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PRELIMINARY CONSIDERATIONS OF THE STATUS OF ELASMOBRANCHS IN THE ITALIAN WATERS

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Ministero delle Politiche Agricole Alimentari e Forestali

Environmental Prtotection Agency
Tuscany Region

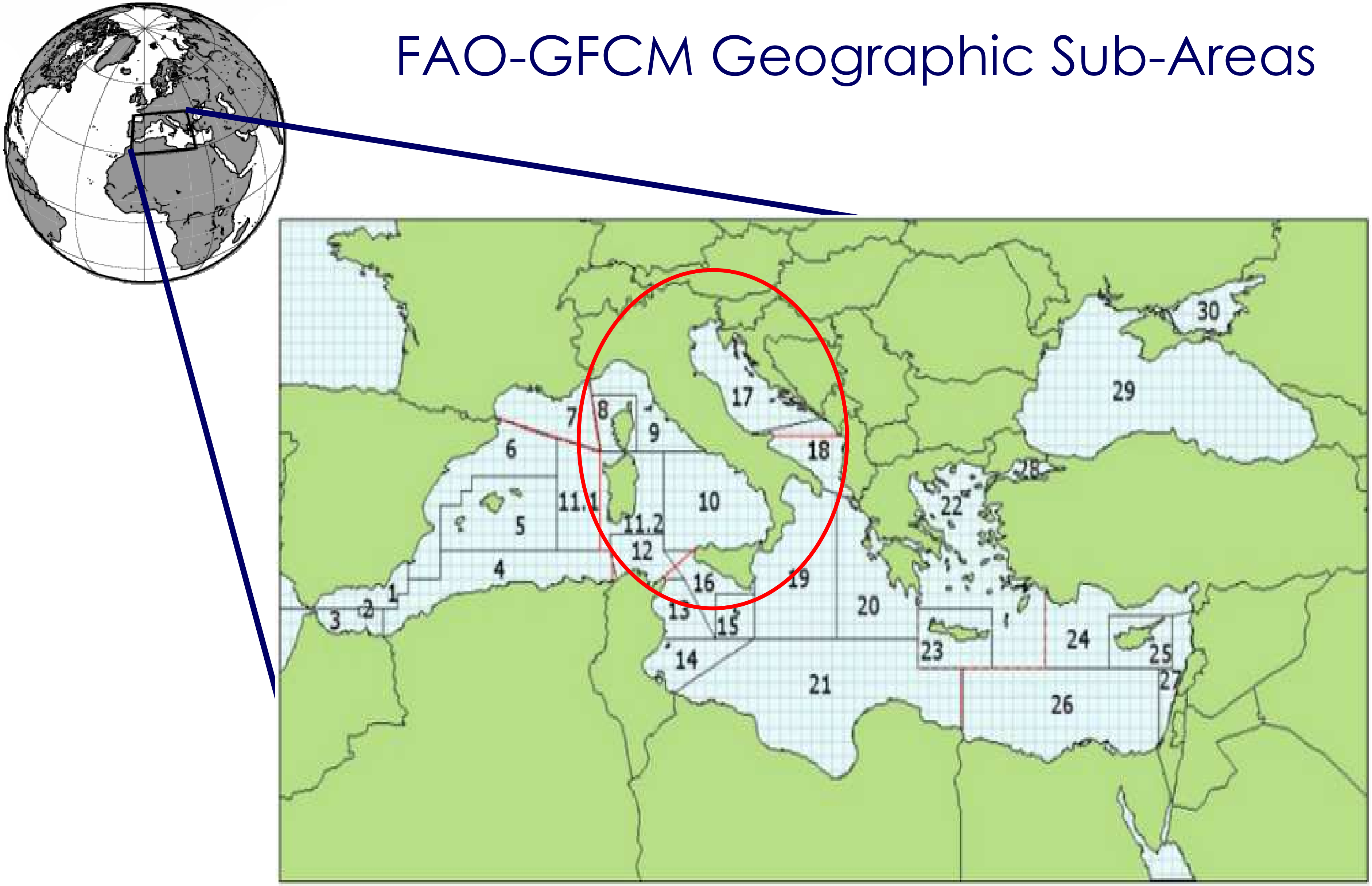
Italian Marine Biological Association

GENERAL OBJECTIVE

Use of available data for a better perception of the CURRENT exploitation status of the elasmobranchs involved in Italian fisheries (with special attention on demersal stocks)

AREAS OF INTEREST

FAO-GFCM Geographic Sub-Areas



SOURCES OF DATA

- DATA COLLECTION FRAMEWORK (EU)

  -TRAWL SURVEYS (MEDITS+GRUND)

  -LANDINGS

- MEDLEM Mediterranean Large Elasmobranchs Monitoring

- ELASMOIT For a national Protection Action Plan

- ELASMOSTAT Present work

- Etc.

DATA QUALITY

- Landings statistics limited to few species and imprecise
- Species identification issues
- Limited attention to elasmobranchs during sampling
- Limited knowledge on biological features for several species
- No specific fisheries targeting elasmobranchs in the last decades
- No good information on by-catch for each fishery
- Shortage of time series of catches, size/age composition

ELASMOSTAT PROJECT

- GENETICS
- HISTORICAL INFORMATION
- REPRODUCTION
- BY-CATCH
- TAGGING EXPERIMENTS
- SPECIES LIST
- DISTRIBUTION

Main

Specific objectives

MAIN USED APPROACHES

- ANALYSIS OF TRENDS (NUMBER AND BIOMASS)
- PRESENCE AND ABUNDANCE BY AREA
- SIZE-BASED INDICATORS

  (MEAN SIZE OF THE POPULATION, MEAN SIZE OF FIRST MATURITY)
- PSA

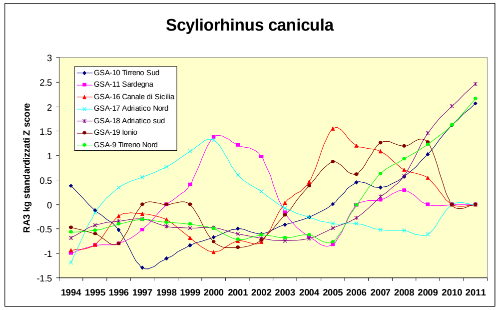
  (PRODUCTIVITY-SUSCEPTIBILITY ANALYSIS)
- PRELIMINARY ASSESSMENTS USING YIELD PER RECRUIT AND DEMOGRAPHIC ANALYSES

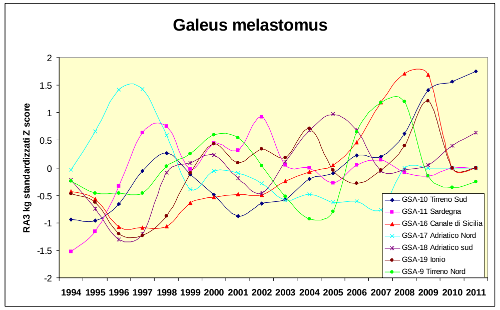
  (Leslie Matrix)

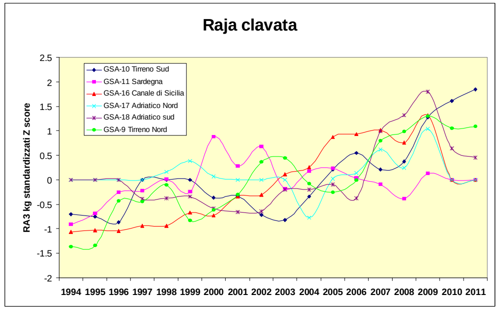
ANALYSIS OF TRENDS

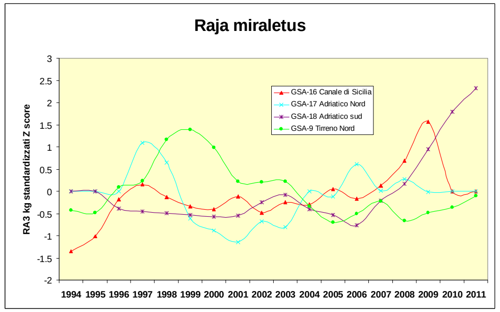
Non-parametric tests were used (Spearman's rho and Theil Sen)

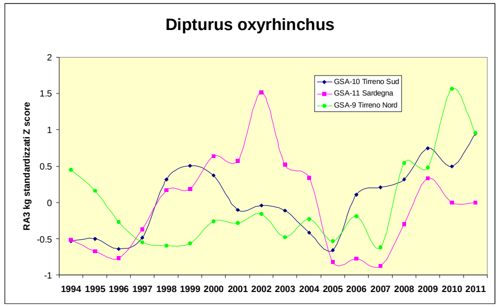
For most of the species abundance appears to increase but significative trends were observed only in few cases

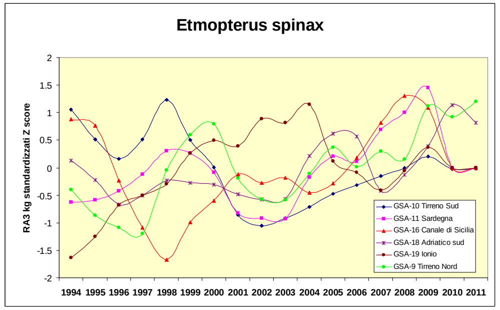


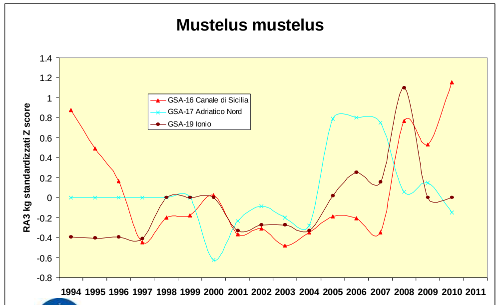


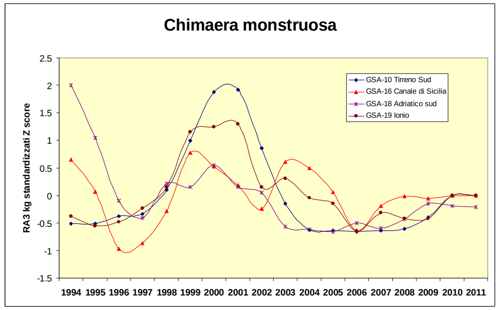












PRESENCE AND ABUNDANCE BY AREA

Specie	GSA 9	GSA 10	GSA 11	GSA 16	GSA 17	GSA 18	GSA 19
Alopias vulpinus					x		
Centrophorus granulosus	x	x	x	x		x	x
Chimaera monstrosa	x	x	x	x	x	x	x
Dalatias licha	x	x	x	x	x	x	x
Dasyatis centroura			x				x
Dasyatis pastinaca	x		x	x	x		x
Dasyatis tortonesei			x				
Dipturus batis	x	x		x			x
Dipturus oxyrinchus	x	x	x	x	x	x	x
Etmopterus spinax	x	x	x	x	x	x	x
Galeorhinus galeus		x		x			
Galeus melastomus	x	x	x	x	x	x	x
Gymnura altavela							x
Heptranchias perlo	x		x	x			x
Hexanchus griseus	x	x	x	x			x
Leucoraja circularis	x		x	x	x	x	x
Leucoraja fullonica	x					x	x
Leucoraja melitensis				x			
Leucoraja naevus				x			
Mobula mobular	x			x			
Mustelus asterias				x	x	x	
Mustelus mustelus	x	x	x	x	x	x	x
Mustelus punctulatus				x	x		
Myliobatis aquila	x	x	x	x	x	x	x
Oxynotus centrina	x	x	x	x	x	x	x
Prionace glauca			x				
Pteromylaeus bovinus			x	x	x		x
Pteroplatytrygon violacea	x	x		x	x		
Raja asterias	x	x	x	x	x	x	x
Raja brachiura		x	x	x			
Raja clavata	x	x	x	x	x	x	x
Raja miraletus	x	x	x	x	x	x	x
Raja polystigma	x	x	x	x	x	x	x
Raja radula			x	x			x
Raja undulata	x						
Rhinoptera marginata					x		
Rostroraja alba				x	x	x	x
Scyliorhinus canicula	x	x	x	x	x	x	x
Scyliorhinus stellaris	x	x	x	x	x	x	x
Squalus acanthias	x	x	x	x	x	x	x
Squalus blainvillei	x	x	x	x	x	x	x
Torpedo marmorata	x	x	x	x	x	x	x
Torpedo nobiliana	x	x	x	x	x	x	x
Torpedo torpedo	x	x	x	x	x	x	x
Numero Totale specie	**31**	**27**	**32**	**38**	**30**	**26**	**33**

PRESENCE

OF

SPECIES

BY **GSA**

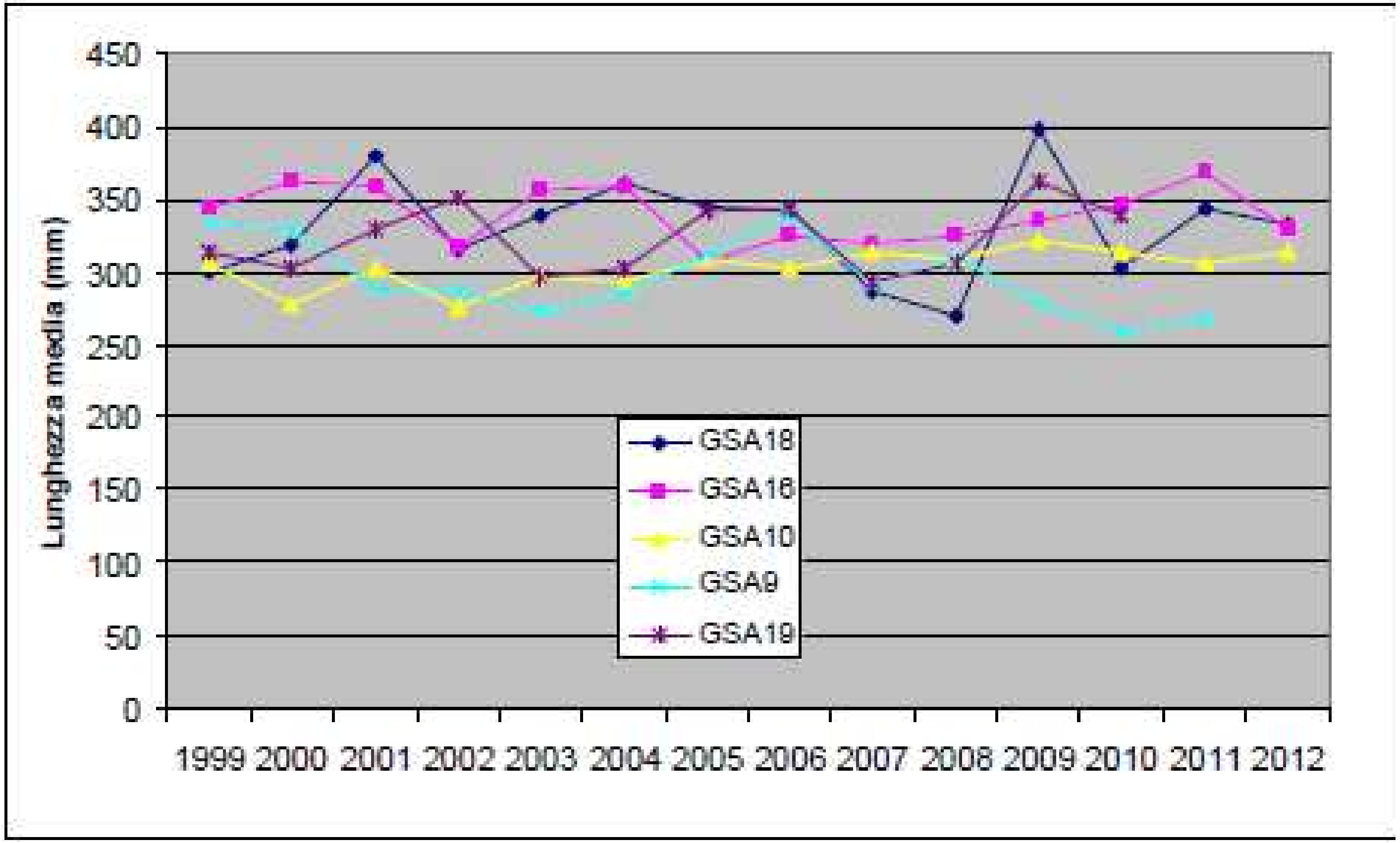
19

SPECIES FOUND

IN ALL GSAs

MEAN SIZE OF THE POPULATION

Evolution for *Galeus melastomus*



Stability for all the analysed species

MEAN SIZE OF FIRST MATURITY

Positive trends of abundance of spawners were observed for **15 species** but it was not possible to analyse any trend of recruitment. Data regarding maximum and minimum size at maturity in each GSA, species and sex are presented.

GSA	Species	Sex	TL min (mm)	TL max (mm)	TL min spawners (mm)	TL max spawners (mm)	L50 (mm)±ES
16	Centrophorus granulosus	F	450	930	560	930	
16	Centrophorus granulosus	M	450	870	-	-	815
11	Etmopterus spinax	F	100	457	343	457	369±0.54
11	Etmopterus spinax	M	97	418	290	418	330±1.18
10	Galeus melastomus	F	70	600	400	600	471±1
	Etc.						

Indicators used

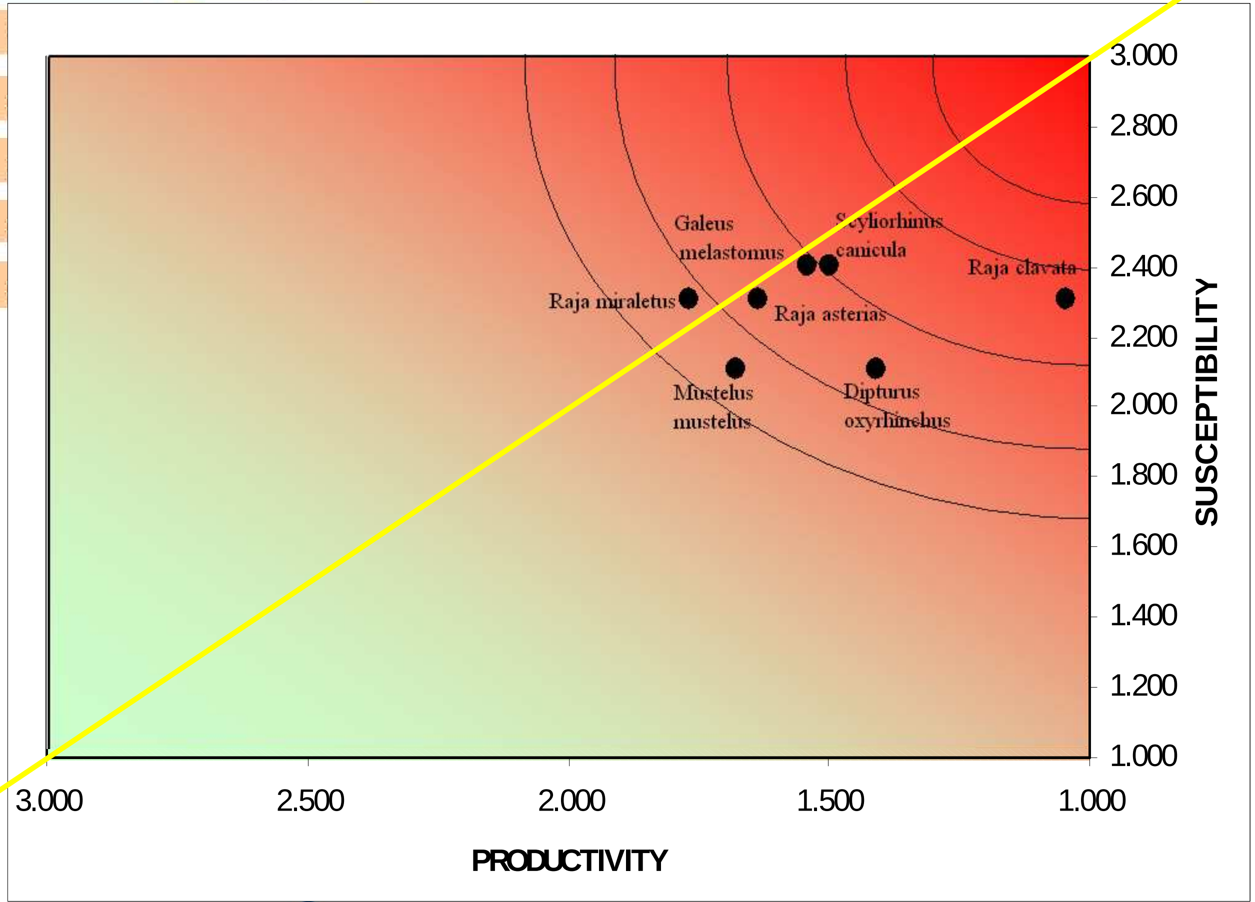
Productivity Attributes	High (3)	Moderate (2)	Low (1)
r	>0.5	0.5-0.16 (mid-pint 0.10)	<0.16
Maximum Age	< 10 years	10 - 30 years (mid-point 20)	> 30 years
Maximum Size	< 60 cm	60-150 cm (mid-point 105)	> 150 cm
von Bertalanffy Growth Coefficient (k)	> 0.25	0.15-0.25 (mid-point 0.20)	< 0.15
Estimated Natural Mortality	> 0.40	0.20-0.40 (mid-point 0.30)	< 0.20
Measured Fecundity	> 10e4	10e2-10e3	< 10e2
Breeding Strategy	0	between 1 and 3	?4
Recruitment Pattern	highly frequent recruitment success (> 75% of year classes are successful)	moderately frequent recruitment success (between 10% and 75% of year classes are successful)	infrequent recruitment success (< 10% of year classes are successful)
Age at Maturity	< 2 years	2-4 years (mid-point 3.0)	> 4 years
Mean Trophic Level	<2.5	2.5-3.5 (mid-point 3)	>3.5

Susceptibility Attributes	Low (1)	Moderate (2)	High (3)
Management Strategy	Targeted stocks have catch limits and proactive accountability measures; Non-target stocks are closely monitored.	Targeted stocks have catch limits and reactive accountability measures	Targeted stocks do not have catch limits or accountability measures; Non-target stocks are not closely monitored.
Areal Overlap	< 25% of stock occurs in the area fished	Between 25% and 50% of the stock occurs in the area fished	> 50% of stock occurs in the area fished
Geographic Concentration	stock is distributed in > 50% of its total range	stock is distributed in 25% to 50% of its total range	stock is distributed in < 25% of its total range
Vertical Overlap	< 25% of stock occurs in the depths fished	Between 25% and 50% of the stock occurs in the depths fished	> 50% of stock occurs in the depths fished
Fishing rate relative to M	<0.5	0.5 - 1.0	>1
Biomass of Spawners (SSB) or other proxies	B is > 40% of B0 (or maximum observed from time series of biomass estimates)	B is between 25% and 40% of B0 (or maximum observed from time series of biomass estimates)	B is < 25% of B0 (or maximum observed from time series of biomass estimates)
Seasonal Migrations	Seasonal migrations decrease overlap with the fishery	Seasonal migrations do not substantially affect the overlap with the fishery	Seasonal migrations increase overlap with the fishery
Schooling/Aggregation and Other Behavioral Responses	Behavioral responses decrease the catchability of the gear	Behavioral responses do not substantially affect the catchability of the gear	Behavioral responses increase the catchability of the gear [i.e., hyperstability of CPUE with schooling behavior]
Morphology Affecting Capture	Species shows low selectivity to the fishing gear.	Species shows moderate selectivity to the fishing gear.	Species shows high selectivity to the fishing gear.
Survival After Capture and Release	Probability of survival > 67%	33% < probability of survival < 67%	Probability of survival < 33%
Desirability/Value of the Fishery	stock is not highly valued or desired by the fishery	stock is moderately valued or desired by the fishery	stock is highly valued or desired by the fishery
Fishery Impact to EFH or Habitat in General for Non-targets	Adverse effects absent, minimal or temporary	Adverse effects more than minimal or temporary but are mitigated	Adverse effects more than minimal or temporary and are not mitigated

PRODUCTIVITY-SUSCEPTIBILITY ANALYSIS

All the analyzed species showed low levels of productivity and variable levels of susceptibility to trawling and set gears

Stock Name	Productivity Weighted Attribute Score	Susceptibility Weighted Attribute Score	Vulnerability
Scyliorhinus canicula	1.500	2.400	1.72
Galeus melastomus	1.545	2.400	1.69
Mustelus mustelus	1.682		
Raja clavata	1.045		
Raja asterias	1.636		
Raja miraletus	1.773		
Dipturus oxyrhinchus	1.409		



Some species can be considered as more at risk, as observed in the plot

Vulnerability line

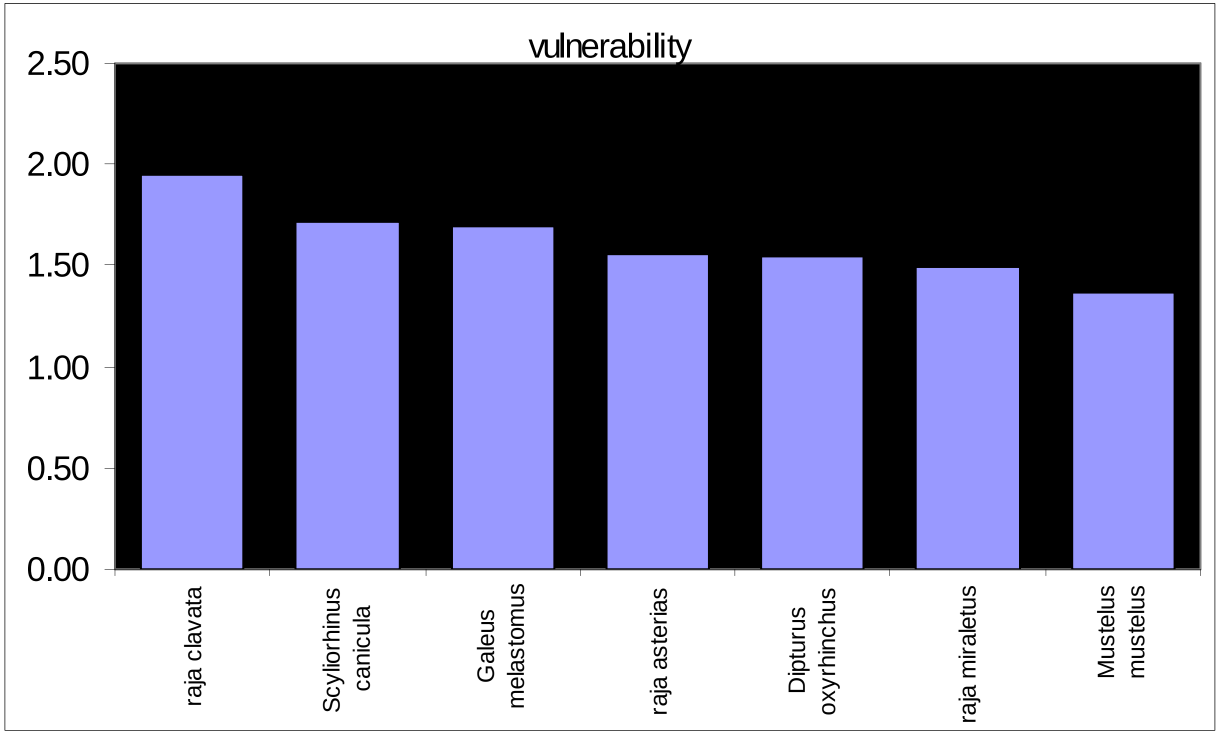
PRODUCTIVITY-SUSCEPTIBILITY ANALYSIS

As more at risk resulted:

Raja clavata

Scyliorhinus canicula

Galeus melastomus



Raja asterias and ***Raja miraletus*** have shown higher values of **r** while lower generation time. For these species less time is needed in the absence of fishing for doubling the population.

Deep sea species ***Dipturus oxyrinchus*** is only partially susceptible to the fishing fleets.

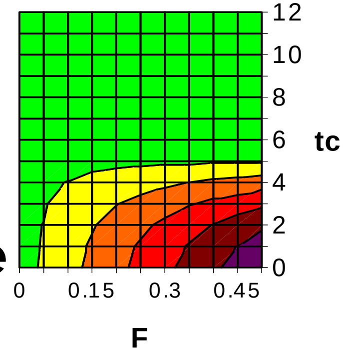
Mustelus mustelus is mainly vulnerable by small scale fisheries and is a relatively high productive elasmobranch species.

Reference Points

Identification of precautionary **Reference Points** useful for a preliminary evaluation of stock status and for advice in management

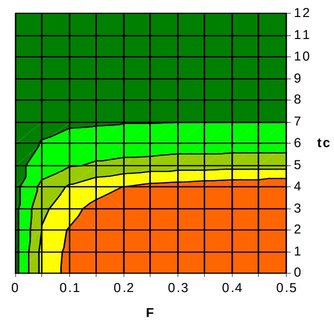
Two RPs expressed in mortality rates:

Population growth rate



$F_{0.1}$ derived from the analysis of yield per recruit

replacement

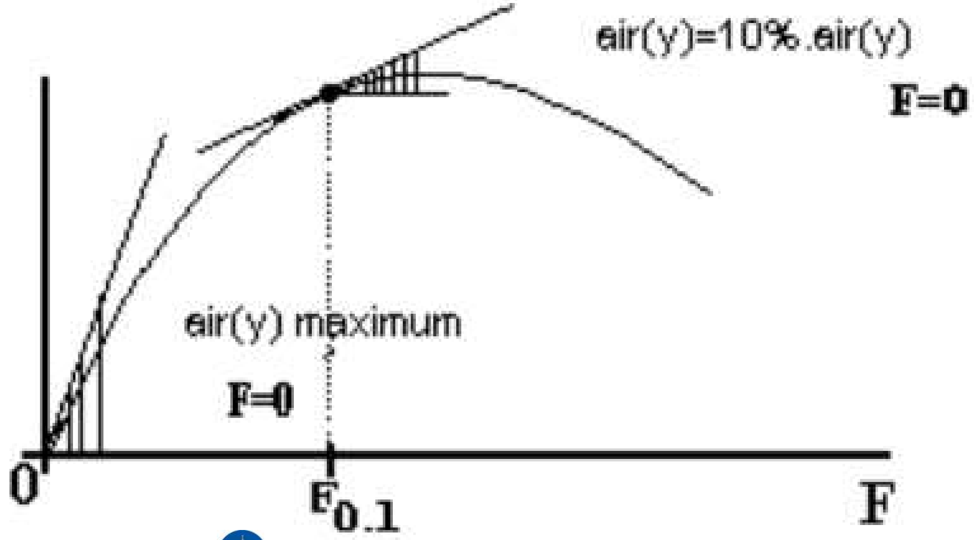


$F_{(repl)}$ based on demographic analysis with a Leslie matrix

Reference Points

Estimation of $\mathbf{F_{0.1}}$ with Y/R

- Information on growth in size and weight, natural mortality rate, exploitation pattern
- Several data proceeds from literature



Demographic model

- Rely on life history parameters
- Survival rates in each year
- Age at first maturity
- Lifespan
- Fecundity at age

Demographic model

Model with Leslie Matrix

Species	r	generation time	time needed for doubling population
R.asterias	0.247	4.36	2.81
R.clavata	0.155	6.61	4.47
R.miraletus	0.176	5.69	3.94
G.melastomus	0.195	5.4	3.55
S.canicula	0.114	6.72	6.08
M.mustelus	0.387	4.37	1.79

The elasmobranchs are few resilient to various sources of stress and their intrinsic rate of population growth **r** shows low values

e.g.

Raja clavata
Scyliorhinus canicula

Demographic model

Elasticity analysis

Eigenvalues		Eigenvectors (R&L)		
Real	Imaginary	Age/stage struct		Reprod val
1.16798	0		38.6%	0.3%
0.628151	-0.9249		28.1%	0.4%
0.628151	0.924901		17.5%	0.6%
0.090908	-0.17811		9.3%	1.2%
0.090908	0.178106		4.2%	2.6%

Allows estimating how much vulnerable to changes in the survival of the juveniles (or the adults) depending on the characteristics of each species that may show very distinct biological characteristics of size, growing speed, lifespan

0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.013	0.106	1.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.010	0.091	1.000
R (expecte															
2.791262	3.275576	4.510886577	7.2899	13.825	30.769	35.959	39.718	42.147	42.827	43.723	44.697	45.681	45.471	42.000	0.000
elasticity															
0	0	0	0	0	0.09	0.0411	0.014	0.0038	0.0008	0.0002	2E-05	3E-06	3E-07	3E-08	0
0.152556	0	0	0	0	0	0	0	0	0	6E-08	0	0	0	0	0
0	0.152556	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0.152556102	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0.1526	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0.1526	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0.0599	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0.0188	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.0048	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0.001	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0.0002	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	3E-05	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	3E-06	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	4E-07	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	3E-08	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Demographic model

Elasticity analysis

Allows defining suitable management choices likely to produce more benefits to the analysed stocks

Elasticity analyses suggest for all the analysed stocks that is in the first ages where smallest changes in vital rates are likely to produce biggest changes in the population growth rate

Management measures aimed at protecting juveniles (e.g., mesh size increase, nursery area closures) should provide greater benefits to the population than a strategy aimed at protecting adults.

Fishing mortality estimates

VPA approaches not feassible

In most of the cases Z estimated using the mean size in the catch with the Gedamke & Hoenig approach. Z-M=F

Such approach does not need of the asumption of equilibrium as the classical Beverton & Holt equation, but needs in any case of strong assumptions.

Stock status

Only for few species available data made possible such preliminary assessments

	GSA	F0.1	Fr	Fcurr	Fcurr vs F01	Fcurr vs Fr
Raja asterias	9	0.212	0.150	0.17	0.80	1.13
Scyliorhinus canicula	9	0.144	0.088	0.15	1.04	1.70
Scyliorhinus canicula	16	0.144	0.088	0.11	0.76	1.25
Raja clavata	9	0.111	0.055	0.26	2.34	4.73
Raja clavata	16	0.111	0.055	0.09	0.81	1.64
Galeus melastomus	9	0.134	0.075	0.3	2.24	4.00
Galeus melastomus	10	0.134	0.075	0.15	1.12	2.00
Galeus melastomus	16	0.134	0.075	0.07	0.52	0.93
Galeus melastomus	18	0.134	0.075	0.12	0.90	1.60
Galeus melastomus	11	0.134	0.075	0.1	0.75	1.33
Mustelus mustelus	16	0.120	0.040	0.10	0.83	2.50

Stocks appear to be exposed to excessive fishing pressure. Sustainability is not guaranteed

Final remarks

- Several stocks seem to be very vulnerable considering their biological features and impact of fishing activities.

- More data are needed in order to allow sound assessments and for providing useful management advice

Acknowledgements

I would like to thank all colleagues involved in the scientific trawl surveys carried out from the seventies till now whose work allowed me to produce this contribution