dieuzeidei, T. lyra, C. lastoviza, P. cataphractum* or *E. gurnardus*) with a similar level of abundance, together accounting for more than 90% of the relative biomass for the examined period. An opposite pattern was observed in the Levantine Sea, where only data for Cyprus are available. Here the k-dominance curve is steep with three species, *L. cavillone*, *C. cuculus* and *C. lastoviza* dominating the species guild.

The Alboran Sea is featured by the lowest relative biomass of gurnards; the two *Lepidotrigla* species are the most common gurnards and the grey gurnard is absent. This peculiarity can be related to the influence of Atlantic inputs and the semi-permanent Almería–Oran hydrographic front, which plays a key role in defining the Alboran Sea as a specific fish fauna area within the northern Mediterranean Sea (Gaertner et al. 2005).

In the Adriatic region, the guild is dominated by *L. cavillone, A. cuculus* and *C. lucerna*. Here gurnards were found to be more abundant on the east than on the west side of the basin, probably also due to the eastward ontogenetic migration of the juveniles towards the Croatian coasts, as observed for *C. cuculus* (Vallisneri et al. 2014). Interesting is the absence in this region of the longfin gurnard (*C. obscurus*), which was also absent in Crete (GSA 23), as reported also by Tsimenides et al. (1992), and in Cyprus (GSA 25). The longfin gurnard also appears rare in the Aegean Sea, where it was not found in a study carried out in the 1970s (Papaconstantinou 1983). In this region, the four most abundant gurnards, in order of importance, were found to be *C. cuculus*, *C. lastoviza*, *C. lucerna* and *L. cavillone*.

The species displaying the highest geographical differences are *E. gurnardus* and *P. cataphractum.* The first is abundant only in the Gulf of Lions, rare in most of the GSAs and absent in the southern Tyrrhenian (GSA 10), Crete and Cyprus. The dominance of *E. gurnardus* on the continental shelf of the Gulf of Lions was already reported by Campillo et al. (1992). *P. cataphractum* is consistently more abundant in the Maltese waters than in all the other GSAs.

In terms of overall abundance, the Balearic Islands (GSA 5), Maltese waters (GSA 15), the Gulf of Lions (GSA 7), eastern Corsica (GSA 8) and the eastern Ionian Sea (GSA 20) are the areas with the highest relative biomass of gurnards, while the lowest biomasses are observed in the Alboran and Tyrrhenian seas (GSAs 9 and 10), on the Italian side of the Adriatic (GSA 17a) and in the western Ionian Sea (GSA 19). At first glance this pattern in gurnard abundance could likely be the result of the current distribution of trawl fleets and fishing effort in the Mediterranean (see Colloca et al. 2017, Ferrà et al. 2018). The areas with the highest gurnard relative biomass are those that have the lowest trawl pressure on the continental shelf, while the opposite is observed in areas that have a high effort. Trawl catchability of gurnards is probably high since they live close to the sea bottom, mostly on soft and detrital sediments that are easily exploitable by trawlers. Some local studies support this hypothesis. For example, gurnards were the species showing the highest rate of abundance increase (about 500 fold) on the outer shelf (50-100 m) of northwest Sicily after some years of trawling ban (Pipitone et al. 2000). In the Ionian Sea species like *T. lyra*, *L. dieuzeidei* and *P. cataphractum* were several times more abundant on the poorly exploited continental slope of Greece than on the intensively exploited Italian fishing grounds (D'Onghia et al. 2003). Similarly, in the northern sector of the Strait of Sicily the abundance of gurnards on poorly exploited fishing grounds on the continental slope was several time higher than in the traditionally exploited areas (Gristina et al. 2006). In the same region, Dimech et al. (2008) found higher relative biomass of *C. cuculus* and *L. cavillone* inside the less exploited Fisheries Management Zone (FMZ) of Malta than in the areas outside the FMZ. This evidence supports the hypothesis that the observed geographical differences in gurnard abundance may result from the different levels of fishing pressure, with areas less impacted by fishing hosting a higher gurnard biomass. Although more investigation is required on the subject, the results of our study point to a possible future use of gurnards as indicators of the fishing pressure exerted on the ecosystem and, as such, a useful tool for monitoring the fishing impact on the demersal fish communities. A summary of the trend observed since the mid-1990s by species and areas is provided in Figure 14 using a traffic light approach. In the western Mediterranean, a general decrease was found for the shallowest species (*C. obscurus, C. lastoviza* and *C. lucerna*), while a "green" status was more common for the upper slope species (*T. lyra* and *P. cataphractum*). A better situation was observed in the Ionian ecoregion (GSAs 15, 16, 19 and 20), where the "green" status was common for the deep-shelf (e.g. *Lepidotrigla* spp., *C. cuculus*) and upper-slope species. The only significant linear decrease in this region was found for *C. obscurus* and *C. lastoviza* in the south of Sicily.

The opposite was observed in the Aegean Sea (GSAs 22-23) and in Cyprus, where the trend was generally positive or stable for the shelf species, with most of the red lights found for deep-shelf and slope gurnard (Fig. 14). A shifting of fishing activities of Greek vessels towards slope resources has recently

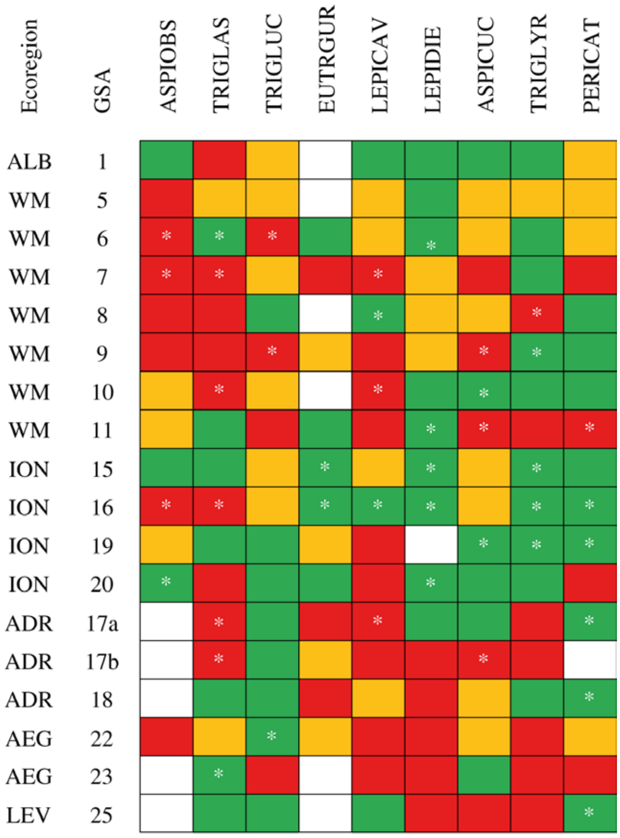

Fig. 14. – Temporal trend in MEDITS biomass index (BI_y: kg km^{-2}) of Mediterranean gurnards displayed using traffic lights: red, decreasing; green, increasing; orange, stable. Only BI_y variation higher than 30% between the initial and final MEDITS period were considered as significant. *, significant linear trend in BI_y: ($p<0.05$). Species code as in Figure 2.

been postulated as an effect of the implementation of EC regulation 1967/2006, which bans bottom trawl activities within 1.5 nautical miles off the coast (Tserpes et al. 2016).

Similarly, deep-water gurnards in Sardinian waters showed the lowest relative biomasses in recent years, with the exception of *L. dieuzeidei*. *P. cataphractum* in particular showed a significant linear decrease in abundance across years, in strong contrast with all other ecoregions and GSAs. This temporal pattern may, besides ecological factors, reflect the modernization of the trawling fishing fleet that took place in the Sardinian fisheries (Marongiu et al. 2017), allowing fishing pressure to shift towards deeper habitats such as those inhabited by *P. cataphractum.*

While there is clear evidence that the excess fishing pressure is reducing the sizes of the gurnard populations in many Mediterranean sectors, there are still important aspects related to the ecology of this guild of species that would be worth exploring in order to understand the factors driving species abundance and distribution. One key feature is related to the habitat preferences of the species. Gurnards seem to prefer detrital sediments on both the continental shelf and slope. *L. cavillone* and *C. cuculus* off the western coasts of Italy appear more abundant on the detrital bottoms over the continental shelf break (Serena et al. 1990, Colloca et al. 1997, Damalas et al. 2010). *L. diuzeidei* was found to be more common on the detrital and muddy bottoms of the shallow part of the upper slope (Voliani et al. 2000), while on the coastal shelf, *C. lucerna* was concentrated on the coastal and detrital sandy bottoms and *C. lastoviza* on the coastal detrital sediments (Serena et al. 1990, Ordines et al. 2014). In this study, we found that the areas showing the highest gurnard abundances are those characterized by the prevalence or the wide extension of detrital bottoms, such as Malta, the Balearic Islands, the Greek GSAs and the south of Sicily, the latter characterized by wide offshore banks (Di Lorenzo et al. 2018). Another important aspect is connected with the occurrence of “refugia”, where large spawners of species like *C. lucerna* can find protection from trawling, as was observed in the western Ionian Sea (D’Onghia et al. 2017).

The rapid ongoing warming of the Mediterranean is another key factor that, in combination with fishing pressure, might explain the species temporal trends observed. The increase in water temperature can be potentially beneficial for sub-tropical species such as the harmoured searobin but have a negative effect on the temperate ones such as *E. gurnardus*). The overall effect may be a progressive shift in gurnard distribution and abundance as effects of climate forcing. The NAO index, for example, was found to have an indirect effect on triglids by shaping their prey’s availability (López-López et al. 2011). In Portuguese waters the landings of the large-scaled gurnard, a species with a sub-tropical affinity, decreased unexpectedly during the warm years (Teixeira et al. 2014). On the other hand, the congeneric sub-tropical *L. dieuzeidei* has expanded its distribution range in the Atlantic as an effect of the water temperature increase (Punzón et al. 2016).

Future studies on Mediterranean gurnards should focus on the above aspects, in order to understand specifically how fishing pressure, climate forcing and habitat suitability interact to determine the trends observed in the present study. Other important aspects that would be worth exploring are related to the compensatory effects that may occur within the gurnards guild. The nine species of gurnards inhabiting the Mediterranean basin exploit similar trophic niches, preying on the same groups of crustaceans. Therefore, a decrease in the abundance of one or more of these species could be compensated by the increase and the expansion of the more tolerant species, thus avoiding a functional diversity loss in the ecosystem.

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APPENDICES

Appendix 1. – *Lepidotrigla cavillone*. Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 36-187 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.7	0.0	0.3	0.0	5.4	1.9	0.2	2.0	1.7	0.7	1.2	3.6	3.0	7.3	4.4	1.8	0.3	9.2	0.8	0.4	1.7	1.1	
5														21.8	8.0	13.3	16.1	13.4	13.2	9.1	13.4	10.2	
6	5.1	7.2	2.3	3.4	3.3	2.8	2.1	2.3	1.7	1.4	3.5	3.6	5.7	5.6	1.0	3.2	1.6	2.5	2.0	3.9	4.0	6.0	
7	32.4	35.2	44.0	16.0	23.3	51.2	15.7	23.0	18.4	19.3	10.3	7.5	8.3	13.0	18.8	11.4	9.1	8.4	9.1	15.5	8.4	10.6	–69.1
8	12.7	20.3	0.0	18.8	9.5	22.0	10.3	15.4		9.8	8.0	16.2	13.2	10.6	24.5	29.1	11.3	27.3	31.7	30.0	10.8	28.3	109.3
9	6.4	3.8	3.9	3.8	3.8	4.8	4.8	3.2	4.7	1.8	3.4	2.8	2.9	3.6	4.4	4.5	5.5	3.6	5.5	3.2	4.0	1.6	
10	7.9	16.2	15.8	5.9	16.9	11.2	11.5	1.2	11.7	5.5	1.3	6.1	5.7	8.6	3.5	9.8	9.0	10.6	11.7	4.4	3.7	1.8	–75.1
11	19.7	6.8	9.0	11.6	14.9	11.6	15.3	29.4	2.3	6.1	9.7	12.0	10.4	29.1	8.8	14.8	15.8	7.3	9.8	4.2	3.0	6.7	
15												14	41.5	39.7	44.0	33.3	16.0	35.8	20.4	25.8	26.3	26.6	
16	5.6	4.7	3.0	7.1	5.5	6.1	8.4	4.9	15.5	2.1	11.2	26.0	17.6	14.5	23.0	21.0	25.9	10.9	8.2	14.2	20.0	8.8	224.0
17a	0.1	3.2	3.8	3.1	0.8	2.0	2.3	0.9	1.2	1.1	1.3	1.1	0.8	0.9	1.4	1.2	2.0	0.9	1.0	0.9	1.0	0.8	–62.9
17b			12.6	6.3	4.9		7.6	5.6	8.2	4.2	13.3	14.0	7.8	5.7	15.8	18.7	12.4	7.0	12.8	6.0	4.6	8.4	
18	1.2	1.4	1.3	1.3	1.7	4.6	3.7	11.1	13.7	2.3	3.6	10.8	2.8	1.3	2.2	3.3	6.9	5.1	6.0	0.7	3.1	0.5	
19	9.9	0.6	0.5	0.0	0.2	0.0	0.1	0.2	5.3	1.0	3.7	1.1	1.4	0.4	1.8	0.5	0.3	0.7	2.0	1.3	2.6	1.3	
20	8.9	10.5	27.0	11.3	23.0	15.6	18.2	16.0		15.5	22.7	69.9	25.8		25.3						7.8		
22	11.2	14.5	13.3	11.5	12.4	13.1	17.2	7.3		9.8	8.1	13.3	3.5		9.5						3.6		
23	16.7	35.9	24.8	15.9	27.2	42.3	5.4	20.0		29.8	19.6	7.2	8.1		26.5						0.0		
25												8.8	10.3	11.8	6.9	9.8	4.5	7.3	12.1	35.0		18.4	

Appendix 2. – *Lepidotrigla dieuzeidei*. Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 70-360 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.4	0.3	3.5	0.8	+
5														3.8	3.7	12.4	11.7	14.9	19.3	8.6	11.8	9.2	
6	0.0	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.6	10046.4
7	0.0	0.2	0.6	1.1	0.5	2.5	2.7	1.1	1.4	0.8	0.8	0.1	0.8	2.4	0.7	0.1	0.1	1.3	1.0	1.2	1.3	0.8	
8	21.8	20.3	34.5	6.8	0.1	40.5	5.3	50.2		18.2	15.1	25.8	34.3	48.4	20.8	0.7	31.2	29.4	14.3	19.3	34.1	23.8	
9	0.3	1.2	3.2	3.3	6.5	3.1	2.6	0.3	1.1	14.1	4.2	3.6	1.9	1.4	2.4	5.0	5.7	4.3	2.1	1.2	1.5	3.7	
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	1.1	0.8	0.7	0.5	0.6	0.7	0.5	+
11	2.6	4.7	7.5	2.9	16.8	20.7	4.8	18.1	10.0	11.8	2.5	9.2	11.4	14.3	2.6	18.3	10.3	22.8	19.9	10.8	8.1	23.7	187.2
15												0.0	0.0	2.8	6.8	12.7	5.4	16.3	10.3	9.5	10.4	6.4	843.1
16	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	7.6	2.8	0.0	3.4	5.5	25.3	14.3	5.7	5.1	5.9	8.7	4.6	4.1	35838.2
17a	0.0	0.0	0.0	0.0	0.9	0.2	0.2	0.0	0.5	0.0	0.1	0.2	0.0	0.0	0.9	0.3	0.2	0.1	0.4	0.1	0.3	0.1	+
17b			0.3	0.0	0.0		0.8	0.0	0.4	0.7	2.5	1.3	0.2	0.7	1.3	0.1	1.5	0.4	0.6	0.2	0.2	0.4	
18	0.0	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1	9.5	1.1	0.9	1.7	2.0	0.6	0.0	
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
20	0.0	0.0	4.6	0.9	3.1	4.1	5.1	11.5		29.6	19.6	25.6	25.4		19.4						9.0		485.5
22	1.3	0.0	4.7	1.4	0.4	0.6	0.7	0.5		3.1	6.1	3.4	2.6		3.4						0.7		
23	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0		0.0	0.3	0.0	0.0		0.0						0.0		
25												1.0	1.2	1.6	0.0	0.1	0.1	0.0	0.0	0.0		0.6	

Appendix 3. – *Lepidotrigla* spp. Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 26-360 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.6	0.0	0.2	0.0	5.4	1.4	0.1	1.2	1.3	0.5	1.1	3.2	2.4	5.3	3.7	1.5	0.2	6.6	1.1	0.8	5.5	1.7	917.7
5														22.5	10.4	21.8	23.9	23.9	26.2	15.3	21.8	15.9	
6	5.1	6.4	2.1	3.2	3.5	3.0	2.0	2.2	1.6	1.2	3.2	3.3	5.1	5.2	0.9	3.0	1.3	1.9	1.8	3.2	3.9	6.1	
7	28.8	35.8	43.3	16.8	23.9	52.7	18.5	22.4	19.2	20.1	11.6	7.4	9.6	15.9	18.8	11.8	9.2	10.0	10.7	16.3	9.8	11.1	–65.5
8	12.7	16.4	29.8	9.6	7.8	22.0	10.6	31.2		16.6	15.7	18.7	13.6	38.7	44.9	23.0	33.7	43.7	38.7	37.0	23.6	35.0	62.2
9	6.1	4.6	6.8	6.7	10.2	7.2	6.5	3.9	4.9	17.4	7.2	6.6	4.6	4.5	6.4	9.6	12.7	8.0	7.0	3.7	4.5	4.9	
10	5.9	12.7	10.9	4.6	14.7	11.4	10.3	7.0	7.9	4.3	1.1	6.7	6.1	6.1	3.8	8.8	7.9	9.5	9.9	4.3	3.7	2.2	–65.5
11	18.2	9.2	13.0	13.9	21.6	28.5	16.0	45.1	4.9	26.0	9.5	18.9	20.7	36.5	11.1	29.6	22.1	26.3	29.7	13.1	10.7	24.4	
15												126	42.7	42.4	44.5	41.4	19.0	48.1	30.2	31.7	34.7	29.8	
16	4.4	3.4	2.1	5.8	4.3	4.2	6.6	4.0	13.0	31.7	12.7	20.1	17.8	21.5	45.8	32.4	28.3	13.7	12.2	22.3	20.9	11.9	459.3
17a	0.1	2.8	3.7	2.6	1.4	1.9	2.0	0.7	1.4	0.9	1.2	1.1	0.7	0.8	1.8	1.2	1.8	0.8	1.0	0.8	1.0	0.7	–62.1
17b			11.3	5.8	4.6		8.1	4.8	7.8	4.2	13.9	13.6	7.2	5.5	15.3	16.7	12.4	6.4	11.4	4.9	3.7	7.1	
18	0.9	1.1	1.2	1.2	1.7	5.2	3.4	10.5	13.0	2.3	3.5	10.3	2.6	1.2	2.1	3.6	7.1	5.5	5.9	2.3	3.4	0.5	
19	8.9	0.6	0.4	0.0	0.1	0.0	0.1	0.2	3.5	0.6	2.7	0.8	1.0	0.3	1.3	0.4	0.2	0.5	1.3	0.9	1.9	0.9	
20	6.4	8.5	35.6	13.1	24.2	16.4	18.1	24.3		27.7	30.3	82.4	46.9		45.2						10.9		
22	10.0	10.6	12.4	9.9	10.4	10.8	14.1	6.6		9.6	10.4	18.4	5.0		31.3						4.9		–55.1
23	9.2	25.4	22.3	11.5	28.5	31.6	5.2	20.7		32.0	18.1	6.5	8.0		21.9						0.0		
25												8.8	10.1	11.5	6.3	8.9	4.2	6.6	11.1	31.3		16.8	

Appendix 4. – *Chelidonichthys cuculus*. Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 60-270 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.1	0.0	0.3	1.1	0.9	0.3	0.7	0.1	0.4	0.4	0.2	0.6	0.5	1.0	0.1	0.0	0.0	0.1	0.0	0.1	1.4	1.7	
5														70.5	33.3	40.6	70.1	62.8	49.8	39.2	68.7	23.5	
6	2.0	3.1	0.9	0.6	7.6	3.0	2.3	7.1	0.9	1.9	2.1	4.5	8.2	9.5	1.0	1.8	1.6	3.5	3.7	3.6	4.3	4.6	
7	8.3	11.2	12.4	7.9	8.5	18.9	9.6	16.0	6.2	6.4	4.5	4.9	8.4	11.8	8.4	3.9	7.7	6.3	8.4	13.3	4.6	4.4	
8	8.1	10.4	20.1	6.4	45.8	19.3	10.6	19.7		13.9	18.1	10.2	11.3	31.7	18.2	13.5	11.6	8.1	12.4	17.1	5.8	9.4	
9	5.1	8.7	9.1	9.5	5.8	6.1	5.9	5.4	4.4	14.8	5.3	2.0	1.2	3.3	2.1	3.9	3.1	1.8	5.6	2.7	1.4	1.6	–75.0
10	0.4	0.4	0.2	0.0	0.5	0.5	9.9	0.8	2.1	5.9	7.6	12.6	7.5	4.6	4.5	8.1	8.2	7.2	7.9	7.0	3.8	1.7	1102.0
11	22.3	22.0	18.4	8.6	12.3	30.0	10.1	43.4	19.2	22.0	13.1	23.4	14.0	36.3	7.1	11.2	7.7	10.1	7.6	1.0	1.6	6.6	–85.3
15												8.1	11.4	13.3	17.3	14.0	11.2	11.6	13.1	8.8	17.3	13.4	
16	7.9	33.0	17.3	3.9	3.7	1.6	4.0	4.0	16.2	15.5	20.6	29.8	32.4	33.6	32.3	25.0	30.5	12.2	14.7	18.5	22.9	17.9	
17a	0.1	0.6	0.5	0.6	0.2	1.9	2.6	0.2	2.3	0.8	0.5	0.6	0.3	1.7	1.2	0.5	0.4	1.8	0.9	0.4	1.2	0.5	
17b			9.6	5.8	6.3		30.6	6.9	25.7	11.7	13.9	6.1	6.2	13.1	8.7	3.2	6.7	0.6	2.1	2.2	3.6	1.8	–73.7
18	5.7	8.0	10.3	0.8	1.9	38.7	8.4	13.0	12.1	5.4	10.5	20.3	8.0	13.2	12.2	17.6	14.2	10.1	19.3	7.2	7.9	2.8	
19	0.7	0.5	1.2	0.1	0.8	0.6	1.0	1.3	5.3	9.1	12.5	9.0	5.6	4.7	3.7	2.6	2.6	2.1	9.8	10.8	10.7	4.6	1039.8
20	0.0	2.1	14.3	4.7	10.7	3.1	4.6	13.5		17.9	9.5	18.7	15.7		17.9						7.1		
22	16.0	8.4	7.9	13.4	18.1	11.4	28.7	19.8		40.7	28.9	32.1	22.4		21.7						11.5		
23	1.2	0.8	0.1	6.2	14.1	5.0	3.1	5.4		33.7	9.0	13.4	12.4		16.0						6.0		
25												10.7	19.4	11.7	4.8	1.7	3.0	1.6	3.2	3.1		7.8	

Appendix 5. – *Chelidonichthys obscurus.* Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 20-120 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.3	0.4	0.0	0.0	0.0	1.5	0.5	0.2	0.0	0.0	0.6	0.0	0.9	0.9	0.1	
5														0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
6	0.1	1.8	0.3	0.1	0.1	0.0	0.6	0.2	0.2	0.0	0.1	0.2	0.3	0.2	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	–87.9
7	1.2	6.7	2.0	0.4	0.1	0.1	0.1	0.0	3.1	0.4	0.1	0.1	0.1	0.7	0.4	0.2	0.0	0.0	0.1	0.3	0.0	0.0	–96.1
8	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	
9	0.7	0.3	0.5	0.2	0.2	0.2	0.3	0.2	0.3	0.1	1.0	0.4	0.0	2.1	0.0	0.0	0.1	0.0	0.8	0.1	0.1	0.3	
10	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.1	0.1	0.4	0.1	0.2	0.0	0.2	0.2	0.2	0.0	0.2	0.0	0.0	
11	1.5	0.3	0.5	2.3	0.9	1.0	1.2	4.0	3.0	0.8	0.2	1.9	0.6	3.5	0.0	1.4	1.3	1.2	1.6	1.5	0.9	0.3	
15												0.0	0.7	0.2	0.5	0.0	0.0	0.0	0.0	0.3	0.0	1.0	
16	1.2	5.2	7.8	14.3	3.2	3.3	9.2	2.0	2.5	5.3	8.8	1.7	1.6	3.1	4.4	3.0	4.7	6.3	1.2	2.5	0.2	1.1	–64.6
17a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17b			0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.02	0.1	0.1	0.3	0.1	0.0	0.0	0.3	0.1	0.0	0.0	0.0	
20	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0		0.0	0.0	0.2	0.0		0.3						0.1		572.7
22	0.0	0.04	0.0	0.0	0.0	0.0	0.1	0.0		0.0	0.0	0.0	0.0		0.0						0.0		
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0						0.0		
25												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	

Appendix 6. – *Eutrigla gurnardus.* Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 30-165 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5														0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.1	
6	0.3	3.8	0.3	0.9	0.0	0.1	3.1	0.2	0.2	0.2	0.3	1.2	1.6	0.1	0.1	0.3	0.1	0.1	0.2	0.7	1.6	5.4	
7	46.2	108.1	53.0	22.6	16.9	22.2	35.9	38.5	44.4	27.9	28.5	22.0	39.4	31.6	53.3	47.4	36.5	25.5	37.2	35.9	11.7	10.5	
8	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	
9	0.3	0.3	0.1	0.2	0.0	0.1	0.1	0.1	0.3	0.1	0.1	0.05	0.02	0.6	0.05	0.3	0.7	0.4	0.1	0.1	0.3	0.1	
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
11	0.0	0.2	0.1	0.2	0.03	0.3	0.5	1.2	0.0	0.5	0.1	0.6	0.2	1.2	0.1	0.3	0.3	0.2	0.8	0.6	0.7	0.3	
15												0.0	3.5	3.8	3.4	1.6	1.7	4.0	4.9	2.8	5.0	3.8	58.8
16	0.0	0.0	0.0	0.04	0.0	0.0	0.1	0.0	0.04	0.0	0.3	0.01	0.2	0.2	0.02	0.01	0.1	0.04	0.2	0.1	0.3	0.6	11008.1
17a	1.1	0.5	0.6	0.3	0.3	1.6	1.8	0.7	3.5	3.0	2.6	2.2	1.7	0.9	1.4	0.4	0.5	0.6	0.4	0.3	0.5	0.6	
17b			4.0	1.0	1.0		2.4	0.9	7.4	6.8	5.7	5.7	2.9	1.6	2.8	2.0	1.0	0.6	1.1	1.4	0.4	9.6	
18	0.1	0.3	0.1	0.04	0.0	0.2	0.3	0.4	2.3	0.4	0.7	0.3	0.2	0.1	0.4	0.5	0.3	0.2	0.2	0.2	0.1	0.03	
19	0.0	0.2	0.03	0.03	0.1	0.2	0.1	0.01	0.9	0.4	1.3	0.4	0.5	0.0	0.6	0.1	0.1	0.1	0.1	0.1	0.2	0.01	
20	0.2	0.0	0.8	0.0	0.1	0.2	0.7	2.4		0.4	3.9	1.0	1.3		1.2						0.8		
22	1.4	0.7	1.1	0.4	0.9	2.1	0.7	0.9		4.4	2.1	3.2	2.8		0.6						1.4		
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0						0.0		
25												0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.01	0.0		0.0	

Appendix 7. – *Chelidonichthys lucerna.* Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 15-175 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.6	0.0	0.0	0.0	1.4	0.6	1.9	1.9	0.5	0.2	0.0	0.0	0.6	0.0	0.0	1.7	0.0	0.5	0.0	0.5	0.0	0.0	
5														0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.7	0.0	
6	0.6	0.0	0.4	0.5	0.5	0.4	1.2	0.6	0.5	1.3	1.7	0.1	0.5	0.2	0.0	0.1	0.0	0.01	0.1	0.1	0.0	0.05	–88.5
7	0.2	0.2	0.1	0.3	0.1	1.2	0.4	0.1	0.4	0.2	0.0	0.4	0.4	0.3	0.6	0.4	0.2	0.3	0.1	0.3	0.2	0.0	
8	0.0	0.0	0.6	0.0	0.0	2.5	0.0	3.3		0.2	0.8	1.3	0.0	0.0	0.0	0.0	3.7	0.0	0.4	0.4	0.5	0.0	
9	0.8	1.5	1.8	1.3	1.3	1.4	0.9	0.4	1.6	1.8	1.5	0.8	0.6	1.3	0.4	1.1	0.2	0.4	0.8	0.6	0.4	1.3	–44.5
10	1.6	0.8	0.3	2.0	0.8	0.5	0.4	1.6	1.4	2.1	0.3	1.2	2.5	1.5	0.7	2.0	0.4	0.9	0.8	1.5	1.4	0.6	
11	1.4	0.5	1.6	0.5	0.6	0.8	0.3	0.5	0.6	0.4	0.2	0.6	1.1	2.5	0.0	0.2	0.3	0.4	0.6	0.2	0.1	0.1	
15												0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.0	0.0	0.0	
16	1.0	0.5	1.8	1.8	2.4	0.5	2.9	0.5	1.0	3.3	1.3	1.8	0.8	1.1	1.2	1.7	1.4	0.4	1.0	2.0	0.8	1.4	
17a	0.3	0.03	0.6	0.4	0.4	13.5	3.8	1.3	8.3	1.6	2.4	4.3	4.6	1.2	0.9	0.3	0.7	1.0	0.7	1.2	2.4	2.3	
17b			0.1	0.1	0.0		0.8	0.3	0.5	0.6	0.4	0.5	0.7	0.5	0.6	2.6	0.4	0.0	0.5	0.7	0.2	0.7	
18	0.1	0.2	1.1	1.2	0.9	9.2	1.0	0.9	3.9	1.9	0.3	1.2	1.6	3.4	4.4	0.9	0.9	0.7	1.1	1.8	1.0	0.5	
19	0.5	2.9	0.9	0.1	3.1	2.0	0.5	1.0	15.1	1.0	8.6	3.0	1.2	1.0	4.7	1.3	2.2	2.9	4.0	3.3	1.7	1.7	
20	0.0	0.1	0.7	0.0	0.5	1.4	1.1	0.8		5.9	0.0	0.0	0.1		0.1						0.9		
22	0.9	0.3	1.0	1.2	0.7	0.9	0.9	0.7		2.5	1.5	1.8	1.0		1.2						8.3		999.3
23	5.3	0.8	1.4	1.1	12.8	3.9	0.6	3.8		9.6	3.2	3.0	1.5		3.0						0.7		
25												0.4	0.3	0.2	0.1	0.2	0.1	0.2	0.2	2.3		0.2	

Appendix 8. – *Trigla lyra.* Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 90-445 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0	0	0.18	0.1	0	0	0	0	0.07	0	0	0.01	0.2	0.23	0	0.13	0	0.08	0	0	0.05	0.25	
5														17.5	27	29.5	21.5	35.9	22.9	24.2	29.1	16.6	
6	0.77	2.15	1.86	2.11	5.02	0.82	8.81	1.49	0.8	0.89	1.19	1.44	4.01	2.62	0.45	3.74	0.61	5.32	2.46	1.95	3.76	2.19	
7	6.07	34	20.5	14.6	9.41	27.9	37.4	30.5	19.5	36.9	18.6	29.6	16.6	16.8	12.7	31.8	20.2	29.9	26.4	31.6	36.5	32.7	
8	7.94	34.4	17.5	30	8.81	4.88	5.5	0.21		4.67	9.59	6.71	9.18	6.19	12.2	6.05	5.39	2	2.15	4.28	7.17	3.92	–74.3
9	0.94	2.22	1.28	0.92	0.77	0.55	0.91	0.48	0.82	1.35	1.82	0.93	1.15	0.87	2.14	5.12	2.14	1.24	0.7	5.7	2.25	1.37	110.1
10	0.17	0.26	0.11	0.15	4.81	0.3	0.2	0.44	0.2	0.9	1	0.75	0.46	1.72	0.51	1.32	2.7	0.85	0.91	0.92	0.82	0.13	
11	3.39	1.93	4.63	3.78	3.08	1.3	1.09	2.83	2.67	3.24	4.58	5.62	1.77	5.19	2.79	1.92	1.9	2.85	1.84	1.22	1.18	2.27	
15												3.25	14.2	4.94	10.6	17.7	12.1	59.6	13.7	27.4	44.5	21.3	317.1
16	0.08	0.23	0	0.02	0.57	0.53	0.32	2.34	0.72	1.58	1.25	3.02	2.96	7.14	5.5	35.6	4.66	4.98	5.67	7.45	6.08	6.59	6443.5
17a	0	0.12	0.37	0.2	0.08	0.32	0.11	0.09	0.21	0.23	0.39	0.15	0.31	0.26	0.33	0.12	0.1	0.08	0.05	0.04	0.18	0.09	
17b			0.97	0.89	0.2		0.43	0.73	0.59	0.66	0.32	0.22	0.47	0.96	1.03	2.87	0.3	0.13	0.1	0.18	0.19	1.46	
18	0.23	0.05	0.48	0.39	0.06	0.25	0.38	0.6	0.68	0.6	1.89	0.68	0.46	0.57	1.55	1.26	1.64	0.41	0.95	0.25	0.36	0.1	
19	0.21	0.41	0.08	0.3	0	0.15	0.02	0.11	0.32	0.07	0.27	0.21	0.79	0.48	0.28	0.21	0.27	0.32	3.01	1.51	0.37	0.55	248.1
20	2.08	0	0.13	0.74	0.62	1.3	0.74	1.43		0.6	2.77	6.2	2.54		3.05						1.52		
22	9.08	4.55	3.4	1.39	6.47	15.5	6.92	2.16		11.1	6.62	2.76	4.26		1.98						1.54		
23	7.13	0	6.98	0	0	0	0.49	0		0	0	0	0		0						0		
25												0	0.11	0.53	0.06	0.53	0	0	0	0		0	

Appendix 9. – *Chelidonichthys lastoviza.* Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 25-120 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	1.0	5.9	1.8	0.8	0.6	9.5	1.3	0.9	0.7	0.3	9.7	2.2	35.7	20.1	2.0	5.6	0.1	0.5	1.0	0.2	2.7	0.9	
5														62.9	23.3	16.6	35.3	64.4	56.2	17.9	61.9	23.8	
6	1.5	1.5	1.1	1.5	4.0	4.1	3.6	4.4	0.9	0.1	1.5	1.8	2.1	5.5	4.1	8.1	13.6	18.1	2.2	11.7	7.1	4.2	357.2
7	0.7	0.4	0.3	0.1	0.2	0.2	0.4	0.7	0.3	0.8	0.1	0.0	0.3	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.1	0.1	–82.8
8	10.0	10.5	7.5	28.1	3.8	5.6	1.2	2.3		7.3	2.6	3.8	6.0	5.5	8.1	5.2	0.0	7.4	8.1	7.9	5.2	2.1	
9	0.1	0.4	0.6	0.1	0.8	1.0	0.6	0.2	0.2	0.1	0.4	0.4	0.1	0.0	0.3	0.2	0.7	0.1	0.4	0.0	0.1	0.0	
10	3.9	1.6	0.8	1.1	1.5	1.9	2.3	0.3	0.3	1.4	0.3	0.4	0.4	1.8	0.5	0.2	0.3	0.5	0.1	0.2	0.1	0.0	–90.4
11	0.0	0.0	7.5	17.2	11.6	15.3	0.0	0.0	18.0	11.6	11.9	16.3	12.6	31.3	10.3	10.1	13.4	11.4	12.8	3.6	4.8	1.7	
15												5.6	25.4	31.9	30.7	25.9	8.4	21.6	2.5	27.1	111.0	39.8	
16	1.7	5.5	9.3	13.5	8.9	5.5	8.5	10.1	4.2	5.0	7.1	4.7	3.0	4.4	4.9	5.9	6.7	4.7	4.5	3.3	0.4	2.5	–60.3
17a	2.9	0.1	3.5	1.4	1.4	1.1	4.2	2.4	0.5	0.7	0.6	0.5	0.2	0.3	0.7	0.3	0.6	0.3	0.7	0.4	0.8	0.7	–69.1
17b			4.4	3.8	2.8		4.4	6.2	5.9	5.6	3.3	3.4	1.8	3.5	4.0	3.8	2.3	1.3	3.7	4.0	1.8	2.3	–28.3
18	0.2	0.0	0.1	0.0	0.0	0.3	0.1	0.3	0.8	0.2	0.2	0.5	0.1	0.0	0.0	0.5	1.4	0.9	1.1	0.2	0.2	0.1	
19	0.3	0.1	0.3	0.0	0.0	0.2	0.6	0.1	6.7	1.9	8.6	0.4	0.7	0.1	0.4	0.1	0.8	0.9	0.9	0.4	0.4	0.7	
20	0.9	0.0	25.6	19.5	1.2	0.8	1.7	1.9		2.4	2.6	4.8	5.0		5.4						5.4		
22	5.1	16.1	14.2	7.1	5.1	11.2	11.2	7.3		25.4	12.1	18.5	9.9		20.7						12.8		
23	0.7	0.0	1.8	0.0	0.0	3.7	8.2	1.8		7.9	3.5	13.4	3.2		6.5						16.6		1269.0
25												3.6	3.0	5.6	3.6	2.0	1.1	3.2	3.8	5.0		9.4	

Appendix 10. – *Peristedion cataphractum.* Mean MEDITS biomass index (BI_y: kg km^{-2}) per GSA and year from 1994 to 2015 in the 115-550 m depth range where 90% of positive hauls occurred. The proportional rate of change (% change) in BI_y was calculated between the first and the last three years of the time series in the GSAs where a significant linear trend in BI_y was found.

GSA	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	% change
1	0.0	0.6	0.1	0.1	0.1	0.0	0.1	0.2	0.6	0.2	0.0	0.0	0.1	0.2	0.2	0.2	0.0	0.5	0.3	0.1	0.2	0.2	
5														0.7	1.1	2.0	1.4	1.8	1.8	3.1	0.7	1.0	
6	0.0	0.2	1.1	0.2	0.1	0.0	0.2	2.5	0.4	0.0	0.1	0.0	1.1	0.7	0.7	1.0	0.2	2.6	1.1	0.7	0.3	0.4	
7	0.1	14.7	0.0	0.0	3.4	3.3	2.6	0.1	0.0	1.7	0.8	0.1	0.1	1.7	0.0	1.6	0.4	0.0	0.9	0.0	0.1	0.2	
8	1.6	2.2	3.9	2.1	1.6	3.7	2.5	5.0		3.5	7.3	4.4	8.6	5.8	3.3	3.5	1.6	2.2	3.9	4.2	3.3	3.1	
9	0.2	0.1	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.3	0.2	0.1	0.1	0.3	0.1	0.3	0.3	0.3	0.2	0.2	0.4	0.2	
10	0.3	0.9	0.4	2.3	2.4	2.0	1.3	1.1	0.5	3.6	1.3	2.3	2.4	0.4	2.9	2.0	1.6	0.7	0.8	1.6	0.8	0.4	
11	5.7	6.5	5.2	8.1	10.2	5.3	4.3	10.5	12.8	6.9	1.4	8.4	0.4	0.3	0.6	0.7	0.6	0.5	0.9	0.6	0.2	0.6	–91.5
15												15	20.3	3.3	60.0	42.4	44.6	41.9	27.4	16.0	25.9	40.1	
16	0.1	0.2	0.4	0.2	0.5	0.6	0.4	0.6	4.5	1.4	0.8	0.4	0.8	1.4	3.1	5.8	3.6	2.7	2.3	1.8	0.1	1.1	315.2
17a	0.0	0.0	0.01	0.0	0.0	0.01	0.0	0.01	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02	0.04	0.05	1333.1
17b			0.0	0.0	0.0		0.0	0.0	0.0	0.1	0.0	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.1	0.3	0.4	0.3	0.1	0.3	0.3	0.4	0.7	0.5	0.8	0.4	0.7	0.7	5469.0
19	0.0	0.1	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.1	0.3	0.0	0.0	0.3	0.3	0.4	0.2	1.8	0.0	0.5	523.8
20	13.0	0.0	12.0	0.4	6.5	20.9	10.5	16.6		13.7	6.9	10.9	12.3		18.5						3.4		
22	0.8	0.7	0.6	0.2	1.7	3.4	1.5	0.8		1.9	2.7	1.2	1.4		0.8						0.5		
23	0.6	0.0	3.8	0.0	0.0	0.0	0.1	0.0		0.0	0.0	0.0	0.0		0.0						0.0		
25												0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.6		2.3	1760.1