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CHONDRICHTHYES CAUGHT DURING THE MEDITS SURVEYS IN ITALIAN WATERS

I CONDROITTI PESCATI DURANTE LE CAMPAGNE MEDITS NELLE ACQUE ITALIANE

Key-words*: fish, trawl survey, biomass, Mediterranean Sea.*

Abstract *– Data on chondrichthyes fished during 16 surveys as part of the MEDITS project carried out from 1994 to 2009 on trawlable bottoms up to 800m depth in all seas around Italy are presented and discussed. From a total of 7 GSAs (10255 hauls) 38 elasmobranch species, including 21 rays and skates, 16 sharks and 1 chimaera, have been identified. Only 10 species occurred in all GSAs, 31 in the Strait of Sicily and 19 in the South Adriatic Sea. The number of species caught per year ranged from 23 to 31.*

Introduction - Although the contribution of elasmobranchs to the market is low (in Italy during 2008, 1375t were landed, according to IREPA data) the by-catch discarded at sea is high and so the management of these fish needs particular attention above all in order to maintain biodiversity and the functions and services of the ecosystem. The interaction between species and the removal of top predators are crucial for the structure and function of the ecosystems. At present some species are threatened, often as a result of human activities. The main reasons for this is that these fish have a k-strategy life span: they grow slowly, mature at a relatively late age, have few young, low natural mortality rates and a very slow population increase (Hamlett 1999, 2005), they are generally top predators and some are rare. They are an important indicator of resource exploitation and the evolution of the community in an area, particularly where there are important multispecies fisheries. The non-sustainable exploitation of elasmobranchs implies an urgent need for a more systematic approach to the assessment and conservation of elasmobranchs.

Action Plans for the conservation of Cartilaginous Fish in the Mediterranean have been proposed at national and international level (in particular, UNEP MAP RAC/SPA 2003; FAO 1998). But there is an urgent need for our knowledge to be updated and no specific research on elasmobranchs has been financed or carried out for more than a year. Most of the data come from trawl surveys for demersal stock assessment (Relini, 2000 and Relini *et al*., 2000) or, in the case of pelagic fish, from longline fisheries. Some data were collected during the ELASMOIT project (Relini *et al*., 2010) supported by the Ministry for the Environment, Land and Sea Protection. There are 72 species present in Italian seas (plus 7 doubtful species) of which one is a chimaera, 41 are sharks and 30 are rays and skates (Vacchi and Serena, 2010). Some species are large, high-speed swimmers, which makes them very difficult to catch by bottom trawling.

At present there is no target fishery for elasmobranchs in Italy. All the landed catch

is a by-catch of other fisheries. As mentioned above, the landed commercial catch in 2008 was 1375t, 63% of which was fished by otter trawlers and 54% were sharks.

Materials and methods - Data were collected during the Medits surveys carried out each year from 1994 to 2009 in the 7 GSAs (Geographical SubAreas established by GFCM-FAO in 2001) of Italian seas (Fig. 1) between May and July on all trawlable bottoms between 10m (Posidonia meadows excluded) and 800m depth. The sampling design was random stratified, five strata were established (see Tab. 1) and the number of hauls was proportional to the surface of strata and the position of hauls was the same in all years. The duration of the hauls was one hour at depths more than 200 m and half an hour at depths less than 200 m. The gear had a vertical opening of 2-2.5 m and small cod end (20 mm stretched mesh).

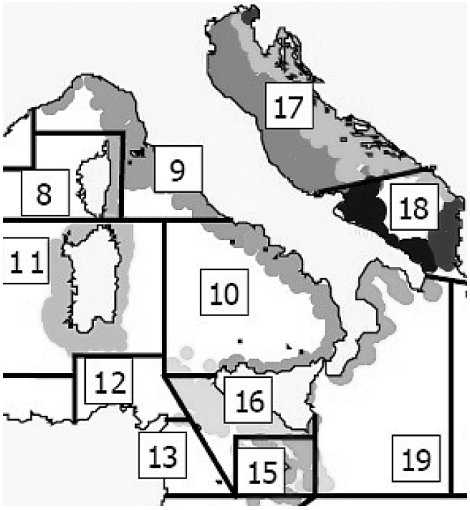

Fig. 1 - The seven Italian GSAs (9, 10, 11, 16, 17, 18, 19).
Le sette GSA italiane (9, 10, 11, 16, 17, 18, 19).

Tab. 1 - The total number of hauls per stratum and GSA.
Numero totale di cale per strato e GSA.

Depth strata (m)	GSA9	GSA10	GSA11	GSA16	GSA17	GSA18	GSA19	Total
0-50	283	118	294	106	671	206	144	1822
51-100	304	145	345	208	494	234	128	1858
101-200	554	248	413	165	359	385	160	2284
201-500	606	324	343	281	110	163	233	2060
501-800	437	403	353	345	11	195	487	2231
0-200 (Shelf)	1141	511	1052	479	1524	825	432	5964
200-800 (Slope)	1043	727	696	626	121	358	720	4291
0-800 (Total)	2184	1238	1748	1105	1645	1183	1152	10255

For information on gear, protocol of methods and processing of data, see Relini *et al*., 2008 and the website (www.sibm.it/SITO%20MEDITS/principalemedits.htm).

The number of hauls per GSA is given in Tab. 1 and a total of 10255 were performed during 16 surveys. Estimates of abundance indices (density n/km^2, biomass kg/km^2) were based on stratified random sampling and swept area method and were computed for two macrostrata: shelf (10-200 m depth) and slope (200-800 m depth).

For species caught in at least 12 out of 16 campaigns carried out (≥75%) a non-parametric Spearman's rho value was estimated so as to test time trends.

The main references for identification and updated nomenclature are Fisher *et al.* (1987), Serena (2005), Serena *et al.* (2010) and Vacchi & Serena (2010).

The references give record of all the papers published by GSAs on elasmobranchs fished during Medits surveys.

Results - During the course of 16 years, 38 species (Tab. 2) including 21 rays and skates, 16 sharks and 1 rabit fish were collected and identified. Only 9 species (including 5 sharks) occurred in all GSAs, and another 10 were present in 6 GSAs.

Tab. 2 - List of species fished during Medits surveys (1994-2009) in each GSA.
Lista delle specie catturate durante le campagne Medits (1994-2009) in ciascuna GSA.

	GSAs								
Species	9	10	11	16	17	18	19	**Total**	**% GSA**
Chimaera monstrosa Linnaeus, 1758	*	*	*	*	*	*	*	**7**	**100.0**
Galeus melastomus Rafinesque, 1810	*	*	*	*	*	*	*	**7**	**100.0**
Scyliorhinus canicula (Linnaeus, 1758)	*	*	*	*	*	*	*	**7**	**100.0**
Scyliorhinus stellaris (Linnaeus, 1758)	*	*	*	*	*	*	*	**7**	**100.0**
Galeorhinus galeus (Linnaeus, 1758)		*						**1**	**14.3**
Mustelus asterias Cloquet, 1821				*	*			**2**	**28.6**
Mustelus mustelus (Linnaeus, 1758)	*	*	*	*	*		*	**6**	**85.7**
Mustelus punctulatus Risso, 1826				*	*			**2**	**28.6**
Heptranchias perlo (Bonnaterre, 1788)	*		*	*			*	**4**	**57.1**
Hexanchus griseus (Bonnaterre, 1788)	*	*	*	*				**4**	**57.1**
Centrophorus granulosus (Bloch and Schneider, 1801)	*	*	*	*		*		**5**	**71.4**
Centrophorus uyato (Rafinesque, 1810)		*		*			*	**3**	**42.9**
Dalatias licha (Bonnaterre, 1788)	*	*	*	*	*	*	*	**7**	**100.0**
Etmopterus spinax (Linnaeus, 1758)	*	*	*	*	*	*	*	**7**	**100.0**
Oxynotus centrina (Linnaeus, 1758)	*	*	*	*	*		*	**6**	**85.7**
Squalus acanthias Linnaeus, 1758	*	*	*	*	*	*		**6**	**85.7**
Squalus blainvillei (Risso 1826)	*	*	*	*		*	*	**6**	**85.7**
Dasyatis centroura (Mitchill, 1815)							*	**1**	**14.3**
Dasyatis pastinaca (Linnaeus, 1758)	*	*	*	*	*		*	**6**	**85.7**
Pteroplatytrygon violacea (Bonaparte, 1832)		*						**1**	**14.3**
Gymnura altavela (Linnaeus, 1758)							*	**1**	**14.3**
Myliobatis aquila (Linnaeus, 1758)	*	*	*	*	*	*		**6**	**85.7**
Pteromylaeus bovinus (Geoffroy St-Hilarie, 1817)					*		*	**2**	**28.6**
Dipturus batis (Linnaeus, 1758)	*							**1**	**14.3**
Dipturus oxyrinchus (Linnaeus, 1758)	*	*	*	*			*	**5**	**71.4**
Leucoraja circularis (Couch, 1838)	*		*	*	*	*	*	**6**	**85.7**
Leucoraja fullonica (Linnaeus, 1758)	*			*		*	*	**4**	**57.1**
Leucoraja melitensis (Clark, 1926)				*				**1**	**14.3**
Raja asterias Delaroche, 1809	*	*	*	*	*	*	*	**7**	**100.0**
Raja brachyura Lafont, 1873			*	*				**2**	**28.6**
Raja clavata Linnaeus, 1758	*	*	*	*	*	*		**6**	**85.7**
Raja miraletus Linnaeus, 1758	*	*	*	*	*	*	*	**7**	**100.0**
Raja montagui Fowler, 1910	*	*		*	*	*	*	**6**	**85.7**
Raja polystigma Regan, 1923	*	*	*		*	*		**5**	**71.4**
Rostroraja alba Lacépède, 1803				*				**1**	**14.3**
Torpedo marmorata Risso, 1810	*	*	*	*	*	*	*	**7**	**100.0**
Torpedo nobiliana Bonaparte, 1835	*	*	*	*	*	*	*	**7**	**100.0**
Torpedo torpedo (Linnaeus, 1758)	*	*	*	*	*		*	**6**	**85.7**
Total species caugth (38)	**27**	**26**	**25**	**31**	**23**	**19**	**24**		

The highest number of species was found in the Strait of Sicily (GSA16: 31 species), the lowest (19 species) in the South Adriatic Sea (GSA18). Eight species including 1

shark were found only in one GSA and three of them during one year only: they are *Galeorhinus galeus* (GSA10, 1995 and 2001), *Dasyatis centroura* (GSA19, 2002) *Pteroplatytrygon violacea* (GSA10, 2000 and 2002), *Gymnura altavela* (GSA19, 2006) *Pteromylaeus bovinus* (GSA17, ten years), *Dipturus batis* (GSA9, 1996) *Leucoraja melitensis* (GSA16, all years excluding 1994 and 2003) and *Rostroraja alba* (GSA16, 1995, 2000, 2003, 2005, 2007, 2008 and 2009).

The number of species caught per year (Tab. 3) was 23 in 1994, 30 in 1995 and fell to 23 in 1997, then increased with some fluctuation to 31 in 2008 and 2009.

Tab. 3 - List of species caught per year in all GSAs.
Lista delle specie catturate ogni anno in tutte le GSA.

	Years																
Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	**Total**	**% su GSA**
Chimaera monstrosa Linnaeus, 1758	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Galeus melastomus Rafinesque, 1810	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Scyliorhinus canicula (Linnaeus, 1758)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Scyliorhinus stellaris (Linnaeus, 1758)		*		*	*		*	*	*			*		*		*	**9**	**56.3**
Galeorhinus galeus (Linnaeus, 1758)		*						*									**2**	**12.5**
Mustelus asterias Cloquet, 1821									*			*	*		*	*	**5**	**31.3**
Mustelus mustelus (Linnaeus, 1758)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Mustelus punctulatus Risso, 1826								*		*	*				*	*	**5**	**31.3**
Heptranchias perlo (Bonnaterre, 1788)		*				*			*	*	*	*	*	*	*	*	**10**	**62.5**
Hexanchus griseus (Bonnaterre, 1788)	*	*	*		*	*	*	*	*		*		*	*	*	*	**13**	**81.3**
Centrophorus granulosus (Bloch and Schneider, 1801)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Centrophorus uyato (Rafinesque, 1810)		*					*						*				**3**	**18.8**
Dalatias licha (Bonnaterre, 1788)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Etmopterus spinax (Linnaeus, 1758)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Oxynotus centrina (Linnaeus, 1758)	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	**15**	**93.8**
Squalus acanthias Linnaeus, 1758	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Squalus blainvillei (Risso 1826)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Dasyatis centroura (Mitchill, 1815)									*								**1**	**6.3**
Dasyatis pastinaca (Linnaeus, 1758)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Pteroplatytrygon violacea (Bonaparte, 1832)							*		*								**2**	**12.5**
Gymnura altavela (Linnaeus, 1758)													*				**1**	**6.3**
Myliobatis aquila (Linnaeus, 1758)	*	*	*		*	*	*	*	*	*		*		*	*	*	**13**	**81.3**
Pteromylaeus bovinus (Geoffroy St-Hilarie, 1817)		*	*	*		*			*		*	*	*		*	*	**10**	**62.5**
Dipturus batis (Linnaeus, 1758)			*														**1**	**6.3**
Dipturus oxyrinchus (Linnaeus, 1758)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Leucoraja circularis (Couch, 1838)			*	*			*	*		*	*	*	*	*	*	*	**11**	**68.8**
Leucoraja fullonica (Linnaeus, 1758)					*	*									*		**3**	**18.8**
Leucoraja melitensis (Clark, 1926)		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**15**	**93.8**
Raja asterias Delaroche, 1809	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Raja brachyura Lafont, 1873	*	*	*		*		*	*	*	*	*	*	*	*	*	*	**14**	**87.5**
Raja clavata Linnaeus, 1758	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Raja miraletus Linnaeus, 1758	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Raja montagui Fowler, 1910	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Raja polystigma Regan, 1923	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Rostroraja alba Lacépède, 1803		*					*			*		*		*	*	*	**7**	**43.8**
Torpedo marmorata Risso, 1810	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Torpedo nobiliana Bonaparte, 1835	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Torpedo torpedo (Linnaeus, 1758)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**16**	**100.0**
Totale species caught	**23**	**30**	**27**	**23**	**26**	**26**	**29**	**28**	**30**	**27**	**27**	**29**	**29**	**28**	**31**	**31**		
Percentage of total species (38)	**57.5**	**75.0**	**67.5**	**57.5**	**65.0**	**65.0**	**72.5**	**70.0**	**75.0**	**67.5**	**67.5**	**72.5**	**72.5**	**70.0**	**77.5**	**77.5**		

With regard to vertical distribution, the presence of species in different strata is reported (Tab. 4). In the last column on the right there are literature data on the vertical distribution of the species. In grey are the Medits data that conflict with the literature data and hence change the known vertical distribution of some species. There is interesting information about *S. stellaris*, *T. marmorata* and *T. torpedo*: whereas previously their vertical distribution was known up to 100 m depth, during the Medits surveys they were collected at more than 500 m depth. Sixteen species were found in all five strata, five in one stratum alone. The highest number of species occurred at the fourth and fifth strata, while the lowest was found at the second stratum, with a difference of five species. Five species were found only on the slope and six only on the shelf.

Tab. 4 - Species occurrence in different strata and literature data regarding depth range.
Presenza delle specie nei diversi strati e dati della letteratura sulla distribuzione batimetrica.

Species	0-50m	51-100m	101-200m	201-500m	501-800m	Literature depth range (m)
Centrophorus granulosus	*			*	*	150-1400
Centrophorus uyato		*			*	50-1400
Chimaera monstrosa			*	*	*	200-700 (1000)
Dalatias licha				*	*	90-1000
Dasyatis centroura	*					up to 200
Dasyatis pastinaca	*	*	*	*	*	up to 200
Dipturus batis					*	up to 600
Dipturus oxyrinchus	*	*	*	*	*	90-900
Etmopterus spinax	*		*	*	*	100-1000
Galeorhinus galeus				*	*	20-470
Galeus melastomus		*	*	*	*	200-1200
Gymnura altavela				*		up to 60
Heptranchias perlo			*	*	*	50-400 (1000)
Hexanchus griseus				*	*	100-1000
Leucoraja circularis			*	*	*	70-275
Leucoraja fullonica				*	*	30-550
Leucoraja melitensis	*	*	*	*	*	60-600
Myliobatis aquila	*	*	*			semipelagic up to 200
Mustelus asterias	*		*			up to 100
Mustelus mustelus	*	*	*	*	*	up to 450
Mustelus punctulatus	*		*			up to 200
Oxynotus centrina		*	*	*	*	60-660
Pteromylaeus bovinus	*					semipelagic 100
Pteroplatytrygon violacea	*	*				pelagic 100 (240)
Raja asterias	*	*	*	*	*	up to 200
Raja brachyura	*	*	*	*		up to 100
Raja clavata	*	*	*	*	*	20-700
Raja miraletus	*	*	*	*	*	50-150
Raja montagui	*	*	*	*	*	up to 650
Raja polystigma	*	*	*	*	*	100-400
Rostroraja alba		*		*	*	40-500
Squalus acanthias	*	*	*	*	*	10-700
Squalus blainvillei	*	*	*	*	*	15-720
Scyliorhinus canicula	*	*	*	*	*	up to 550
Scyliorhinus stellaris	*	*	*	*	*	20-100
Torpedo marmorata	*	*	*	*	*	10-100
Torpedo nobiliana.	*	*	*	*	*	10-150
Torpedo torpedo	*	*	*	*	*	70 (+)
N° species per stratum	**25**	**23**	**26**	**30**	**30**	
Percentage of total species (38)	**66**	**61**	**68**	**79**	**79**	

Grey areas represent new data that conflict with the literature
Le aree in grigio si riferiscono a dati nuovi discordanti con quelli della letteratura

Data on numbers of individuals and biomass per GSA and year in the shelf (10-200 m) and in the slope (200-800 m) are given in Tabs. 5, 6, 7, 8, in which (when applicable) the Spearman rho values show the trend in each GSA.

The most abundant species on the shelf (Tab. 5) are *S. canicula*, *R. asterias*, *R. brachyura* and *R. miraletus.*

A clear negative trend occurs for *S. acanthias* in GSA 17, while positive trends are evident for *R. brachyura* (GSA11), *M. mustelus* (GSA16), *R. clavata* (GSA9 and GSA16), *R. miraletus* (GSA11) and *S. blainvillei* (GSA16). In 87 out of 110 series the data are insufficient to calculate the coefficient, in 24 there is no trend, 6 are positive and 1 negative as mentioned above.

Tab. 5 - Density index (n/km^2) for shelf stratum (10-200 m depth) per GSA. Medits 1994-2009. Significant Spearman rho values are in bold.

Indici di densità (n/km^2) per la piattaforma (10-200 m) e per GSA. Medits 1994-2009. In grassetto i valori del rho di Spearman significativi.

C. granulosus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9																0.076	n.c.
GSA11							0.220										n.c.
C. uyato	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16	4.314																n.c.
C. monstrosa	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA18											0.454						n.c.
D. centroura	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA19									0.873								n.c.
D. pastinaca	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9											0.303				0.378		n.c.
GSA10				0.689													n.c.
GSA11		37.654	4.546	12.660	21.420		6.344	8.909				33.237		70.876	15.238	34.319	n.c.
GSA16									2.316	0.814	0.785	1.361	0.430	0.400	1.607	0.399	n.c.
GSA17									0.415	0.222				0.320			n.c.
GSA19					1.622		7.440	0.880			6.006	10.985	0.858	0.851	10.485	2.623	n.c.
D. oxyrhincus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.241			0.234	0.243			1.032		0.330		0.324		0.326	0.319	0.941	n.c.
GSA11	6.234	3.319	1.076	1.791	0.638	4.339	2.143	8.810		8.373	2.387	2.325	2.801	1.684	2.031	6.898	0.079
GSA16									0.772								n.c.
E.spinax	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA11		3.626					64.690					37.780					n.c.
GSA18														5.274			n.c.
G. melastomus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9			1.438					0.258									n.c.
GSA11						0.189		0.404		0.242	6.600	5.870		0.237	9.641		n.c.
GSA16													0.430				n.c.
GSA18							0.485				3.635						n.c.
H. perlo	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9														0.326			n.c.
GSA16														1.201			n.c.
L. circularis	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16														0.400			n.c.
GSA18												0.460					n.c.
L. melitensis	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16		2.635								4.070	0.785		1.719	0.400	2.009	3.591	n.c.
M. aquila	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.270								1.197					0.410		0.376	n.c.
GSA10		0.698	0.717		2.824	4.245	2.773	4.347		0.778				1.405			n.c.
GSA11	0.277	0.263			1.008		0.529		0.255			0.478			0.996		n.c.
GSA16										4.070					0.402	1.197	n.c.
GSA17				1.451	0.563	6.407	2.154	3.266	16.878	2.188	1.034	1.408	7.584	0.961	7.125	3.330	0.231
GSA18															0.569		n.c.
M. asterias	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16												0.454	3.009		2.411	0.399	n.c.
GSA17									0.866								n.c.
M. mustelus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9					0.262	0.263		0.601									n.c.
GSA10													0.402				n.c.
GSA11					0.252												n.c.
GSA16	1.438	1.318	12.175	5.337	2.547	26.854	11.259	3.896	31.657	8.953	29.056	15.884	8.597	8.008	18.887	32.320	**0.582**
GSA17			7.363	8.526		2.218	0.269	3.859	15.364	1.591	0.207	20.513	7.788	0.801	6.563	1.726	-0.143
GSA18	0.512	2.091				0.371		0.356									n.c.
GSA19	1.595	7.590	2.309	6.776	8.111		0.930	0.880	18.566	1.504	0.858	0.738	6.864	27.246	0.855	25.270	-0.004
M. punctulatus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16											1.571				2.411	0.798	n.c.
GSA17								1.187		2.785	0.414					0.555	n.c.
O. centrina	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.241	0.469	0.266											0.326			n.c.
GSA11						0.189	0.380		132.238								n.c.
GSA16		1.318											0.430				n.c.
P. bovinus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA17				0.284													n.c.
GSA19		2.577	0.778	0.847		0.835			0.873		0.858	1.690	2.574		0.855	0.874	n.c.
P. violacea	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA10							0.699		0.704								n.c.
R. asterias	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	1.526	1.680	5.576	2.112	2.367	8.922	2.505	1.080	4.473	8.076	3.227	1.799	0.413	2.016	1.491	0.376	-0.344
GSA10	1.744	1.871	1.386	0.666	1.263	0.545	2.627	0.725			0.661	2.128			0.756		n.c.
GSA11	14.980	4.654	6.566	1.756	7.985	6.235	5.858	4.657	5.908		1.923	43.059	31.076	18.643	5.509	10.253	0.289
GSA16	10.066	11.858	1.353	2.668	1.273	8.951	2.502	7.792	3.088	2.442	5.497	5.446	4.299	39.237	2.411	9.576	0.059
GSA17	0.289	0.752		0.284	0.992	0.810	0.486		4.253	0.580	0.857	2.166	0.922	0.320	0.844	0.370	0.200
GSA18	0.321	0.548			0.934	0.371			0.538	0.536	0.463	0.465	1.726			0.682	n.c.
GSA19		1.715	1.555			0.835	0.930		1.746		0.858	0.738	7.517	3.406	3.393		n.c.
R. brachyura	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA11	0.456	1.580	0.432		1.260		0.264	15.076	2.348	15.269	102.858	57.466	35.001	42.956	9.756	44.166	**0.754**
GSA16													0.430	0.801	4.822		n.c.
R. clavata	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.963	2.629	2.877	4.520	2.432	4.091	2.050	5.936	8.885	4.616	4.241	4.861	5.499	8.137	16.758	6.943	**0.794**
GSA10	0.558					0.545	0.553						0.466			2.106	n.c.
GSA11	32.738	48.799	30.557	34.605	29.012	33.791	18.708	53.234	14.450	43.082	47.787		54.361	39.858	23.598	38.173	0.161

(Segue/*Follows*)

GSA16	8.628	9.223	6.764	16.010	19.099	7.672	20.016	2.597	19.303	24.418	32.983	31.314	61.901	30.429	47.419	37.507	**0.829**
GSA17		0.236		0.284	0.300	0.880	1.347			0.995	0.207	0.894	1.435	0.481	0.913	0.956	0.483
GSA18	0.321		0.451													2.589	n.c.
R. miraletus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	5.761	7.423	8.028	10.113	10.644	27.746	14.351	6.046	7.540	11.137	5.151	5.623	10.205	8.051	5.541	5.375	-0.318
GSA10	1.744		2.868	3.443		1.415		0.725		1.555		2.165	0.121		0.602	0.646	n.c.
GSA11	13.546	17.900	11.326	22.576	27.663	15.003	12.790	66.283	3.209	34.817		69.189	38.814	56.100	27.652	40.040	**0.589**
GSA16	66.151	169.965	198.865	381.561	145.152	79.282	290.236	97.399	121.222	90.348	168.055	131.155	165.499	144.537	151.099	246.990	0.047
GSA17			2.383	3.484	2.397	3.590	0.595	1.818	3.575	2.398	0.857	3.268	1.677	2.173	1.256	2.612	-0.244
GSA19				0.742		0.717	6.510	1.539	4.288	3.464	4.290	13.413	4.353		2.564	1.749	n.c.
R. montagui	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.722	0.469	0.240	1.441	0.973	2.277	1.794		2.962	0.659	0.909						n.c.
GSA10													0.214				n.c.
GSA16			8.117	20.012	3.820	1.279	3.753	10.389	4.633	3.256	7.068	5.900	2.579	5.205	6.028	5.586	-0.121
GSA17										0.182		0.178					n.c.
R. polystigma	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9												0.972	2.200	4.235	9.264	6.900	n.c.
GSA10								0.668									n.c.
GSA11	15.765	23.788	37.945	31.659	45.179	45.496	33.956	119.790	7.809	44.396	44.720	34.387	60.035	81.235	21.261	19.091	0.141
GSA17						0.246											n.c.
R. alba	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**n.c.**
GSA16							2.502								0.402	0.798	n.c.
S. acanthias	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9				0.234													n.c.
GSA10													0.690				n.c.
GSA11								1.678					0.560				n.c.
GSA17	12.753	50.877	7.403	7.247	387.306	18.549	21.161	20.308	11.331	15.049	14.930	5.457	9.273	7.587	9.106	7.747	-0.368
GSA18	0.321		0.451			0.411											n.c.
S. blainvillei	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9					3.892												n.c.
GSA11	2.724	2.849	1.937	3.382	20.275	99.050	0.577	0.210	10.538	3.115	6.336	0.470	1.680	0.242	2.030	0.276	-0.421
GSA16		6.588	2.706	1.334			1.251		29.340	1.628	21.203	36.306	92.852	58.856	93.633	78.606	**0.811**
GSA18																0.518	n.c.
S. canicula	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	26.261	15.986	16.807	15.211	16.804	14.514	29.473	14.968	4.273	26.708	13.026	8.864	25.609	44.933	39.475	28.940	0.279
GSA10	0.558	1.123							1.273				0.263			0.646	n.c.
GSA11	142.691	148.370	173.564	197.214	212.531	359.392	201.579	557.129	205.049	335.793	148.576	127.126	163.596	329.751	184.288	275.355	0.200
GSA16	33.075	72.466	82.522	129.411	34.378	46.035	35.028	23.376	42.466	18.721	74.604	60.359	105.318	38.837	39.784	72.222	0.021
GSA17	0.266	0.473	10.393	8.187	3.088	13.721	8.370	5.141	4.695	3.656	2.174	3.726	1.615	0.799	2.080	3.325	-0.168
GSA18	5.770	1.274	0.451		0.467	0.960		0.481			0.454			0.499			n.c.
GSA19	0.898	0.856		0.899						0.950	1.637	1.779	1.842		0.931	0.919	n.c.
S. stellaris	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9				0.234					0.329								n.c.
GSA10					0.557				1.273					0.627			n.c.
GSA11								0.404									n.c.
GSA16				2.668	1.273							0.454					n.c.
GSA17							0.269		0.216			0.402					n.c.
GSA18																1.036	n.c.
GSA19							0.930										n.c.
T. marmorata	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	1.509	1.864	1.492	1.804	1.014	2.767	1.025	0.995	0.982	1.319	1.212	0.324		2.031	1.315	2.030	-0.125
GSA10	3.825		1.137	0.555			0.553		1.273				0.322		0.788		n.c.
GSA11	0.636		1.077	0.180			0.192					0.239		0.726	0.249	0.526	n.c.
GSA16	4.314	3.953	6.764	6.671	1.273	3.836	3.753	2.597	2.316	8.139	1.571	3.177	1.290	4.404	5.224	5.586	-0.047
GSA17		0.292				0.274	0.297	0.310	0.409	0.218	0.287		0.205			0.216	n.c.
GSA18		1.504	0.409	0.407	0.403	2.044		2.313	2.564	1.015	1.389	0.465	0.485	0.499	0.944	2.127	0.178
GSA19	3.593	3.422	0.853		2.329	0.717	6.541	1.842	1.591	0.950	1.556	3.362	1.842	0.749	2.538	0.919	-0.291
T. torpedo	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9			4.808	0.785	0.992		0.546		0.399	4.600	0.606	0.770		0.652	1.708		n.c.
GSA10		1.685				2.830	0.677										n.c.
GSA11	0.277	1.317	0.936					0.492	0.259		0.290	0.713	0.537	5.092	1.010	0.251	n.c.
GSA16										1.628		0.908		0.400	1.206		n.c.
GSA17										0.218							n.c.
GSA19					28.719	1.670	1.860	19.355		5.195	3.432	0.845	9.336	17.778	7.692	1.749	n.c.
T. nobiliana	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9						0.454	0.256		0.329								n.c.
GSA11		0.263	0.215	0.846	0.847	2.025	1.710	1.122		0.242		0.474	0.840	0.484			n.c.
GSA16	1.438			1.334					0.772						0.402		n.c.
GSA19							0.946	0.921			0.819	1.779			0.931	1.568	n.c.

The most abundant species On the slope (Tab. 7 and 8) are *G. melastomus* (GSA9), *E. spinax* (GSA9), *S. canicula* (GSA11), *R. clavata* (GSA11) and *D. oxyrhincus* (GSA11). In 103 out of 144 series the data are insufficient to calculate the Spearman coefficient; in 29 situations there are no trends, in two there are negative trends for biomass and three for density. There are ten positive trends for biomass and seven for density.

The trends of some common species on the shelf and on the slope in different GSAs are shown in Figs. 2-8. On the slope the biomass of *R. clavata* and *S. canicula* is quite different from one GSA to another. The highest values were reached in

Tab. 6 - Biomass index (kg/km²) for shelf stratum (10-200 m depth) per GSA. Medits 1994-2009. Significant Spearman rho values are in bold.

Indici di biomassa(kg/km²) per la piattaforma (10-200 m) e per GSA. Medits 1994-2009. In grassetto i valori del rho di Spearman significativi.

C. granulosus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9																0.296	n.c.
GSA11							0.022										n.c.
C. uyato	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16	1.079																n.c.
C. monstrosa	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA18											0.545						n.c.
D. centroura	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA19									0.087								n.c.
D. pastinaca	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9											1.759				1.211		n.c.
GSA10				1.377													n.c.
GSA11		27.990	11.011	18.516	11.441		7.534	6.135				11.119		29.972	9.248	32.415	n.c.
GSA16									6.061	3.256	0.020	7.057	10.231	0.761	3.617	0.718	n.c.
GSA17									1.844	0.333				0.881			n.c.
GSA19					4.461		14.139	0.792			7.642	8.257	0.264	0.736	2.981	4.762	n.c.
D. oxyrhincus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	1.373			0.328	0.131			0.186		0.178		0.536		0.052	0.006	3.669	n.c.
GSA11	8.702	5.641	2.001	1.701	0.950	6.575	2.667	11.243		10.687	0.833	2.119	5.769	2.298	3.679	10.305	0.125
GSA16									0.178								n.c.
E.spinax	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA11		0.596					2.737					4.902					n.c.
G. galeus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA18														0.204			n.c.
G. melastomus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9			0.324					0.005									n.c.
GSA11						0.057		0.030		0.019	1.056	1.479		0.071	0.190		n.c.
GSA16													0.010				n.c.
GSA18							0.080				0.918						n.c.
H. perlo	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9														0.603			n.c.
GSA16														2.002			n.c.
L. circularis	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16														0.080			n.c.
GSA18												0.251					n.c.
L. melitensis	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16		0.395								0.488	0.232		0.288	0.320	0.362	1.564	n.c.
M. aquila	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.243								0.311					0.148		0.113	n.c.
GSA10		1.012	1.792		3.918	13.301	2.175	5.180		4.978				10.706			n.c.
GSA11	0.802	0.053			2.016		0.925		0.153			0.167			0.796		n.c.
GSA16										3.500					2.411	2.574	n.c.
GSA17				5.708	0.338	11.631	4.993	10.146	31.925	2.823	2.316	2.508	22.527	1.362	9.900	8.554	0.033
GSA18															5.275		n.c.
M. asterias	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16												0.340	2.257		1.929	0.559	n.c.
GSA17									0.675								n.c.
M. mustelus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9					0.068	0.105		0.075									n.c.
GSA10													1.609				n.c.
GSA11					0.030												n.c.
GSA16	0.431	0.329	3.585	4.936	1.592	15.422	24.457	6.234	24.476	16.523	44.605	25.165	25.319	5.565	24.654	21.451	**0.741**
GSA17			2.036	1.947		2.390	0.059	1.062	4.662	0.899	0.414	4.062	7.106	0.292	3.731	2.925	0.258
GSA18	0.114	0.311				1.079		0.082									n.c.
GSA19	0.361	1.113	0.525	0.556	0.815		0.061	0.076	4.032	1.506	0.071	2.583	0.858	4.852	0.112	31.277	0.371
M. punctulatus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16											0.942				1.343	1.317	n.c.
GSA17								0.338		3.155	1.344					0.317	n.c.
O. centrina	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.349	0.798	0.744											0.176			n.c.
GSA11						0.491	1.815		1.611								n.c.
GSA16		2.108											1.075				n.c.
P. bovinus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA17				0.256													n.c.
GSA19		6.012	0.933	1.694		4.509			3.318		1.793	2.403	2.227		1.003	1.118	n.c.
P. violacea	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA10							4.018		1.337								n.c.
R. asterias	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	1.052	1.043	3.329	1.329	2.261	3.458	1.670	1.100	1.937	3.988	1.132	0.294	0.050	1.158	1.198	0.143	-0.318
GSA10	0.305	1.188	0.765	0.999	1.289	0.009	1.899	1.449			1.058	1.440			1.059		n.c.
GSA11	9.568	4.765	6.882	4.150	2.595	6.301	3.092	3.627	6.298		1.877	25.579	20.105	11.362	4.455	9.722	0.286
GSA16	3.955	6.258	2.435	1.227	1.401	3.708	1.126	3.636	1.390	1.574	2.042	1.951	1.999	2.142	1.266	3.783	-0.206
GSA17	0.029	0.622		0.438	0.625	0.607	0.351		0.783	0.291	0.113	0.635	0.120	0.126	0.346	0.154	-0.244

(Segue/*Follows*)

GSA18	0.105	0.400			2.077	0.214			0.020	0.054	0.434	0.050	0.693			0.341	n.c.
GSA19		1.288	1.400			1.002	0.886		0.306		0.955	0.072	6.385	0.867	3.431		n.c.
R. brachyura	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA11	2.303	0.606	2.332		1.386		0.397	7.755	1.325	7.952	2.612	22.555	11.461	13.222	5.032	22.713	**0.763**
GSA16													0.774	1.902	4.139		n.c.
R. clavata	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.703	1.922	2.131	8.877	2.785	4.048	3.844	3.783	7.990	9.628	4.257	3.027	5.254	5.418	10.336	6.388	**0.650**
GSA10	0.017					0.392	0.020						0.657			2.224	n.c.
GSA11	13.807	25.218	29.900	23.931	17.836	27.972	17.992	54.311	11.408	35.133	37.690		38.938	27.354	19.183	28.549	0.336
GSA16	15.747	3.426	6.899	10.540	17.444	12.404	31.025	2.208	32.742	21.364	29.114	31.312	57.415	24.940	32.598	40.025	**0.759**
GSA17		0.274		0.014	0.120	2.418	1.454			0.740	0.004	0.735	3.156	0.530	1.753	1.284	0.420
GSA18	0.571		0.812													2.087	n.c.
R. miraletus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	1.304	1.881	1.571	2.579	2.374	3.566	3.329	1.429	1.836	3.015	1.197	1.027	2.369	1.663	1.300	1.215	-0.385
GSA10	0.698		0.072	0.138		0.071		0.029		0.078		0.321	2.413		0.181	0.168	n.c.
GSA11	1.902	2.090	2.100	5.017	4.840	2.236	2.316	9.992	0.907	5.900		10.763	6.249	7.625	4.978	6.174	**0.639**
GSA16	8.700	13.110	28.612	47.295	22.919	14.642	30.838	25.752	21.728	16.346	31.181	20.331	28.973	21.344	30.300	49.314	0.412
GSA17			0.511	0.999	0.402	0.300	0.027	0.250	0.131	0.298	0.133	0.490	0.209	0.508	0.202	0.397	-0.262
GSA19				0.152		0.359	0.126	0.505	0.179	0.104	0.226	1.009	0.345		0.138	0.066	n.c.
R. montagui	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.157	0.471	0.024	2.004	0.146	0.768	0.682		0.609	0.152	0.106						n.c.
GSA10													0.657				n.c.
GSA16			1.420	2.135	0.764	0.384	2.565	2.877	1.523	1.343	1.999	2.494	1.096	1.822	1.973	2.390	0.204
GSA17										0.135		0.004					n.c.
R. polystigma	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9												0.175	0.418	0.848	2.364	2.051	n.c.
GSA10								0.160									n.c.
GSA11	4.301	4.609	16.954	5.863	13.880	13.893	8.231	31.396	1.622	9.644	14.037	9.452	12.292	26.215	5.440	5.035	0.115
GSA17						0.017											n.c.
R. alba	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA16							5.442								0.100	4.230	n.c.
S. acanthias	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9				1.240													n.c.
GSA10													1.314				n.c.
GSA11								1.028			0.700						n.c.
GSA17	10.061	22.173	5.883	5.422	303.940	19.785	17.402	5.265	8.502	8.893	7.563	3.166	7.816	3.268	6.093	5.138	**-0.562**
GSA18	1.118		0.572			0.085											n.c.
S. blainvillei	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9					0.973												n.c.
GSA11	2.724	2.072	0.506	8.351	2.465	10.613	0.719	0.514	6.856	2.252	6.600	0.493	0.678	0.073	0.951	0.055	-0.491
GSA16		2.042	1.488	0.667			0.250		19.226	1.628	10.013	15.997	29.188	26.245	45.121	35.421	**0.839**
GSA18																3.676	n.c.
S. canicula	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	3.158	2.651	2.705	3.089	2.745	2.735	3.401	2.906	0.871	4.939	2.360	1.415	3.059	6.552	5.191	4.637	0.344
GSA10	0.140	0.309							0.267				0.657			0.097	n.c.
GSA11	16.461	11.545	19.970	15.017	23.431	28.516	21.660	45.499	25.290	27.262	17.134	14.825	16.833	69.347	19.098	16.623	0.174
GSA16	7.406	13.834	17.249	25.615	7.894	9.591	9.258	6.597	9.743	4.612	15.551	11.391	14.447	8.646	8.866	13.410	-0.050
GSA17	0.013	0.161	1.716	1.052	0.480	2.336	1.365	0.832	0.941	0.727	0.323	0.469	0.689	0.264	0.451	0.544	-0.150
GSA18	0.718	0.226	0.021		0.211	0.418		0.133			0.136			0.006			n.c.
GSA19	0.449	0.214		0.005						0.321	0.675	0.662	0.536		0.306	0.339	n.c.
S. stellaris	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9				0.983					1.645								n.c.
GSA10					0.167				0.038					2.384			n.c.
GSA11								0.030									n.c.
GSA16				1.668	5.093							0.045					n.c.
GSA17							0.037		0.078			0.056					n.c.
GSA18																0.054	n.c.
GSA19							0.015										n.c.
T. marmorata	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.327	0.245	0.183	0.520	0.523	0.839	0.208	0.161	0.221	0.142	0.258	0.039		0.342	0.101	0.784	-0.204
GSA10	0.324		0.284	0.166			0.553		0.216				0.804		1.378		n.c.
GSA11	0.202		0.151	0.108			0.010					0.239		0.060	0.174	0.317	n.c.
GSA16	1.726	2.174	1.623	1.468	0.025	2.302	0.976	1.169	1.042	1.791	0.287	0.522	0.301	1.670	1.712	2.657	-0.050
GSA17		0.018				0.007	0.008	0.035	0.040	0.033	0.023		0.074			0.041	n.c.
GSA18	0.233	0.179	0.082	0.042	0.093	0.329		0.531	0.442	0.161	0.220	0.040	0.176	0.078	0.107	0.292	-0.064
GSA19	0.539	0.257	0.036		0.511	0.038	6.062	0.179	0.867	0.154	0.220	0.661	0.467	0.142	0.385	0.101	-0.107
T. torpedo	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9			0.272	0.042	0.139		0.029		0.040	1.505	0.340	0.031		0.059	0.278		n.c.
GSA10		0.112				0.672	0.047										n.c.
GSA11	0.014	0.570	0.638					0.321	0.026		0.023	0.251	0.048	3.053	0.421	0.251	n.c.
GSA16										0.520		0.136		0.112	0.261		n.c.
GSA17										0.007							n.c.
GSA19					3.467	0.206	0.051	0.931		0.903	0.569	0.120	0.703	4.993	1.126	0.275	n.c.
T. nobiliana	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9						0.082	0.038		0.066								n.c.
GSA11		0.024	0.022	1.086	0.478	0.979	0.595	0.333		0.012		0.203	0.028	0.547			n.c.
GSA16	0.072			0.133					0.232						0.024		n.c.
GSA19							0.063	0.037			0.065	0.094			0.045	0.049	n.c.

Tab. 7 - Density index (n/km²) for slope stratum (200-800 m depth) per GSA. Medits 1994-2009. Significant Spearman rho values are in bold.

Indici di densità (n/km²) per la scarpata (200-800 m) e per GSA. Medits 1994-2009. In grassetto i valori del rho di Spearman significativi. In grassetto i valori del rho di Spearman significativi.

C. granulosus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	1.182		1.542	1.486	0.897	0.548	0.152	0.452		0.368			0.699	0.477			n.c.
GSA10	0.531	0.227		0.232	0.693	1.632		0.453		0.240	0.523		0.264	0.264	0.257		n.c.
GSA11			1.344			0.575	0.139	0.402			1.569	0.274					n.c.
GSA16	4.217	0.421	0.859		3.795	2.076	4.501	1.655	6.717	1.338	1.094	8.060	8.128	3.503	6.232	6.733	0.536
GSA18						0.593			0.834					0.819			n.c.
C. uyato	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA10							0.214										n.c.
GSA16		0.421											1.912				n.c.
GSA19							0.199										n.c.
C. monstrosa	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	4.533	4.230	7.204	5.718	7.753	6.545	4.241	5.275	4.010	4.023	5.098	5.858	2.980	5.833	6.266	5.335	-0.056
GSA10	0.266	2.270	1.602	3.019	1.778	2.798	2.574	2.715	0.788	0.240	1.046	1.288	1.056	0.264	1.406	1.637	-0.350
GSA11			2.091	0.949	0.747	1.294	2.925	1.071	0.479	0.435	1.345	0.549	0.450	1.242	1.595	2.188	0.007
GSA16	17.394	8.414	7.300	6.188	12.648	15.360	21.277	8.687	9.404	15.258	17.785	8.746	12.431	13.555	17.137	14.249	0.268
GSA17	14.322		42.034	10.945				13.157		6.229	3.344				2.041		n.c.
GSA18		12.348	35.446	54.466	32.135	85.412	29.241	75.012	76.823	31.855	17.536	55.186	39.871	49.275	25.784	87.116	-0.154
GSA19	1.794	2.910	2.291	2.630	2.368	2.064	5.169	4.084	3.719	6.050	3.100	4.038	4.644	3.171	6.877	1.484	0.424
D. licha	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	1.990	0.619	0.617	0.892	0.449	0.548	1.219	0.301	0.349	0.736	0.146		0.699	0.863	1.044	0.431	-0.193
GSA10	2.015		0.229	0.929	0.462	0.933	0.429	0.905	0.525	0.479	0.957	0.266	0.528	0.529		2.456	0.125
GSA11		0.172		0.158	0.149	0.719		0.535		0.335						0.729	n.c.
GSA16	0.527	0.421	0.429	0.413			1.227	1.655	1.612	2.409	1.915	1.715	0.956	2.132	1.714	2.192	**0.745**
GSA17		1.503		5.970													n.c.
GSA18		0.771		1.649	1.276			2.861		2.631	1.684	2.590	0.868			0.763	n.c.
GSA19		0.909	0.382	1.618	0.911	0.938	0.596	1.377	0.930	1.895	2.215	2.763	1.689	0.634	1.688	0.848	0.325
D. pastinaca	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA11						12.282											n.c.
GSA16													0.159				n.c.
D. batis	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9			0.154														n.c.
D. oxyrhincus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	0.849	1.401	1.631	0.394	0.951	2.165	1.978	3.698	2.501	1.834	1.819	1.139	0.488	2.100	0.162	1.571	0.026
GSA10	0.421	0.770	0.770	0.570	0.979	1.587	0.917	0.173	0.441	0.835	0.217	0.452	0.224	1.986	0.846	0.706	0.006
GSA11	12.412	17.777	23.211	1.791	38.315	18.851	15.875	23.670	25.780	24.589	12.008	31.881	10.619	15.153	21.186	17.461	0.000
GSA16	0.527	1.683	1.288	4.125	3.373	1.245	8.592	5.791	5.642	4.283	3.831	3.773	8.925	3.655	5.297	3.601	0.471
GSA19						0.188	0.199	0.208		0.237	0.221	0.213	0.633	0.211	0.211	0.212	n.c.
E.spinax	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	57.468	83.124	40.652	36.775	51.656	70.323	64.424	51.542	33.728	48.652	64.260	56.477	50.793	58.633	76.401	76.264	0.197
GSA10	95.704	66.919	51.539	96.612	67.135	110.992	51.017	39.250	19.475	23.939	34.380	44.675	44.434	41.920	58.131	49.573	**-0.544**
GSA11		51.664	40.567	61.567	75.841	80.256		50.619	11.620	36.810	67.142	80.414	49.346	104.506	138.498	112.214	0.521
GSA16	30.572	84.561	103.915	12.788	30.778	21.586	42.144	34.333	51.855	33.192	42.958	40.985	47.971	100.522	75.869	64.355	0.359
GSA17	14.053	13.878	15.486		1.168		4.570	2.067	2.065	14.534	40.133				1.020		n.c.
GSA18		51.246	54.864	193.927	126.760	127.907	156.545	58.593	88.908	81.248	76.957	274.289	126.931	39.486	73.631	177.480	0.111
GSA19	5.512	45.461	64.148	53.340	57.599	61.936	81.612	65.322	44.390	200.724	69.757	96.494	39.457	42.909	58.521	51.647	0.082
G. galeus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA10		0.681						0.173									n.c.
G. melastomus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	229.516	268.521	253.986	356.137	316.481	298.430	290.815	415.245	412.700	293.347	258.993	245.122	224.098	827.945	356.717	350.291	0.282
GSA10	127.180	131.794	147.134	350.731	2694.070	263.116	135.211	200.381	114.991	239.724	247.617	244.191	265.330	354.387	253.216	383.988	0.462
GSA11		685.851	735.007	762.155	698.225	999.987	455.720	1234.797	513.184	626.448	663.898	936.686	906.884	996.671	713.924	507.510	-0.043
GSA16	85.391	81.616	112.503	34.650	69.567	96.723	164.893	100.930	138.640	157.661	162.257	219.500	254.519	423.714	553.669	465.203	**0.897**
GSA17	59.996	13.528	174.541	124.096	17.521	17.706	16.349	32.613	4.180	8.276	9.459	16.307	3.525	31.460	7.143		**-0.600**
GSA18		85.478	176.898	210.653	170.752	306.439	144.544	118.053	217.762	95.320	218.601	362.727	199.318	371.348	39.802	183.797	0.211
GSA19	123.406	97.440	153.658	85.793	61.716	111.030	167.293	110.108	49.541	224.262	113.049	106.044	56.867	78.209	182.354	92.929	-0.109
G. altavela	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA19													1.384				n.c.
H. perlo	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9										0.160		0.168					n.c.
GSA11						0.162											n.c.
GSA16		0.421			0.422				0.537	0.268	0.547	0.514	0.797	0.762	0.935	0.626	n.c.
GSA19						0.317									0.348		n.c.

Tab. 8 - Biomass index (kg/km²) for slope stratum (200-800 m depth) per GSA. Medits 1994-2009. Significant Spearman rho values are in bold.

Indici di biomassa (kg/km²) per la scarpata (200-800 m) e per GSA. Medits 1994-2009. In grassetto i valori del rho di Spearman significativi.

C. granulosus	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***rho Spearman***
GSA9	4.237		5.566	5.700	4.156	1.004	0.663	1.809		1.361			2.551	1.907			n.c.
GSA10	2.086	1.589		0.418	3.259	5.572		1.991		0.910	1.673		0.924	1.111	1.518		n.c.
GSA11			6.797			2.186	0.488	1.124			3.417	0.988					n.c.
GSA16	19.187	3.597	2.576		12.438	5.999	15.344	5.315	21.105	4.604	3.749	30.696	25.374	11.568	19.215	23.033	0.511
GSA18						1.723			2.419					0.002			n.c.

(Segue/*Follows*)

C. uyato	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA10							0.794										n.c.
GSA16		0.715											3.873				n.c.
GSA19							0.696										n.c.
C. monstrosa	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA9	1.465	1.278	1.628	1.858	2.445	2.484	1.140	0.913	1.414	1.023	1.030	1.537	0.795	1.480	1.126	0.739	**-0.544**
GSA10	0.027	0.102	0.080	0.186	0.145	0.520	1.137	1.011	0.420	0.024	0.025	0.079	0.011	0.005	0.092	0.049	-0.418
GSA11			0.192	0.055	0.056	0.246	0.347	0.133	0.036	0.047	0.040	0.022	0.014	0.062	0.065	0.289	**-0.657**
GSA16	5.930	3.976	2.791	2.164	4.933	6.505	9.509	2.742	4.046	6.344	8.009	3.563	3.619	3.963	6.852	5.202	0.168
GSA17	0.980		9.789	2.189				5.778		6.125	3.441				0.918		n.c.
GSA18	12.582	5.183	7.183	25.492	18.345	39.328	16.708	37.791	16.946	14.327	4.756	15.372	12.756	11.904	7.601	22.000	-0.024
GSA19	0.777	0.227	0.237	0.865	0.542	0.768	2.241	0.736	0.948	0.736	0.989	0.285	0.491	0.229	0.823	0.367	-0.050
D. licha	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA9	2.685	0.937	1.426	1.379	2.063	1.189	0.808	0.053	0.666	0.699	0.035		3.610	0.624	0.875	0.883	-0.468
GSA10	4.390		0.064	1.718	0.647	2.868	1.718	2.251	1.114	2.611	4.248	0.093	1.636	0.132		3.481	-0.046
GSA11		1.033		0.047	0.060	5.480		1.720		0.570						1.957	n.c.
GSA16	1.239	0.968	0.086	1.774			2.741	3.992	4.057	5.043	4.665	4.201	3.259	5.864	3.334	6.064	**0.785**
GSA17		0.451		0.318													n.c.
GSA18	1.553	3.855		0.449	2.108			1.189		5.812	0.284	4.276	1.002			0.153	n.c.
GSA19		4.286	0.064	1.036	0.211	1.562	2.150	0.407	1.413	2.062	3.565	1.882	2.563	1.503	2.322	1.361	-0.375
D. pastinaca	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA11						11.556											n.c.
GSA16													0.008				n.c.
D. batis	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA9			0.002														n.c.
D. oxyrhincus	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA9	2.264	1.772	0.959	1.341	0.258	0.057	1.838	1.866	1.011	2.314	0.290	1.775	0.845	2.280	0.013	2.713	0.100
GSA10	0.179	0.096	0.269	0.059	0.391	1.803	0.413	0.130	0.882	0.522	0.007	0.316	0.075	1.446	0.486	0.282	0.241
GSA11	10.878	8.487	11.838	1.701	25.019	17.532	14.737	16.443	11.736	24.183	12.973	21.432	5.497	11.163	15.503	16.630	0.253
GSA16	1.581	2.629	1.159	7.858	2.445	0.922	4.435	5.150	6.596	5.204	6.649	5.222	11.625	2.773	7.615	6.481	**0.591**
GSA19						0.030	0.012	0.042		0.013	0.007	0.425	0.239	0.014	0.010	0.247	n.c.
E.spinax	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA9	3.652	4.860	2.788	3.241	4.360	6.432	5.127	4.685	3.049	4.275	5.135	4.872	5.339	3.974	5.517	5.019	0.453
GSA10	6.703	2.696	2.661	5.659	4.193	5.581	2.644	2.095	1.964	1.784	2.615	3.038	2.696	3.320	3.522	3.462	-0.176
GSA11		2.221	2.757	2.757	4.986	5.141		3.567	0.577	2.240	3.539	4.975	3.751	3.675	6.940	5.917	0.560
GSA16	2.477	4.546	5.157	0.726	2.635	2.088	3.895	3.371	4.077	3.027	3.567	3.166	3.830	6.199	6.450	6.690	0.521
GSA17	0.545	0.844	0.299		0.013		0.331	0.010	0.413	1.142	2.207				0.051		n.c.
GSA18	1.894	1.807	1.978	5.051	2.782	4.038	5.554	1.684	4.558	3.904	3.791	10.127	5.354	1.155	2.133	7.331	**0.550**
GSA19	0.061	1.841	2.249	2.060	2.412	2.993	3.954	3.273	2.619	5.588	2.961	3.613	2.122	2.260	2.594	3.353	0.391
G. galeus	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA10		0.023						2.250									n.c.
G. melastomus	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA9	35.827	39.769	30.591	39.331	37.735	46.863	45.486	46.325	44.384	27.076	28.861	31.711	33.677	81.273	48.955	34.123	0.050
GSA10	13.571	9.976	12.774	33.048	39.624	29.614	12.772	22.327	9.098	24.838	26.197	30.361	29.338	43.287	28.087	52.719	0.482
GSA11		20.591	37.326	57.566	53.379	42.133	33.543	61.270	40.871	45.322	42.461	40.280	52.328	57.331	40.639	41.317	0.150
GSA16	19.851	9.718	15.557	5.367	11.443	15.812	29.296	16.902	17.459	27.164	28.576	27.730	34.929	55.407	71.033	67.581	**0.847**
GSA17	3.764	1.804	12.039	13.454	2.208	2.405	2.537	5.975	1.651	1.528	3.594	1.994	0.186	2.569	1.276		-0.514
GSA18	21.756	7.636	12.001	31.442	25.153	43.585	23.455	25.251	31.076	23.114	38.164	57.128	33.300	28.479	6.759	43.824	0.418
GSA19	15.164	6.578	7.752	5.121	5.836	13.562	17.687	15.243	8.198	22.066	12.525	15.737	9.710	8.303	20.498	17.084	0.503
G. altavela	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA19													0.070				n.c.
H. perlo	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*rho Spearman*
GSA9										0.256		0.404					n.c.
GSA11						0.162											n.c.
GSA16		1.893			1.349				0.161	0.402	0.424	1.286	0.234	0.533	2.056	0.877	n.c.
GSA19						0.412									1.322		n.c.

Sardinia (GSA11) and the Strait of Sicily (GSA16). A clear positive trend occurs in GSA9 and GSA16. In GSA19 *R. clavata* was not fished, so in Fig. 4 the trend of *T. nobiliana* and *S. canicula* are shown. When the first species decreases the second increases; but this could be fortuitous.

On the slope *G. melastomus* was fished in all GSAs and all years (Fig. 5). The highest values of biomass were obtained in GSA9 (Ligurian and Northern Tyrrhenian Sea) and GSA11 (Sardinia) and in the last years also in GSA16 (Strait of Sicily) where there was an increasing trend of the catch. The lowest values were obtained in the northern and central Adriatic Seas, but this is due mainly to the reduced surface of the slope.

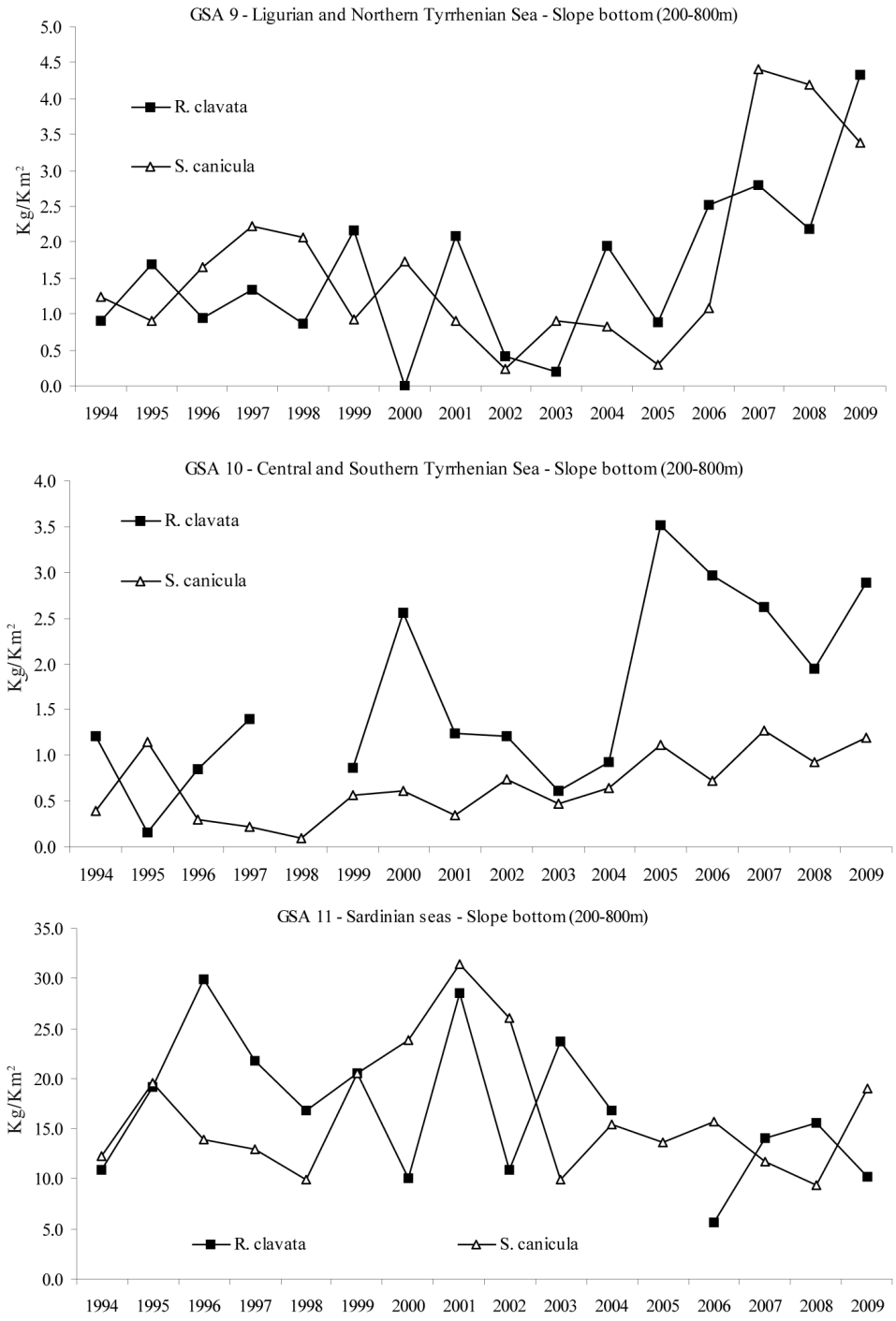

Fig. 2 - Biomass trends (kg/km²) of *R. clavata* and *S. canicula* in different years on the slope of GSA 9, 10 and 11.

Andamenti della biomassa (kg/km²) di R. clavata *e* S. canicula *in diversi anni sulla scarpata delle GSA 9, 10 e 11.*

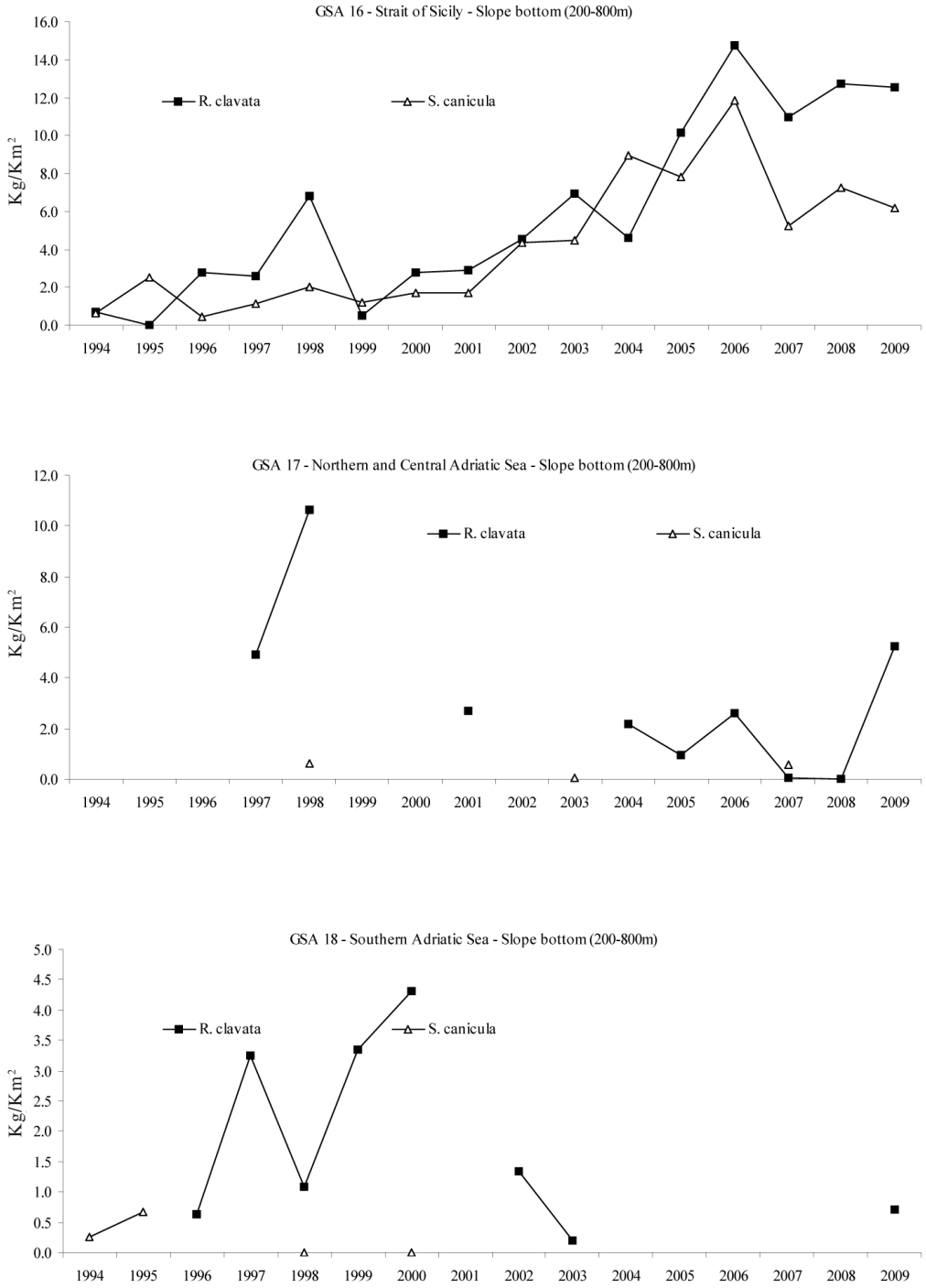

Fig. 3 - Biomass trends (kg/km²) of *R. clavata* and *S. canicula* in different years on the slope of GSA 16, 17 and 18.

Andamenti della biomassa (kg/km²) di R. clavata *e* S. canicula *in diversi anni sulla scarpata delle GSA 16, 17 e 18.*

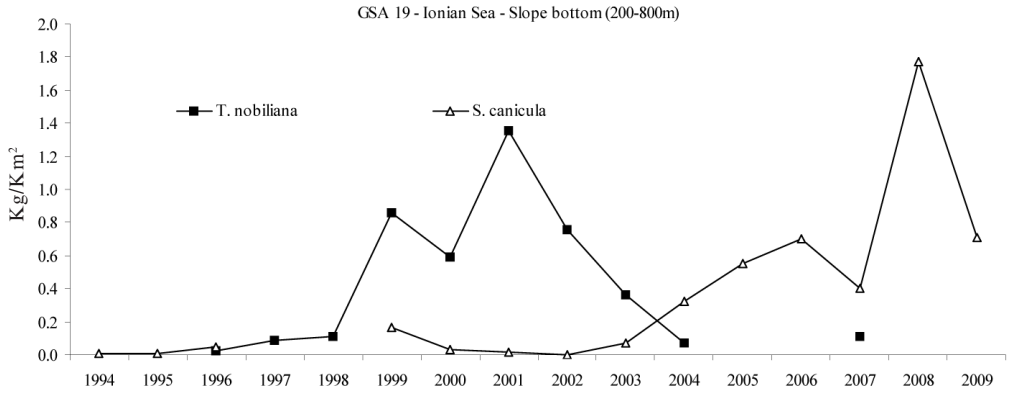

Fig. 4 - Biomass trends (kg/km²) of *T. nobiliana* and *S. canicula* in different years on the slope of GSA19.

Andamenti della biomassa (kg/km²) di T. nobiliana *e* S. canicula *in diversi anni sulla scarpata delle GSA19.*

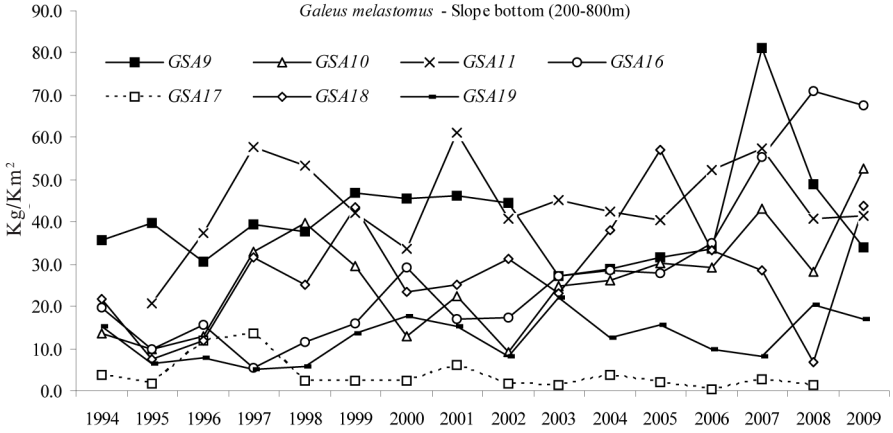

Fig. 5 - Biomass (kg/km²) of *G. melastomus* caught in different years on the slope of seven GSAs.

Biomassa (kg/km²) di G. melastomus *presente nei diversi anni sulla scarpata delle sette GSA.*

R. clavata and *S. canicula* were also caught in the shelf bottoms and the biomass trends of these two species and of the *R. asterias* in three GSA are shown in Fig. 6. The highest biomass was fished in Sardinia (GSA11) and in Sicily (GSA16). The biomass trends of some species fished on the shelf of Northern and Central Adriatic seas are given in Fig. 7. There was an exceptional catch of *S. acanthias* (304 kg/km²) in the 1998 survey, where normally the catch is between 3 and 22 kg/km². The catch of *M. mustelus* is irregular. This species was caught in good quantity (31 kg/km²) in GSA19 during the 2009 survey (Fig. 8). The total biomass of chondrichthyes caught each year during the Medits surveys is given in Fig. 9. The highest values were obtained in Sardinia (GSA11) and Sicily (GSA16), while the lowest were in the Southern Adriatic (GSA18) and Ionian Seas (GSA19). There are no clear trend, positive or negative.

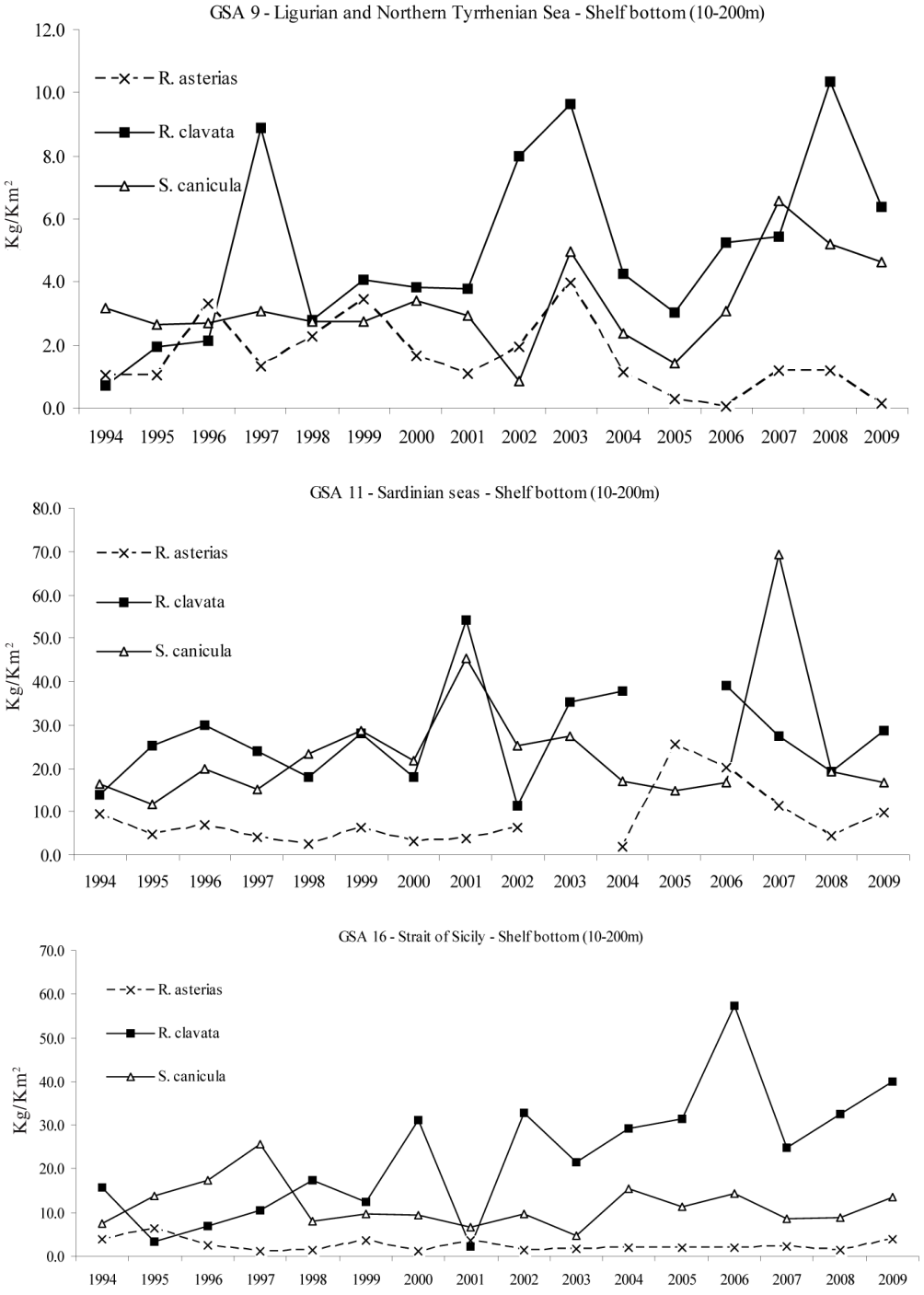

Fig. 6 - Biomass trends (kg/km^2) of *R. asterias, R.clavata* and *S. canicula* in different years on the shelf of GSA 9, 11 and 16.

Andamenti della biomassa (kg/km^2) di R. asterais, R. clavata *e* S. canicula *in diversi anni sulla piattaforma delle GSA 9, 11 e 16.*

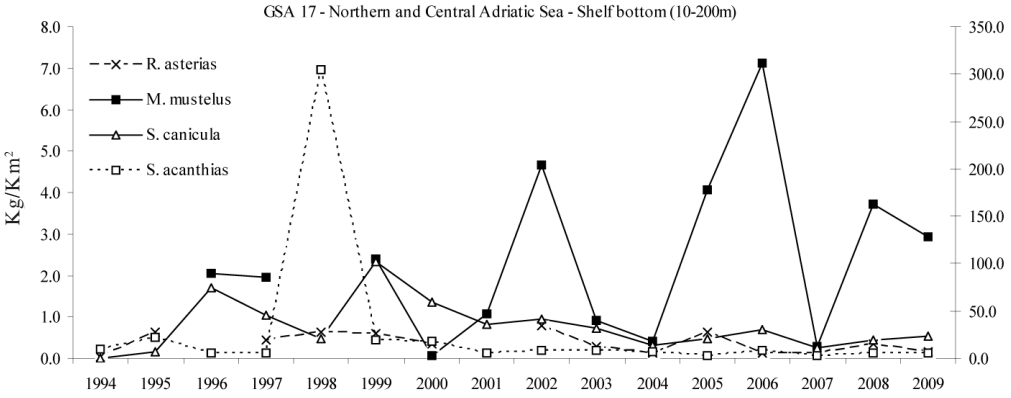

Fig. 7 - Biomass trends (kg/km²) of some species on the shelf of GSA17 in the period 1994-2009. The scale on the right is for *S. acanthias.*

Andamenti della biomassa (kg/km²) di alcune specie della piattaforma delle GSA17 dal 1994 al 2009. La scala sulla destra è per S. acanthias.

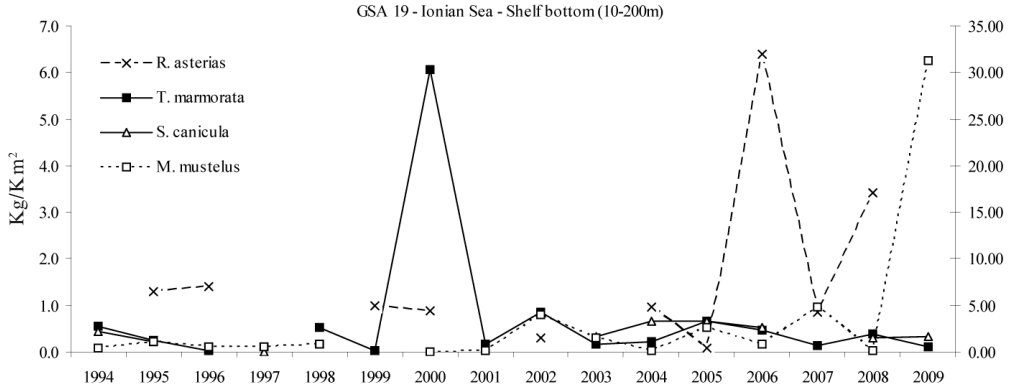

Fig. 8 - Biomass trends (kg/km²) of some species of the shelf of GSA19 in the period 1994-2009. The scale on the right is for *M. mustelus.*

Andamenti della biomassa (kg/km²) di alcune specie della piattaforma delle GSA19 dal 1994 al 2009. La scala sulla destra è per M. mustelus.

Conclusions - During the Medits surveys 16 sharks out of 22 demersal species listed in the checklist of Italian Fauna (Vacchi and Serena, 2010) were fished. All torpedos and 12 skats out of 16, 6 Myliobatiformes out of 9 (some are pelagic) were caught.

In a previous paper (Bertrand *et al.,* 2000) dealing with elasmobranches caught in the whole area covered by the Medits surveys from 1994 to 1998, 44 species were described: 1 chimaera, 19 sharks and 24 rays and skates, of which 35 species are common to the present work. *G. altavela*, *M. punctulatus* and *P. bovines* were not fished in the period 1994-1998, while *S. squatina*, *S. aculeata*, *Galeus atlanticus* (not present in Italian waters), *Hexanchus vitelus* (=*H. nakamurai* only one record in Italy), *Raja naevus*, *R. radula*, *R. undulate*, *Dasyatis tortonesei* (not considered a valid species), *Rhinoptera marginata* are not mentioned in the present paper.

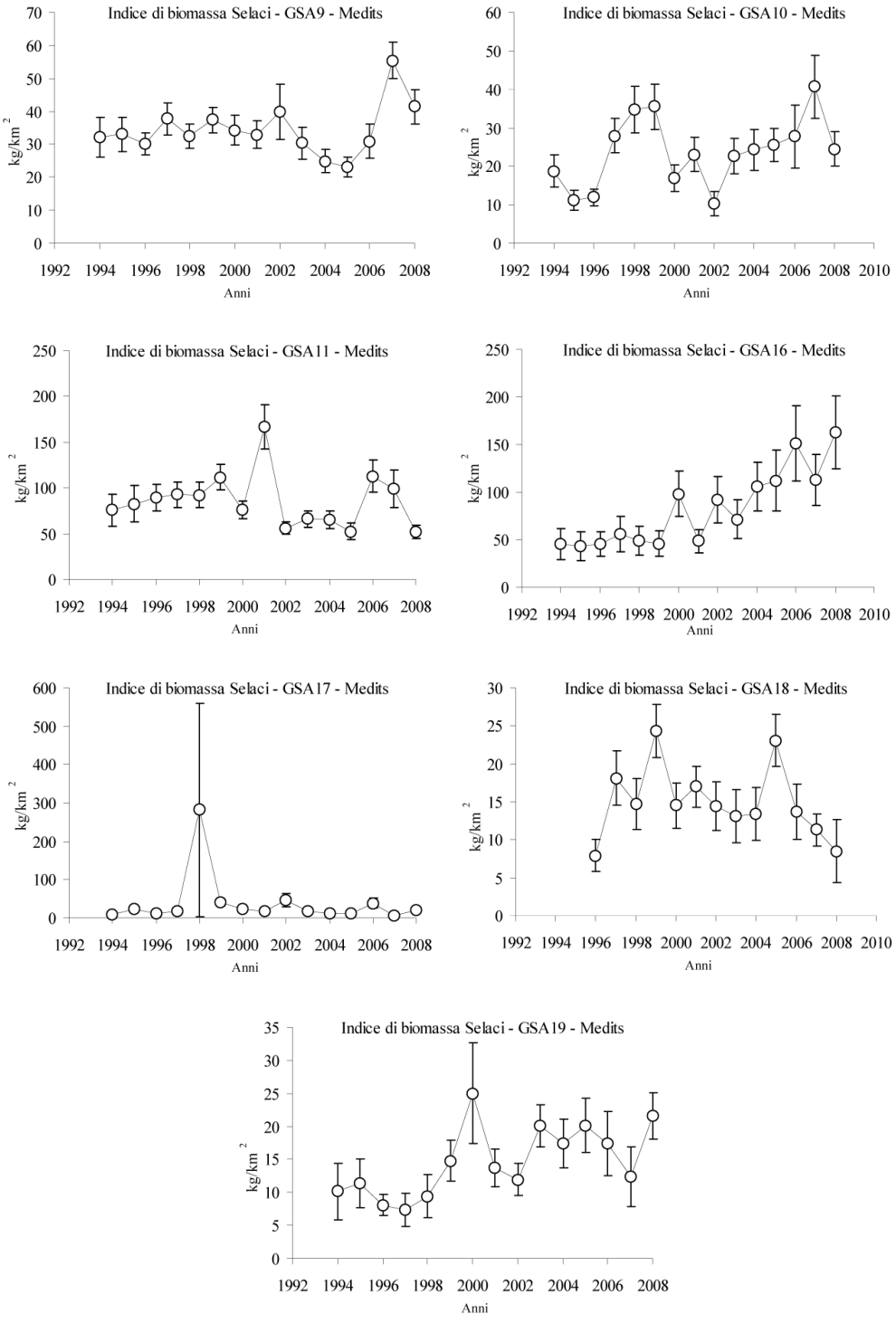

Fig. 9 - Trends of the total biomass of Chondrichthyes in the 7 GSAs.
Andamenti della biomassa totale dei Condroitti nelle 7 GSA.

When we compare these data, we have to bear in mind the different areas and numbers of years considered. For the Italian seas important data come from the GRU.N.D. surveys carried out from 1985 to 1998 (Relini *et al*., 2000). During the Grund surveys all the species recorded in the present paper were found with the exception of *Gymnura altavela*. The species *R. radula*, *R. naevus*, *R. rondeleti* (not valid species), *R. undulata*, *M. mobular* and *S. squatina* fished in Grund surveys were not caught during the 1994-2009 Medits surveys. Although comparison and conclusions are not easy, we can recognize a reduction in the number of species of rays and the disappearance of the *Squatina* species. According to the Medits data, the situation of elasmobranches seems quite stable in the period 1994-2009 both in terms of number of species and biomass. This conflicts with some landing data collected during the Elasmoit project (Relini *et al.,* 2010) which showed low numbers of species and individuals and poor quantity in weight.

In conclusion, we can say that during the Medits surveys there were no changes in the demersal elasmobranch population, whereas there are changes if we compare the Medits data with data collected before 1994. The main difference, as mentioned earlier, is the reduction in the number of rays and the disappearance of the *Squatina* species.

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