A preliminary assessment of the Thornback ray stock in the GSA 15 and 16 based on trawl survey data

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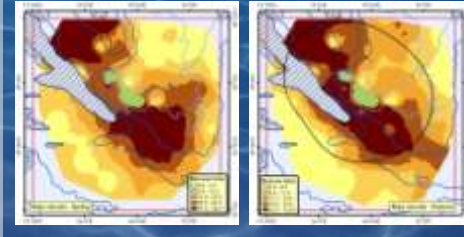
Geographical distribution patterns

- **According to Garofalo et al. (2003) most of the biomass of thorn back ray was located offshore in the central part of the Strait of Sicily, south of Malta. Sparse catches of R. clavata were recorded in the central and eastern part of the Strait on the Sicilian side. Moreover, on the Adventure Bank this species was restricted to the western side.**

Distribution maps of *Raja clavata*, in the Strait of Sicily in the period 1997–2001. Circle radius for each value is proportional to biomass index (from Garofalo et al., 2003)



Isopleths of *Raja clavata* biomass index, averaged over 1993 and 1994, for spring and autumn in GSA 15 (from Camilleri et al., 2008)

Stock identification and biological features

- **The analysis of the distribution over a wider area of the Strait of Sicily does not show a segregation of sub-units in the northern sector of the Straits of Sicily (GSA 15 and 16) (Garofalo *et al.*, 2003). Therefore in the present assessment it was thus assumed that Thornback ray in GSA 15 and GSA 16 are part of a single population, and available data from the two GSAs was combined.**

Growth and length-weight relationship parameters

			Females			*Males*		
Author	**Area**	**Comment**	**L_{inf}**	**k**	**t_0**	**L_{inf}**	**k**	**t_0**
Cannizzaro et al., 1995	Strait of Sicily	Vertebrae readings	126.5	0.098	-0.51	116.7	0.106	-0.41

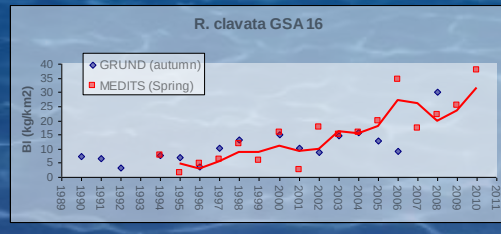
Author	**Area**	**a**	**b**	**a**	**b**
SGMED 01-2011	Strait of Sicily	0.00146	3.364	0.00136	3.359

Size-at-first maturity (length at which 50% of the individuals in the population are mature).

Author	*Area*	*Females*	*Males*
Serena 2005	Mediterranean	85 cm	75 cm
Cannizzaro et al., 1995	Strait of Sicily	77 – 79 cm	57 – 59 cm

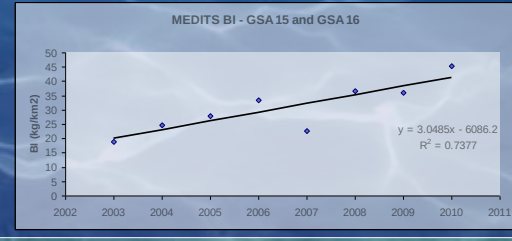
Trends in abundance and biomass

Biomass indices derived from scientific surveys in spring-summer (MEDITS) and autumn (GRUND; GSA 16 only). The abundance and biomass indices were subsequently calculated by stratified means (Cochran, 1953; Saville, 1977).



Both the GRUND and MEDITS BI showed an increasing trend.

Trends in abundance by length are available in the document presented.



Assessment Methods

Method 1: Analysis of survey indices of standing stock

In order to fully analyse the available scientific survey data, trends in standing stock biomass indices derived from MEDITS / GRUND data (1990-2010) were analysed using a quartile approach.

Method 2: Yield and SSB per recruit analysis

The Yield software (Hoggarth et al., 2006) was used to estimate the likely changes in yield (Y) and spawning stock biomass (SSB) per recruit as a function of fishing mortality (F) as well as F0.1 as target reference point for the R. clavata stock. Calculations were done assuming a 20% uncertainty in parameters estimations.

Method 3: Catch curve analysis

Estimation of fishing mortality based on a catch curve analysis under steady state assumption of this data was carried out. Total mortality rates were estimated by using both single year and average over four year abundances. This last choice is considered a best approximation of steady state assumption.

	GRUND	MEDITS
1990	7.26	
1991	6.49	
1992	3.41	
1993	7.87	
1994	6.98	7.64
1995	3.66	1.59
1996	10.29	4.62
1997	13.08	6.26
1998		11.72
1999	14.87	5.98
2000	10.40	15.82
2001	8.68	2.58
2002	14.59	17.54
2003	15.96	15.08
2004	12.76	15.92
2005	9.16	19.93
2006		34.44
2007	30.21	17.42
2008		21.90
2009		25.22
2010		37.86

Method 1: Evolution of standing stock

Time series (1990-2010) of BI (N/km2) in the MEDITS and GRUND surveys in GSA 16. Data from GSA 15 was not used to the shortness of the time series available.

The quartile analysis permitted a clear visualisation of the signals on standing stock status coming from the scientific survey data. The last five years (2006-2010) were characterized by the highest abundance values, in both time series (MEDITS and GRUND). Overall the exercise shows that 8 values out of 18 fall in the upper quartile in the last decade, while only 1 value out 15 in the previous one, clearly

suggesting an increase in standing stock biomass.

	GRUND	MEDITS
min	3.41	1.59
IQ	7.19	6.26
IIQ	9.73	15.82
IIIQ	13.45	19.93
max	30.21	37.86

Method 2: Yield and SSB per recruit analysis

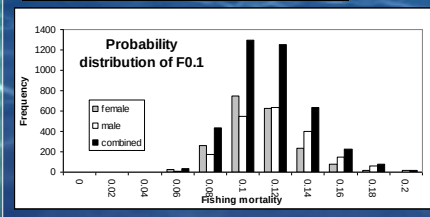
	Females	*Males*
Linf (cm)	126.5	116.7
k	0.098	0.106
to	-0.512	-0.412
a	0.00146	0.00136
b	3.364	3.35905
M	0.2	0.2
Lc (cm)	30.0	30.0
Lmat (cm)	73.0	59.0

Parameters used as input for the Yield software

Source:

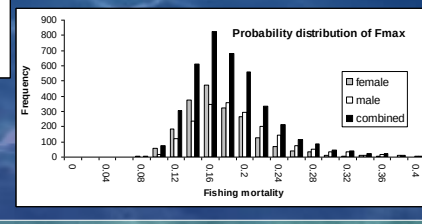
1. **Gravino F. (2010)** Population parameters of *Scyliorhinus canicula, Galeus melastomus* and *Raja clavata* within the GFCM's Geographical-Sub Area (GSA) 15. University of Malta, MSc Thesis, 112 pp.

2. **Cannizzaro et al. (1995)** *Raja clavata* (Linneo, 1758) nel canale di Sicilia: crescita, distribuzione e abbondanza. Biol. Mar. Medit. 2 (2): 257-262.

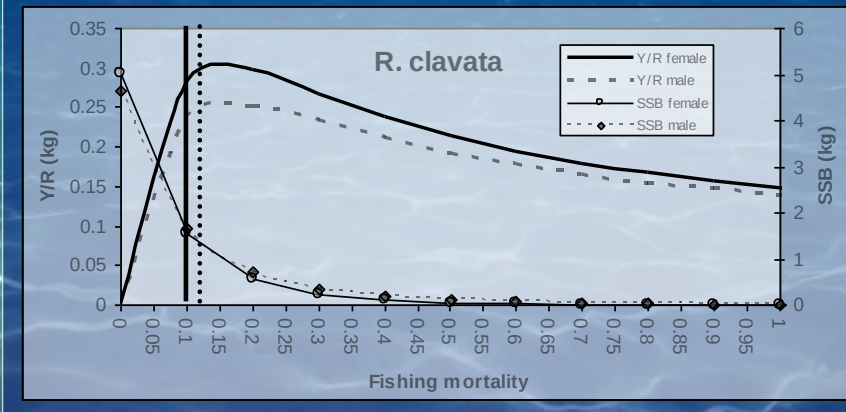


Probability distribution of $F_{0.1}$ estimation for males (0.12), females (0.10) and combined sex (0.10) based on 2000 simulations

Probability distribution of Fmax estimation for males (0.18), females (0.16) and combined sex (0.16) based on 2000 simulations



Results – Yield Package



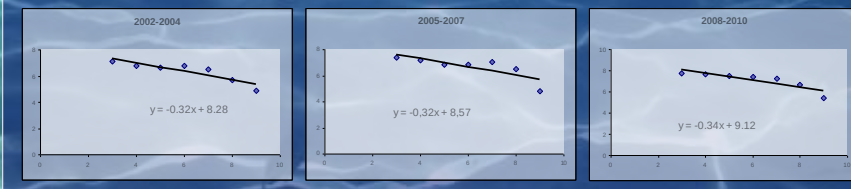
Median of yield and spawning stock biomass per recruit for male and female Thornback ray according to the Yield Package. $F_{0.1}$ target reference points are indicated for females (0.10) and males (0.12)

Method 3: Catch curve analysis

Standardised MEDITS (2002-2010) LFDs by sex were 'age sliced' and used as input data in the software package LFDA 5 (Kirkwood et al., 2001) for the catch curve analysis.

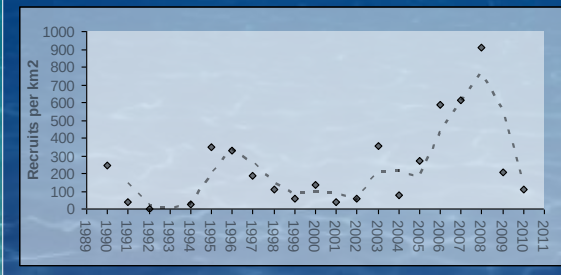
Taking into account the availability of male and female growth parameters, age slicing was done keeping sexes separate. Results were subsequently combined to obtain age frequency distributions for the entire population.

Only final results for males and females and GSA 15 and 16 combined are shown.



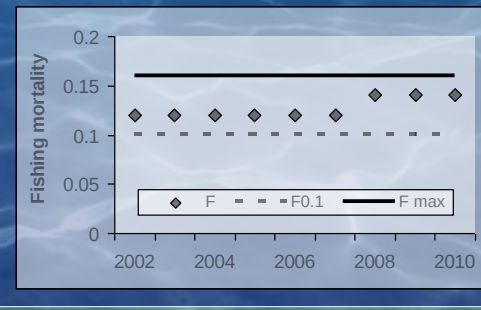
Total mortality (Z) estimations remained stable around 0.32 – 0.34

State of recruitment - State of exploitation



Time series of mean recruitment indices carried out in GSA 16 in the scientific trawl surveys GRUND and MEDITS (individuals smaller than 30 cm TL)

Fishing mortality estimates based on catch curve (age classes included in Z: 3-9 years) analysis of MEDITS survey data compared to $F_{0.1}$ estimates from Yield approach. Z = F+M, with average M of male and female *R. clavata* = 0.2.



Preliminary Assessment Result

1. The analysis of survey data however suggests that the stock of *R clavata* in GSA 15 / GSA 16 is likely to be in a state of overfishing; consequently, a reduction of F (about 30%) may be suggested;

2. The lack of data from commercial fisheries in the time series considered make the assessment of *R clavata* in GSA 15 / GSA 16 "preliminary" and therefore only partially able to provide management advice;

3. Future analysis will consider the data collected in the last years from commercial fisheries that will be compared with the findings derived by scientific trawl survey analyses with the aim to provide a more robust assessment for the management advice.