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Report on the Cartilaginous Fishes in Slovenia, Croatia, Bosnia & Herzegovina and Montenegro: Proposal of a Sub-Regional Working Programme to Support the Implementation of the Regional Action Plan

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CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora

COFI Committee on Fisheries

FAO Food and Agriculture Organization of the United Nations

FAO-AdriaMed Project Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea

GFCM General Fisheries Commission for the Mediterranean

GSA Geographical Sub Area

ICCAT International Commission for the Conservation of Atlantic Tunas

ISSCAAP Standard Statistical Classification for Aquatic Animals and Plants'

IUCN World Conservation Union (International Union for the Protection of Nature

MEDITS MEDIterranean Trawl Surveys

MEDLEM MEDiterranean Large Elasmobranchs Monitoring

RAC/SPA Regional Activity Centre for Specially Protected Areas

SAC scientific Advisory Committee (GFCM)

SIRENO Seguimiento Informatico de los REcursos Naturales Oceanicos

FOREWORD

The problem of depleted and threatened stocks and species of elasmobranch fishes continues to increase, consequentially, the need for effective implementation of the conservation of chondrichthyan fishes is growing. Moreover, the scope of fisheries management for these animals is expanding beyond the focus of sustainable use of the resource to take account of the need for biodiversity conservation and maintenance of ecosystem structure and function.

Management of cartilaginous fishes in Mediterranean suffers the absence of precise and accurate data relating to all aspects of the fisheries: identification of the species composition of the catch; accurate recording of the amount of catch and discards; the amount of fishing effort by gear, area and trade-related information.

Statistics where several species are aggregated by major taxonomic division, e.g. order or family, as in the case of the cartilaginous, can mask basic changes in community structure and profound reductions in populations of the larger, slower growing species. The removal of sharks and rays occupying the role of top predators in their ecosystems can have not only the expected effect of releasing control over their main prey, but sometimes unexpected second and third degree effects on non-prey species through trophic linkages. Therefore the ecosystem approach is particularly important to understand the role of these fishes in the structuring and functioning of this system. Moreover many of the characteristics of elasmobranch fisheries are sufficiently different from that of non-elasmobranch species and their successful management required specialized staff dedicated to this particular management task.

Since the mid-20th century the main change in composition and distribution of demersal fish resources in Adriatic Sea was the decrease of elasmobranch diversity and frequency, mostly referring to skates and rays. The biological response to high fishing pressure and to oceanographic changes, coupled with changes in bottom communities ecosystems appeared to be determining factors. Moreover, results of spatial and temporal distribution of Adriatic elasmobranch fishes group showed their common and shared properties.

In this circumstance the “Action Plan for the Conservation of Cartilaginous (Chondrichthyan) Fishes in the Mediterranean” constitutes a proposal for regional strategies, pointing out priorities and actions to be undertaken at national and regional level, since regional coordination is needed to ensure implementation of conservation measures.

In order to evaluate the biodiversity and the conservation status of the cartilaginous fishes living in the eastern Adriatic Sea, it is very important to collect catch data and information on the geographical distribution at species level. The improvement of the knowledge of life-history data is needed for the application of demographic models. Moreover, information on fisheries, fishing gear and ground fishing are essential in order to estimate the fishing effort, probably the main reason of the biodiversity depletion.

1 AREA OF INTEREST: THE ADRIATIC SEA

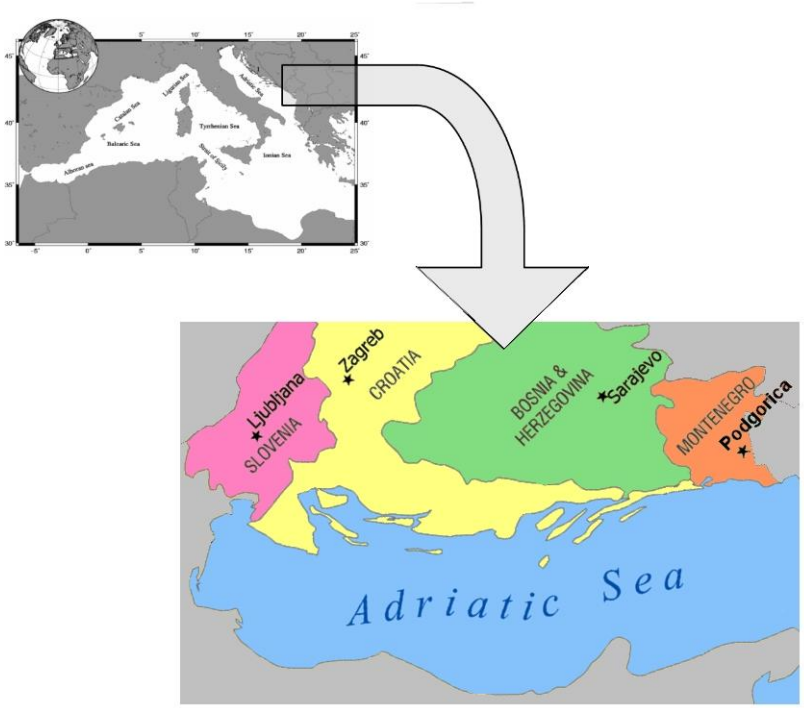


Figure 1. Countries involved in the project

1.1 Oceanographic properties

Excluding the Black Sea, the Adriatic is the northernmost part of Mediterranean. This fact influences some important physical properties of even its southern areas. The Adriatic is 783 long and its average width is 243 km. In the south it is separate from Ionian Sea by the 72 km-wide Strait of Otranto, where a submarine sill of 800 m exists. In the Central Adriatic the Palagruža Sill lowers the sea depth to only 170 m. The two sills define the South Adriatic Basin with its steep sides and an abyssal plain as its bottom with the maximal depth of 1233 m. Adriatic has a surface area, islands included, of 138.292 km^2, which is around 4,6% of the total Mediterranean surface. Most of the bottom, about 102.412 km^2 or 73 % is less than 200 m deep. (Buljan and Zore-Armanda, 1976)

Figure 2. Bathymetric map of the Adriatic Sea (Hrvatski Hidrografski Institut, Peljar, 1999)

The Adriatic was systematically investigated since the end of the last century and broad literature exists describing its oceanographic properties.

The Adriatic is a site of the deep water formation for the eastern Mediterranean. Four water types can be identify in Adriatic, characterized with respect to temperature, salinity and density. Three are deep waters of Adriatic origin (North, Middle and South Adriatic deep

waters) and the forth is formed in the Levantine basin and can be recognized in the intermediate layer of South and Middle Adriatic.

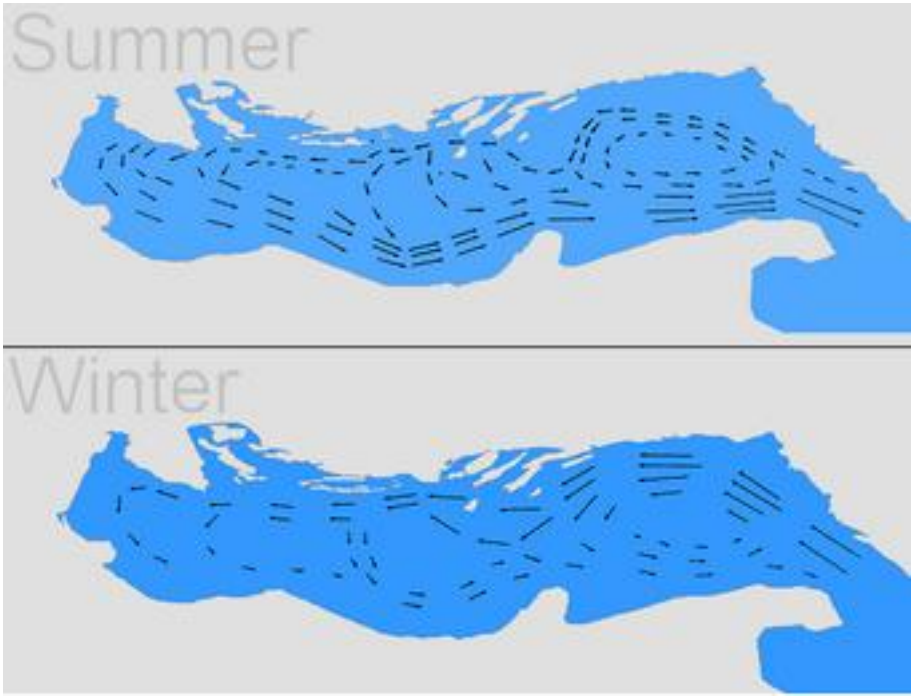


Figure 3. Surface currents in the Adriatic Sea (Zore-Armanda, 1967)

Mean surface current in the Adriatic is cyclonic. Water enters in the Adriatic from Mediterranean along its eastern side and exits from the Adriatic on its western side, with seasonally varying intensity. In winter inflow is stronger, which reinforce currents along the eastern coasts. In summer outflow is stronger along the western coasts (Zore-Armanda *et al.*, 1999).

The most distinguished characteristics of the Adriatic are large annual and year-to-year fluctuation of the main parameters. The horizontal pressure difference varies between the northern and southern Adriatic, which influence the intensity of water exchange between the Adriatic and the eastern Mediterranean as a consequence of distribution of large pressure centred over the wider Mediterranean region. Year-to-year fluctuations of water exchange between these basins influenced long-term fluctuation of a variety of parameters like salinity, temperature, nutrient salt. Nutrients enhance phytoplankton production which reflects on fisheries grounds.

As a whole, the Adriatic Sea is a temperate warm sea. The extremes of the surface temperature embrace a large range, from 6°C to 29°C. Temperatures of even the deepest layers area almost always above 10°C.

Salinity is relatively high with average value about 38,3‰. Generally, it could be said that the Adriatic Sea water salinity decreases from south to north and from the open sea to the coast. The southern part has salinity between 38.4 to 38.9‰ and is especially high in the intermediate layer.

1.2 Marine fisheries

The Adriatic Sea, especially its northern part is one of the richest fishing grounds in Mediterranean. The rich river inflows over the shallow shelf of the North Adriatic and in addition, mixing of bottom sediments, enable high productivity of this area. The Middle and southern Adriatic are less productive, but their exposure to the influence from North Adriatic and to periodically stronger influence of the Mediterranean waters, enable high productivity in these areas as well (Zore-Armanda *et al.*, 1999)

In the Adriatic Sea, the demersal fishery takes place on the entire continental shelf and on a part of the continental slope in the southern Adriatic. Most of the fishing activity is carried out by trawlers of various size and engine power. The use of fixed gear is usually limited to the area unsuitable for trawling (Arneri, 1996).

Unlike the pelagic fishery, where mostly one or two species are targeted, in the demersal fishery the situation is more complex. The demersal fishery is multispecies fishery and main target species are: Hake (*Merluccius merluccius*), Red mullet (*Mullus barbatus*), breams (*Pagellus* spp.), whiting (*Merlangius merlangus*), anglerfish (Lophius spp.), flatfish (*Solea spp.*), *Eledone* spp., cuttlefish (*Sepia officinalis*), squids (*Loligo* and *Illex*), Norway lobster (*Nephrops norvegicus*) and Red shrimp (*Parapenaeus longirostris*). However, according to the GFCM landing statistic, the most common and important species in the whole Adriatic Sea are: Hake, Red mullet, Norway lobster and loliginid squids, because of their relatively high market price (Vrgoč *et al.*, 2004).

According to FAO Major Fishing Areas, Slovenia, Croatia, Bosnia&Herzegovina and Montenegro belong to division 37.2.1: “Adriatic”. Besides they are part of the GFCM - GSAs 17 (Northern and Central Adriatic) and 18 (Southern Adriatic Sea) (GFCM, 2007).

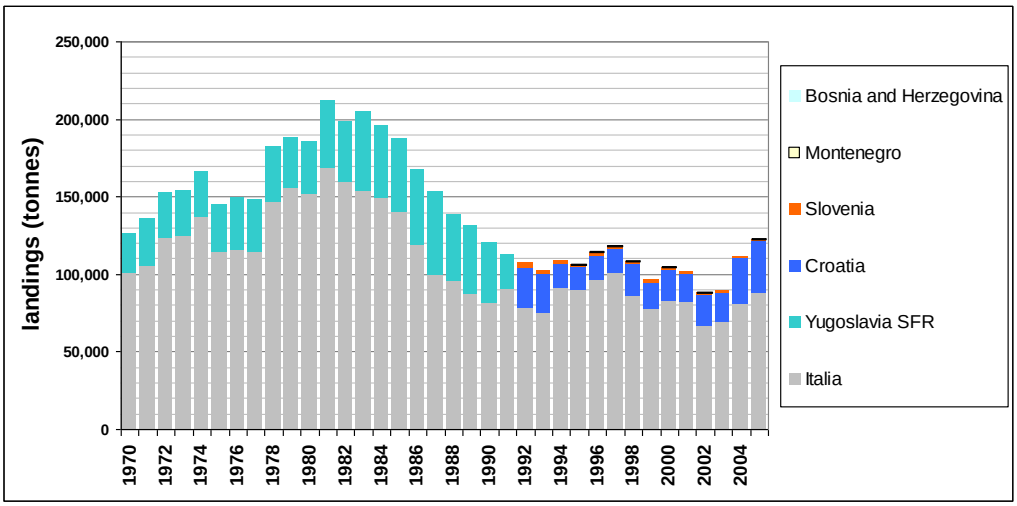


Figure 4. Capture fisheries production in “Adriatic” division (1970-2002) (excluding bivalve molluscs and aquaculture).

By analysing (according to FAO statistics) the total landing of the commercial capture fisheries in the Adriatic Division in 1970-2002, a 32 year-long period, it had reached a maximum in 1981 with about 220.000 t, and minimum values of 110.000 t in 1993 and 90.000 t in 2002 The combined effects of the low small pelagic stock level and the social-economic crisis that affected the fishery, mainly pelagic, of some coastal countries, could have caused the landing decrease (Vrgoč *et al.*, 2004).

It is very difficult to precisely define the level of exploitation and the current state of the demersal resources in the Adriatic, because there are no reliable commercial catch and effort statistics. This is the reason why the stock assessment for standard population dynamic analysis is based mainly on the direct method, i.e. experimental trawl survey. On the basis of direct methods there is enough evidence indicating that demersal stocks are from fully to overexploited (Vrgoč *et al.*, 2004).

The first “Adriatic" trawl survey was carried out in the years 1948-1949. It was the Hvar Expedition, financed by the former State of Yugoslavia and organized by the “Institute of Oceanography and Fishery” of Split. This expedition provided information about post-war conditions over a wide area from the north to the south of the basin. Particular importance of the data collected is the fact that these data can be used for determination of the “zero state in the Adriatic”, which in the time of greater interest for research of long term change, is of

significant importance. (Marasović and Krstulović, 1999; Jukić-Peladić *et al.*, 2001). For a full review of research on demersal resources in the Adriatic Sea see Vrgoč *et al.* (2004).

1.3 Cartilaginous fishes in the Eastern Adriatic Sea

According to GFCM Capture Production (1970-2005), cartilaginous fishes (ISSCAAP group 38: Shark, rays and chimaeras) represent less then 1% of the 2005 total landings in the eastern Adriatic.

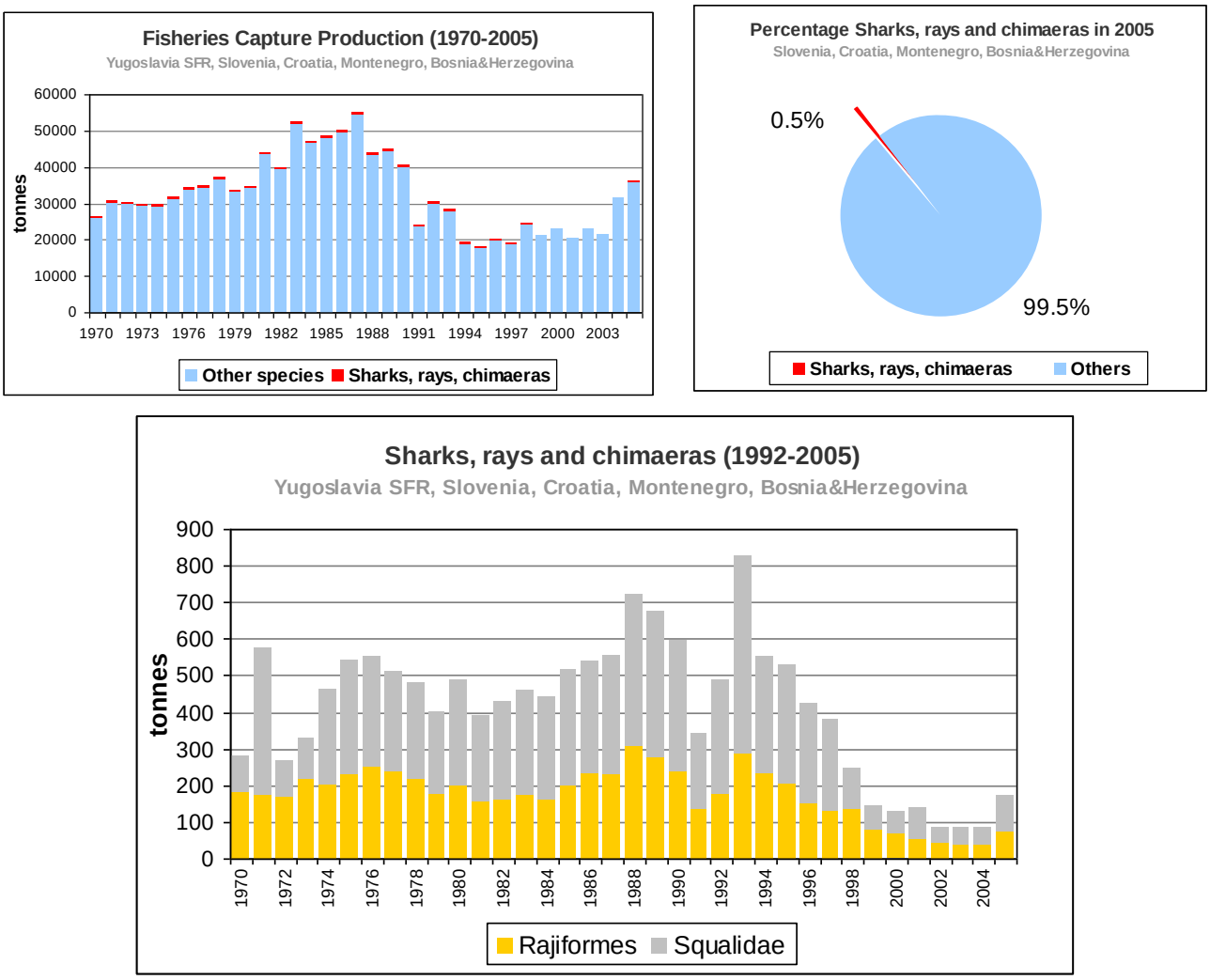


Figure 5. Capture production of cartilaginous fishes (GFCM 1970-2005)

Cartilaginous species are mostly aggregate in Squalidae and Rajformes making it difficult to identify catch trends for individual species. From official capture production of Squalidae and Rajiformes a maximum in 1993 with about 800 tonnes is followed by an evident negative trend with minimum in 2004, when 84 tonnes were recorded. A real decrease in catch likely happened, but the negative trend could be also related to a changing in data collection: from landing monitoring and logbook to exclusively logbook (Vrgoč, pers.comm.).

Analysis of catch per unit of effort data for chondrichthyan fishes in 1948-49 and 1996-97 and catch percentages change in bottom assemblage structure, within two investigated periods, pointed out that cartilaginous fishes in 1948-49 was present, on average, with 32,2%. Analysis made in 1996 and 1997 year showed significant percentage decrease of this group, 13.3% and 12.9% respectively (Jukić *et al.*, 1999).

Moreover, Jukić-Peladić *et al.* (2001) comparing “Hvar 1948” and the “Medits 1998” trawl surveys stated that the main change in composition and distribution of demersal fish resources was the decrease of elasmobranch diversity and frequency. Skates and rays showed the greatest change in biomass percentage. Moreover, there was a change in communities structure: reduction of long lived and slowly growing species. For example, small sized species such as smallspotted catshark (*Scyliorhinus canicula*) and the brown ray (*Raja miraletus*) were frequently collected in both surveys, while some bigger sharks and rays species disappeared or were rarely found in the Medits 1998.

The biological response to high fishing pressure and to oceanographic changes (Jukić *et al.*, 1999), coupled with changes in bottom communities ecosystems (Gislason, 1994) appeared to be determining factors in the declining of this fish group.

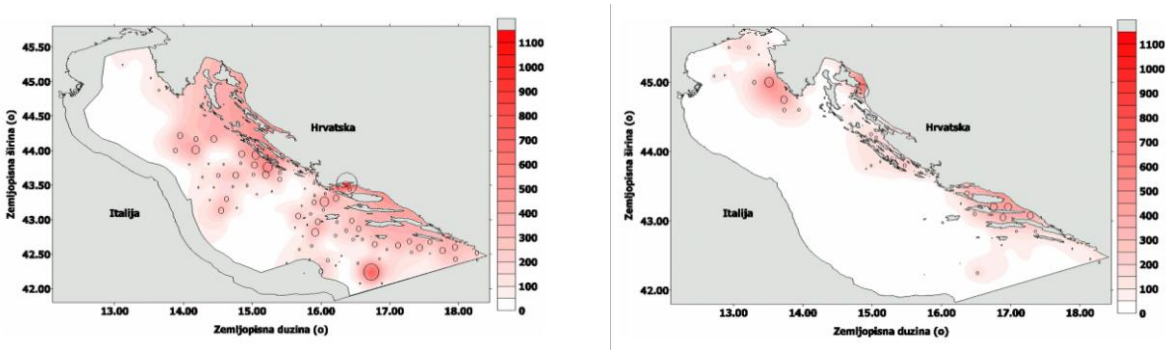


Figure 6. Catch distribution of cartilaginous fishes: Hvar expedition (1948/49) on the left and Medits Trawl Survey on the right. – (Jukić-Peladić *et al.*, 2001).

During 2000 and in the first months of 2001, numerous records of *Cetorhinus maximus* (Gunnerus, 1765) have been collected in the Middle and Northern Adriatic Sea, along the Italian, Croatian and Slovenian coasts. The collected records include both sightings and accidental catches (Zuffa *et al.*, 2008).

Figure 7. Record of basking shark, *Cetorhinus maximus*, in the Eastern Adriatic 19th century – 2000 (Soldo & Jardas, 2002)

A total of 177 catches and sightings of great elasmobranchs were recorded in the Eastern Adriatic Sea from 1800s to current days (MEDLEM, 2008). The more frequently recorded species and the time series are showed in the above graphs. About 95% of catch and sighting came from Croatia waters, remaining from Slovenia. Data collected came from bibliographic resource (81%) and from observations (19%).

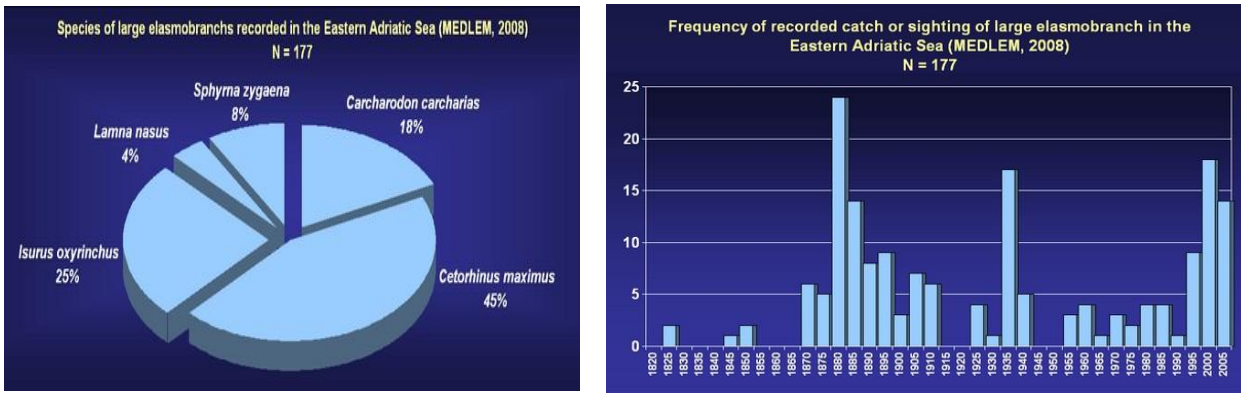


Figure 8. Large elasmobranchs recorded in eastern Adriatic sea and their frequency (MEDLEM programme)

According to the MEDITS data, biomass indices of majority of demersal stocks show decrease from eastern to the western side (Vrgoč, pers. comm.). This situation is especially visible in situation of elasmobranch. Beside, from GFCM capture production data, especially in recent years Italy declared the highest percentage of elasmobranch landings. This aspect highlights the need of common data collection, analysis and future management in this area.

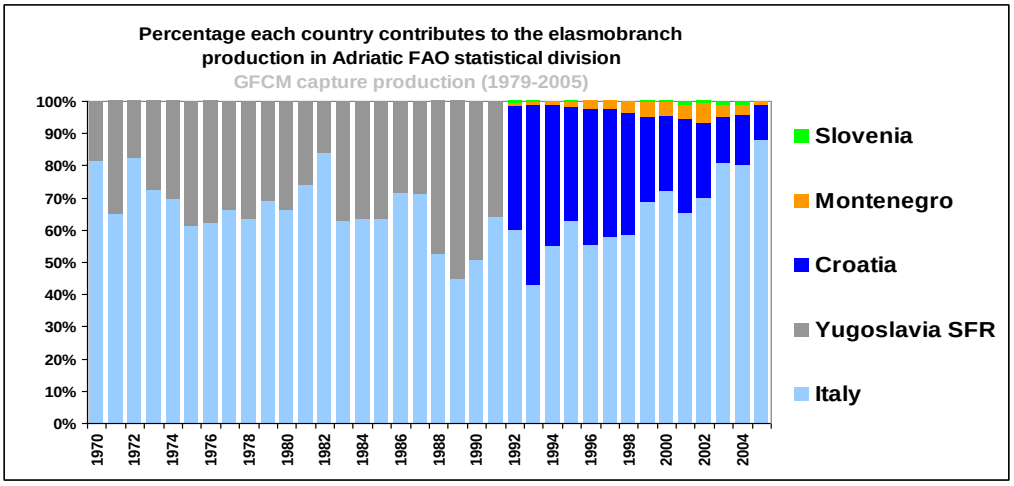


Figure 9. Percentage each country contributes to the elasmobranch production in Adriatic FAO statistical division (GFCM 1970-2005).

It is worth noting that results of spatial and temporal distribution of Adriatic chondrichthyan fishes showed their common and shared properties (Jukić *et al.*, 1999). Like the other demersal resources, elasmobranchs are experiencing different level of exploitation and from recent results the status of populations along eastern and western side of the Adriatic Sea is significant different (Vrgoč, pers. comm.). In this context, the “Mediterranean Action Plan for the Conservation of the Chondrichthyan Fishes” should assure a regional coordination in the Adriatic for the implementation of conservation measures.

2 TAXONOMIC LIST OF THE CHONDRICHTHYAN FISHES OF EASTERN ADRIATIC SEA

The identification at specific level for some cartilaginous species present objective difficulties and this is especially true for skates and rays due their high morphological variability. In the Mediterranean Basin a total of 49 sharks, 34 batoids and 1 chimaera are known. (Serena, 2005).

In order to obtain a good taxonomic list of the cartilaginous species living in the eastern Adriatic Sea, gathering scientific and grey literature is fundamental. Specific research programmes aimed at demersal and pelagic resources can be useful to complete the list. Also the specimens stored in the collections of the Museum of the Natural History should be taken in to account. At least a collection of cartilaginous fishes per country could be recommended. For this reason a specimen of every species collected should be preserved (in formalin) and then deposited in the Museum collection. Catalogue numbers should be given to every specimen deposited in the collection. A good quality label (made of “plastic paper”) with this catalogue number should be attached to the specimens and an external label should be stuck on the jar or on the barrel in which the specimen is kept.

The capture data and the main information on the specimens (TL, sex, weight, etc) should be recorded in a computerized file. Also, every specimen of the collection should be photographed before its preservation and the pictures should be added to the computerized catalogue of the collection. In the same way, any additional information available should be added as observation notes: for instance, some biometrical measurements or meristic characters, the references of tissue samples if some have been taken for genetic analysis, etc.

For the rays, the following photographs should be taken as a minimum: a general dorsal view of the specimen, a general ventral view of the specimen, and a close-up of the mouth-snout region. For the shark, the following photographs should be taken as a minimum: a lateral view of the specimen in a natural position, a dorsal view of the specimen, a ventral view of the snout and close-up pictures of the upper and lower teeth as well as suggested by Seret in the previous report AP to Libya.

In order to identification the cartilaginous species, the main useful publications for the Mediterranean basin are the FAO species catalogues (Sharks of the world, Compagno, 1984) issued in 1984 and more recently, partially reviewed only for Hterodontiformes, Lamniformes and Orectolobiformes the volume 2 (Compagno, 2001); the Fiches FAO d’identification des especes puor les besoins de la pêche (Bouchot, 1987 In: Fisher W., Schneider M., Bauchot M.-L. 1987); the Fishes of the North-Eastern Atlantic and Mediterranean (FNAM, Whitehead et al.., 1984); the “Guida degli squali e delle razze del Mediterraneo” (Notarbartolo di Sciara & Bianchi. 1998) and also the FAO regional guide on the cartilaginous fishes of the Mediterranean Sea (Serena, 2005): the field identification guide to rays of the Mediterranean Sea (Serena ed., in press).

Also specific, particular identification keys will be provided for some groups for which the identification of some species is delicate, such as the sharks of the orders Sqaliformes and Carcharhiniformes.

Anyway for this initiative we can adopt the following simplified classification suggested by Compagno, 2002 (the orders with no representatives in the Mediterranean Sea are indicated by an asterisk).

Table 1. Classification of Chondrichthyes (Compagno, 2005).

CLASS Chondrichthyes (cartilaginous fishes) *Sensu Compagno, 2005*	
SUBCLASS	Holocephali (chimaeras)
Order	Chimaeriformes (chimaera and silver sharks)
SUBCLASS	Elasmobranchii (sharks)
Superorder	Squalomorphi (squalomorph sharks)
Order	Hexanchiformes (cow and frilled sharks)
Order	Squaliformes (dogfish sharks)
Order	Squatiniformes (angel sharks)
Order	Pristiophoriformes (sawsharks) *****
Order	Rajiformes (batoids)
Superorder	Galeomorphi (galeomorph sharks)
Order	Heterodontiformes (bullhead sharks) *****
Order	Lamniformes (mackerel sharks)
Order	Orectolobiformes (carpet sharks) *****
Order	Carcharhiniformes (ground sharks)

2.1 Sharks

Table 2. Sharks: list of order, families and species occurring in the Adriatic Sea

LIST OF ORDER, FAMILIES AND SPECIES OCCURRING IN THE ADRIATIC SEA		
ORDER	**FAMILY**	**SPECIES**
HEXANCHIFORMES	HEXANCHIDAE	*Heptranchias perlo*
		Hexanchus griseus
SQUALIFORMES	ECHINORHINIDAE	*Echinorhinus brucus*
	SQUALIDAE	*Squalus acanthias*
		Squalus blainvillei
	CENTROPHORIDAE	*Centrophorus granulosus*
	ETMOPTERIDAE	*Etmopterus spinax*
	OXYNOTIDAE	*Oxynotus centrina*
	DALATIIDAE	*Dalatias licha*
SQUATINIFORMES	SQUATINIDAE	*Squatina oculata*
		Squatina squatina
LAMNIFORMES	ODONTASPIDIDAE	*Carcharias taurus*
		Odontaspis ferox
	ALOPIIDAE	*Alopias vulpinus*
	CETORHINIDAE	*Cetorhinus maximus*
	LAMNIDAE	*Carcharodon carcharias*
		Isurus oxyrinchus
		Lamna nasus
CARCHARHINIFORMES	SCYLIORHINIDAE	*Galeus melastomus*
		Scyliorhinus canicula
		Scyliorhinus stellaris
	TRIAKIDAE	*Galeorhinus galeus*
		Mustelus asterias
		Mustelus mustelus
		Mustelus punctulatus
	CARCHARHINIDAE	*Carcharhinus plumbeus*
		Prionace glauca
	SPHYRNIDAE	*Sphyrna zygaena*
CHIMAERIFORMES	CHIMAERIDAE	*Chimaera monstrosa*

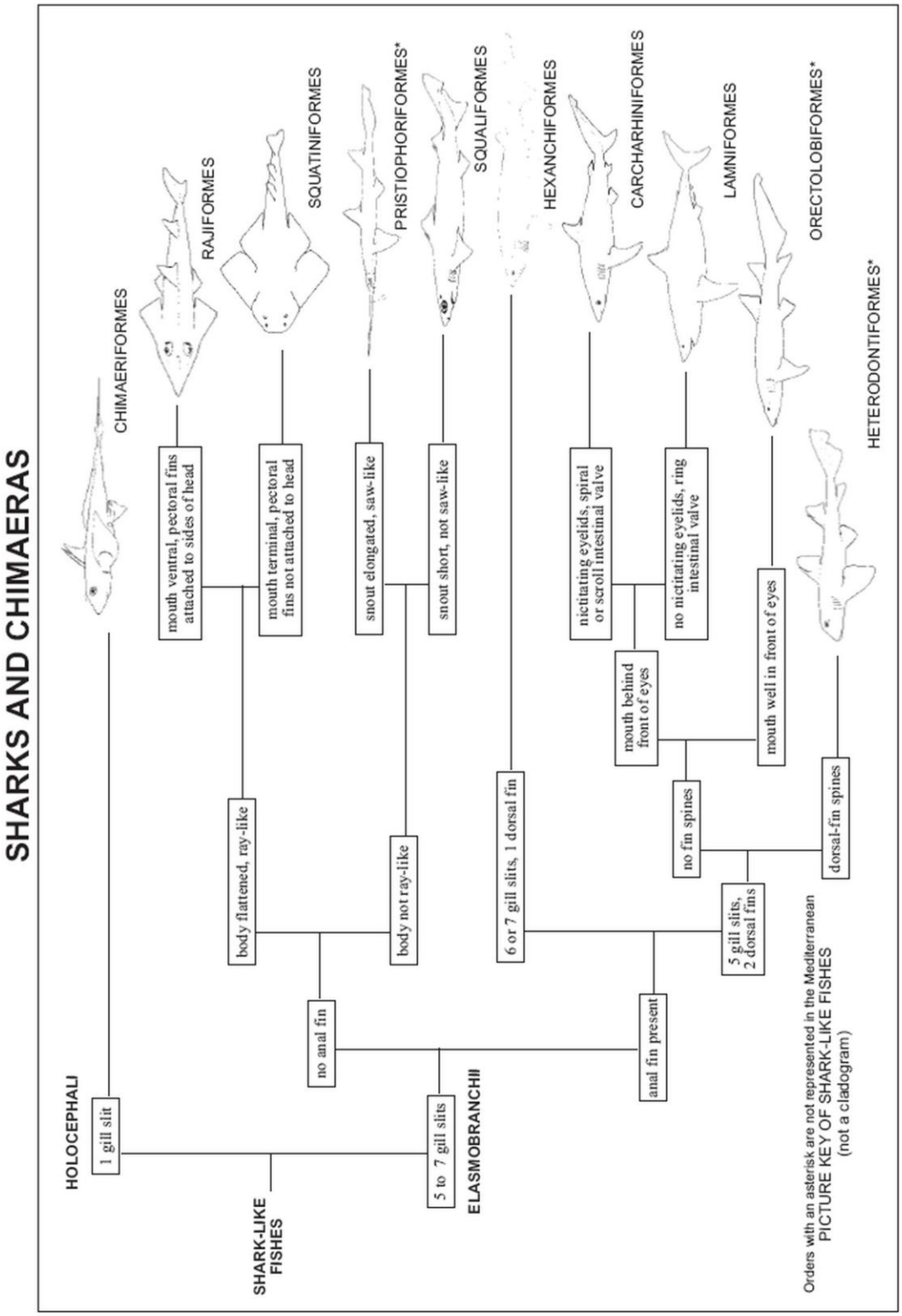


Figure 10. Picture Key of Shark-like Fishes (Serena, 2005)

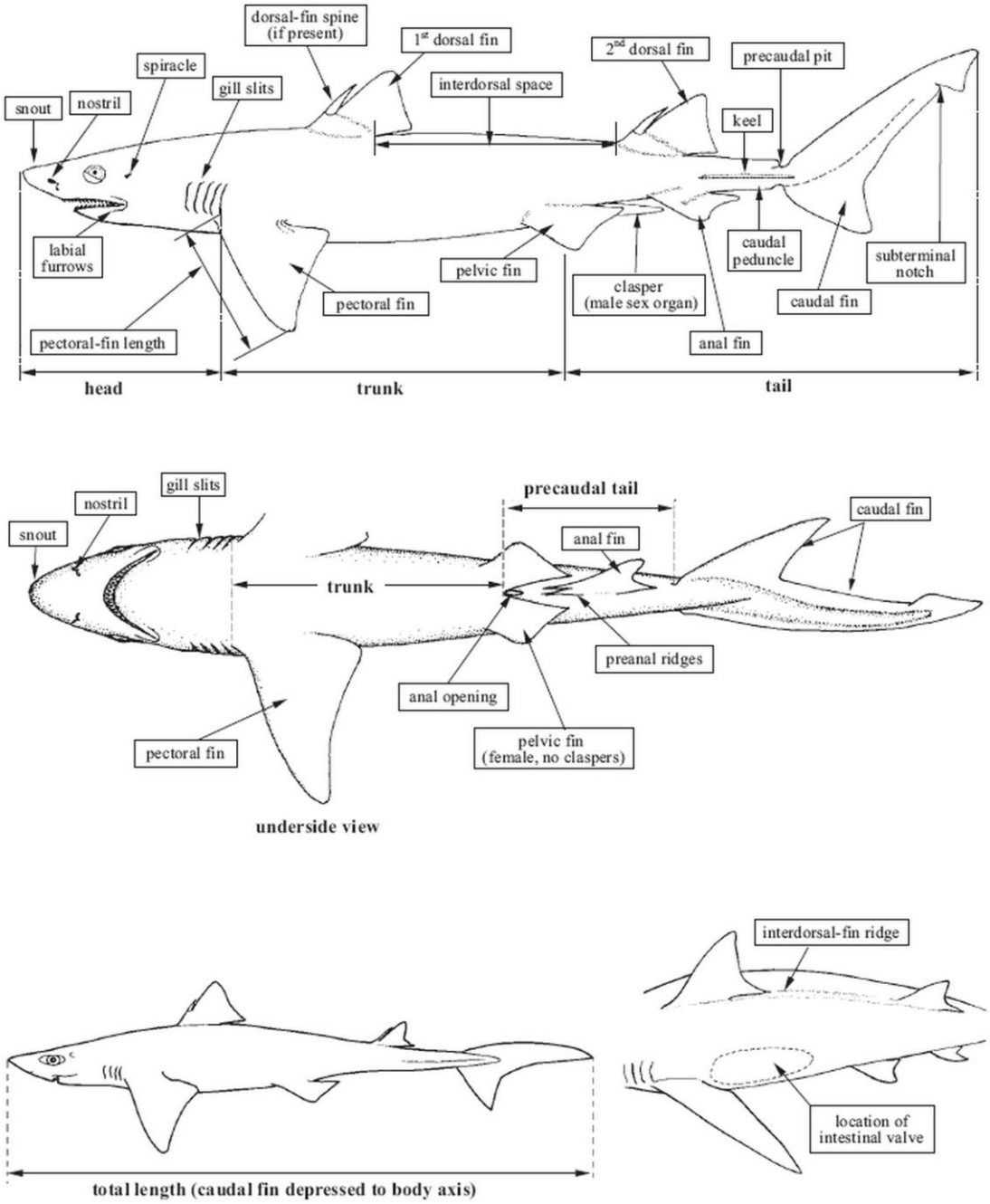


Figure 11. Technical terms and measurements for sharks (Serena, 2005)

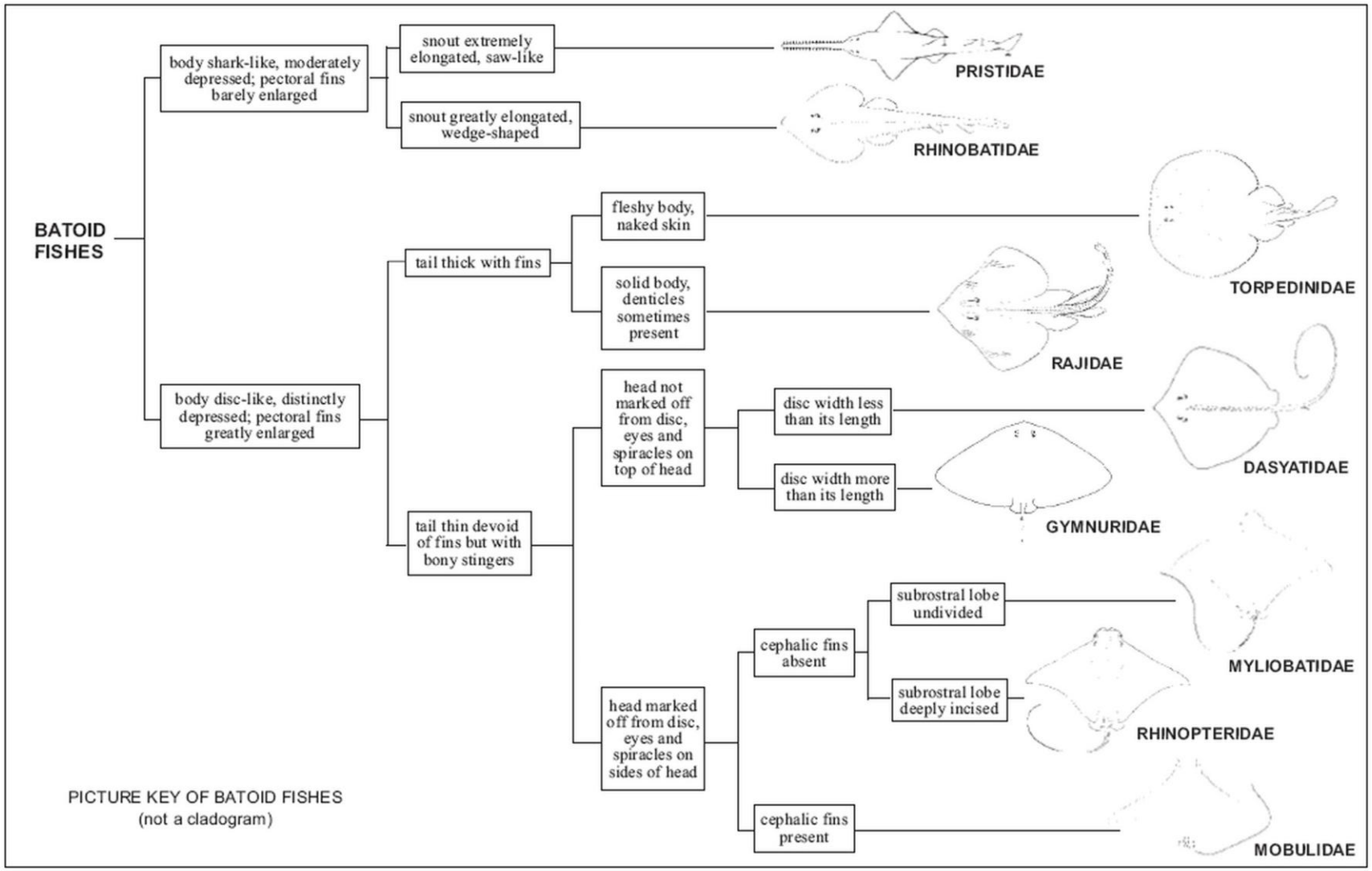
2.2 Batoids

Table 3. Batoids: list of order, families and species occurring in the Adriatic Sea

LIST OF ORDER, FAMILIES AND SPECIES OCCURRING IN THE ADRIATIC SEA		
ORDER	**FAMILY**	**SPECIES**
RAJIFORMES	PRISTIDAE	? *Pristis pectinata*
	RHINOBATIDAE	*Rhinobatos rhinobatos*
	TORPEDINIDAE	*Torpedo marmorata*
		Torpedo nobiliana
		Torpedo torpedo
	RAJIDAE	*Dipturus batis*
		Dipturus oxyrinchus
		Leucoraja circularis
		Leucoraja fullonica
		Raja asterias
		Raja clavata
		Raja miraletus
		Raja polystigma
		Raja radula
		Raja undulata
		Rostroraja alba
	DASYATIDAE	*Dasyatis centroura*
		Dasyatis pastinaca
		Pteroplatytrygon violacea
	GYMNURIDAE	*Gymnura altavela*
	MYLIOBATIDAE	*Myliobatis aquila*
		Pteromylaeus bovinus
	MOBULIDAE	*Mobula mobular*

BATOID FISHES

(sawfishes, guitarfishes, electric rays, skates, rays, and stingrays)



PICTURE KEY OF BATOID FISHES
(not a cladogram)

Figure 12. Picture Key of Batoid Fishes (Serena, 2005)

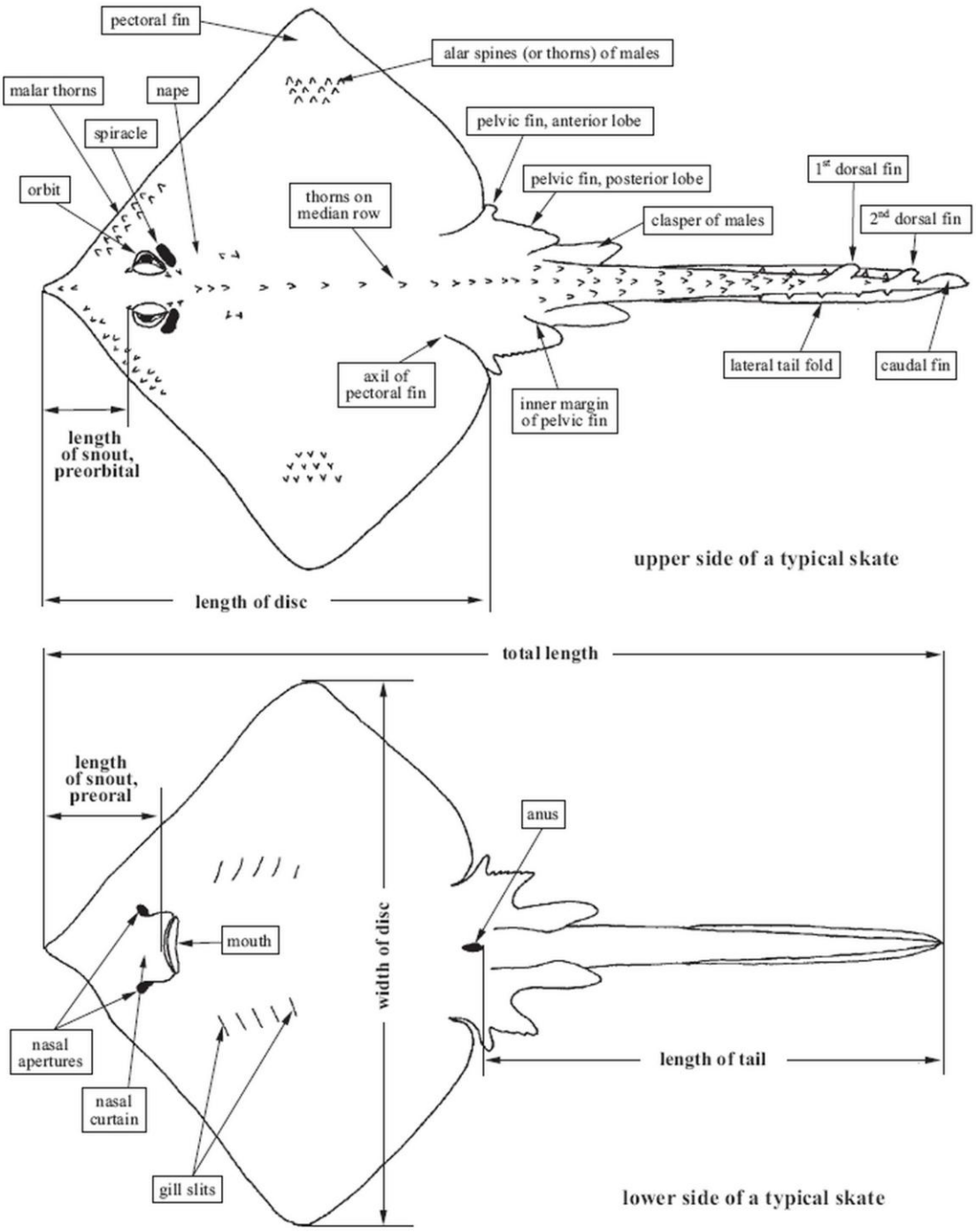


Figure 13. Technical terms and measurements for batoid fishes (Serena, 2005)

3 COUNTRY FISHERY INFORMATION WITH REFERENCE TO CHONDRICHTHYAN FISHES

3.1 Slovenia (by Bojan Marčeta)

Figure 14. Map of Slovenia

3.1.1 Coastal characteristics

Slovenia has a short but important coastline (46,6 km of length) with territorial waters bordering Italy and Croatia. The Slovenian territorial sea is located on the northern most part of the Adriatic Sea. Its surface is about 400 km^2. The Slovenian sea is shallow, mainly about 20 m deep with the deepest area of about 37 m. The sea bottom is mostly muddyMarine fisheries with some notes on cartilaginous fishes

Landing statistics is available from 1982 onward. After Slovenia gained independence in 1991 the dramatic decline of landing has been observed (Figure 1). Among many reasons for the decline the most important are lost of former Yugoslav market, diminution of fishing grounds and decline of the sardine (*Sardina pilchardus*) stock.

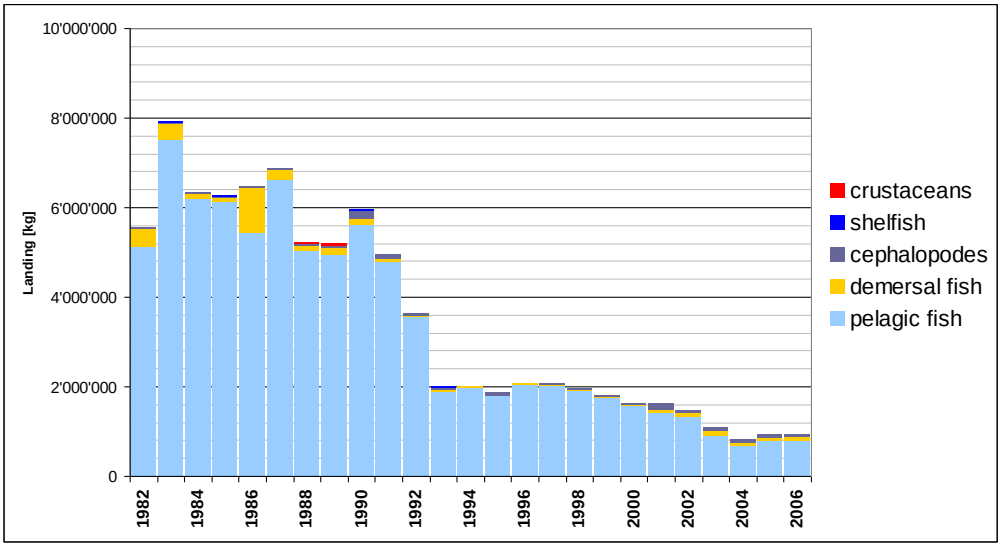
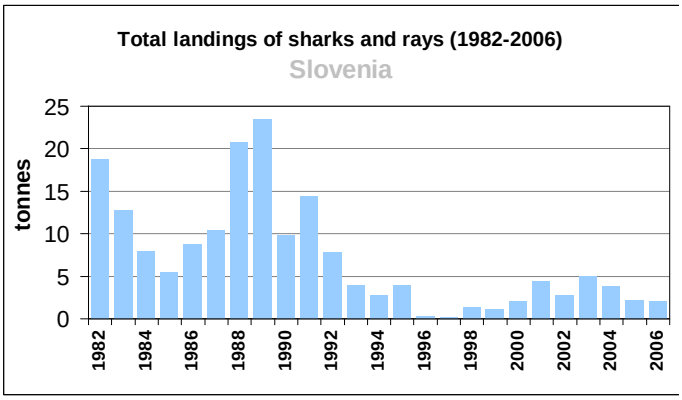
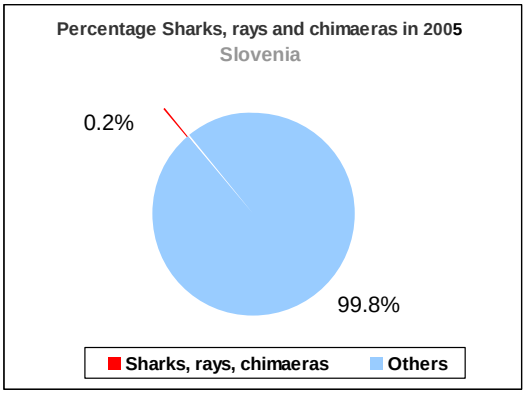


Figure 15. Slovenian fisheries capture production (Source: Statistical Office of the Republic of Slovenia (1982-2004) and Ministry of Agriculture, Forestry and Food (2005-2006)).

In period from 1982 to 2006 pelagic fish was the most important group of landed fish with the average share of 93.3%. Among this sardine was the most important. In recent years the increase of the share of anchovy has been observed. Demersal species comprise 6.7% of landings. Among this the most important was demersal fish and cephalopods comprising 4,0% and 2,4% respectively. In recent years the total landing has been stabilized slightly under 1.000 tones.





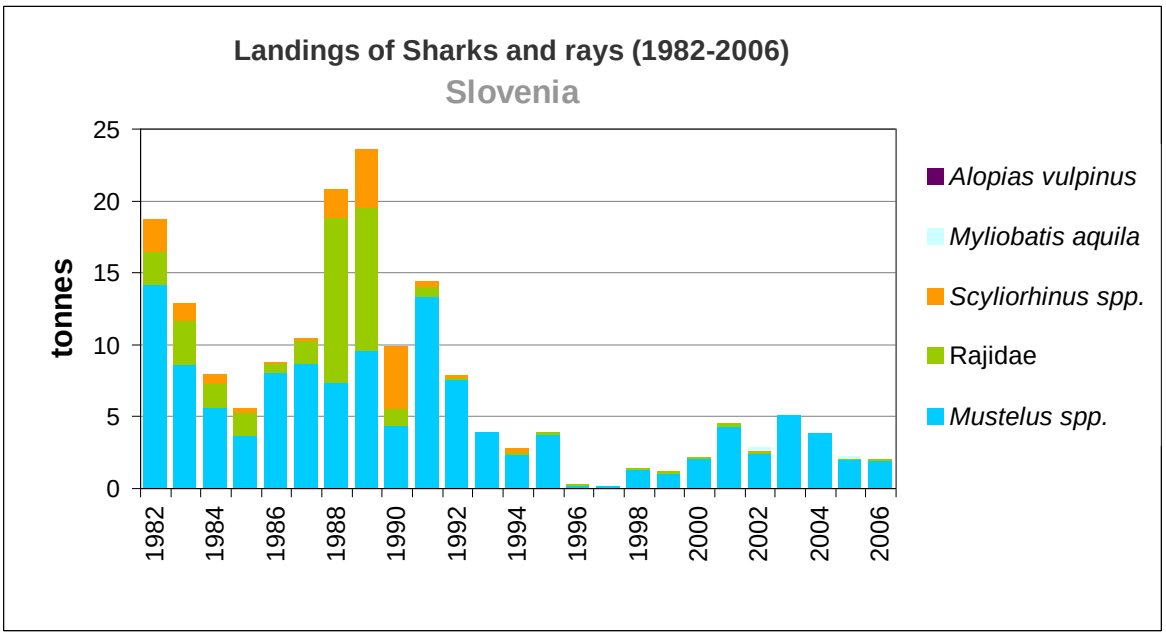


Figure 16. Slovenian fisheries capture production with reference to cartilaginous fishes (Source: Statistical Office of the Republic of Slovenia (1982-2004) and Ministry of Agriculture, Forestry and Food (2005-2006))

Slovenia's domestic fisheries production in 2006 was 933 tonnes. Cartilaginous fishes represent only 0,2% of the total landing declared, about 2 tonnes. In Slovenian fisheries statistics cartilaginous fishes are recorded at family, genus and species level: *Alopias vulpinus*, *Myliobatis aquila*, *Scyliorhinus* spp., Rajidae, and *Mustelus* spp.

The figure about Slovenian landing of sharks and rays has been corrected. The official statistics is showing significant amounts of landed *Squalus acanthias* in the past years replaced with *Mustelus* spp. in last years. The reason for this incorrectness is laying in deficient list of species on the older forms for recording of landing.

In the present Slovenian fishery is not targeting any species of cartilaginous fish. All the catches of those species could be considered as by-catch. According our experiences it's evident that cartilaginous species are very vulnerable to almost any type of fishing gear, especially to bottom trawls and various bottom set nets.

In the past there were some seasonal catch on small sharks with special bottom set nets called "cagnara". This type of fishery was performed in small amounts. Since the stocks of targeted small sharks in recent years are in decline the use of "cagnara" net is no more rational.

Recreational fishery is also present in Slovenian sea but it's not targeting any cartilaginous fish species.

3.1.2 Fishing fleet

In 2006 Slovenian fishing fleet was composed of 174, mainly small fishing vessels (Figure 17) with total of 1.076 gross tonnage and engine power of 11.168 kW (Table 1). Number of vessels with licences was 162 but the number of active vessels was only 93. The Active part of fishing fleet could be divided in segments which are shown in the table (Table 2).

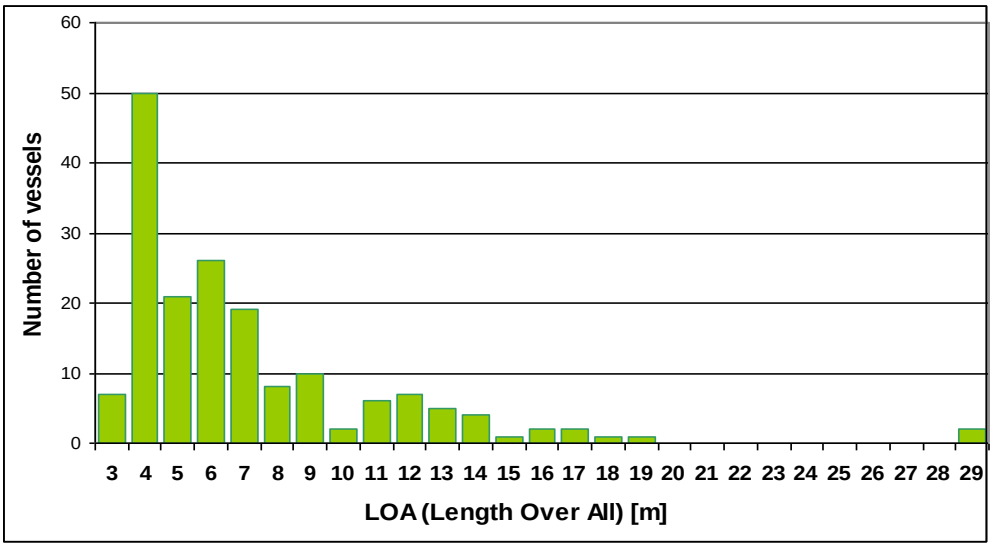


Figure 17. Length composition of Slovenian fishing fleet in 2006 (Source: Ministry of Agriculture, Forestry and Food).

Table 4. Structure of Slovenian fishing fleet in 2006 (Source: Ministry of Agriculture, Forestry and Food).

Length class [m]	GT	kW	Number
<10	**263.61**	**4209.33**	**141**
10-<12	**59.70**	**1141.72**	**8**
12-<15	**186.43**	**3171.97**	**16**
15-<18	**127.69**	**862.10**	**5**
18-<24	**125.76**	**583.00**	**2**
24-<40	**312.40**	**1200.00**	**2**
>=40	0.00	0.00	0
Total:	**1075.59**	**11168.12**	**174**

Table 5. Segmentation of the active part of Slovenian fishing fleet (Source: Ministry of Agriculture, Forestry and Food).

Segment	Number	Share (%)	Power (kW)	Share (%)	Tonnage (GT)	Share (%)
purse seiner	5	5.4	518.97	7.4	47.62	6.5
trawler	18	19.6	3'537.20	50.3	522.65	71.7
gillnetter	60	65.2	2'769.64	39.4	134.64	18.5
trap setter	2	2.2	19.76	0.3	1.98	0.3
polyvalent	7	7.6	186.07	2.6	21.76	3.0
unknown	1	1.1	11.03	0.2	2.16	0.3
Total:	**93**		**7042.7**		**730.8**	

3.1.3 Trawl surveys

From 1987 there were four bottom trawl surveys and one biological sampling of catch.

Table 6. Trawl Surveys in Slovenia

Bottom trawl survey (ŠTIRN and BOLJE, 1989) Period: 1987-1988 Methodology: swept area method Fishing gear: commercial bottom trawl Area covered: Slovenian territorial waters Number of stations: 17 Number of surveys per year: 4 Number of samples: about 43
Bottom trawl survey Period: 1996 to present Methodology: swept area method Fishing gear: commercial bottom trawl Area covered: Whole Adriatic Sea Number of stations: 3 Number of surveys per year: 4 Number of samples: about 150
Mediterranean Trawl Survey Programme (MEDITS) Period: 1995 to present Methodology: according MEDITS protocol Fishing gear: MEDITS bottom trawl Area covered: Slovenian territorial waters Number of stations: 2 Number of surveys per year: 1 Number of samples: 26
Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea (FAO-AdriaMed) – GRUND extension Period: 2002-2007 Methodology: according GRUND protocol Fishing gear: GRUND bottom trawl (“tartana fanese”) Area covered: Eastern Adriatic Coast Number of stations: 2 Number of surveys per year: 1 Number of samples: 6
Biological sampling of catch Period: 2006-present Methodology: observations on board of fishing vessels Fishing gear: various, depending on the national programme for collection and management of data. Area covered: Slovenian territorial waters Number of stations: not relevant Number of samplings per year: 6 per type of fishing gear (3 types of gears yearly)

During the four bottom trawl surveys and one biological sampling of catch altogether nine cartilaginous species were found (Table 3). The most common species were *Mustelus mustelus* and *Myliobatis aquila*. The common characteristics about the catch of cartilaginous fish species is that they were present in small number of samples and represented with one or few specimens.

3.1.4 List of Chondrichthyan fishes of the Slovenian Adriatic Sea

According (MAVRIČ *et al.*, 2006) up to date, 34 elasmobranch species (20 sharks and 14 batoids) have been recorded in the Slovenian coastal sea. Except few species the majority could be considered as occasional visitors. In the determination key for Slovenian Chondrichthyes (LIPEJ, 1999) there are 33 cartilaginous species listed plus one listed in MAVRIČ *et al.*, 2006 (Table 4).

Table 7. List of Slovenian cartilaginous fish species (LIPEJ, 1999, MAVRIČ *et al*., 2006) with common names and status.

Species	**Common name**	**Status**
Hexanchus griseus (Bonnaterre, 1788)	šesteroškrgar	rear (LIPEJ, 1999)
Odontaspis ferox (Risso, 1810)	ščitozobi morski pes	unknown
Carcharodon carcharias (Linnaeus, 1758)	beli morski volk	rear (LIPEJ, 1999)
Isurus oxyrinchus Rafinesque, 1810	atlantski mako	unknown
Cetorhinus maximus (Gunnerus, 1765)	morski pes orjak	occasinal visitor (MAVRIČ *et al.,* 2006)
Alopias vulpinus (Bonnaterre, 1788)	morska lisica	occasinal visitor (MAVRIČ *et al.,* 2006)
Scyliorhinus canicula (Linnaeus, 1758)	morska mačka	rather common (MAVRIČ *et al.,* 2006)
Scyliorhinus stellaris (Linnaeus, 1758)	velika morska mačka	rather common (MAVRIČ *et al.,* 2006)
Galeorhinus galeus (Linnaeus, 1758)	pepelasti morski pes	unknown
Mustelus asterias Cloquet, 1821	pegasti morski pes	unknown
Mustelus mustelus (Linnaeus, 1758)	navadni morski pes	rather common (MAVRIČ *et al.,* 2006)
Mustelus punctulatus Risso, 1827	črnopikčasti morski pes	rather common (MAVRIČ *et al.,* 2006)
Carcharhinus plumbeus (Nardo, 1827)	sivi morski pes	occasinal visitor (MAVRIČ *et al.,* 2006)
Prionace glauca (Linnaeus, 1758)	sinji morski pes	occasinal visitor (MAVRIČ *et al.,* 2006)
Sphyrna zygaena (Linnaeus, 1758)	kladvenica	unknown
Oxynotus centrina (Linnaeus, 1758)	morski prašič	very rear (LIPEJ, 1999)
Squalus acanthias Linnaeus, 1758	trnež	rather common (MAVRIČ *et al.,* 2006)
Squalus blainville (Risso, 1827)	rjavi trnež	rear (LIPEJ, 1999)
Squatina oculata Bonaparte, 1840	pegasti sklat	very rear (LIPEJ, 1999)
Squatina squatina (Linnaeus, 1758)	sklat	rear (LIPEJ, 1999)
Torpedo marmorata Risso, 1810	električni skat	rather common (MAVRIČ *et al.,* 2006)
Torpedo torpedo (Linnaeus, 1758)	pegasti električni skat	very rear (LIPEJ, 1999)
Dipturus batis (Linnaeus, 1758)	kljunata raža	rear (LIPEJ, 1999)
Dipturus oxyrinchus (Linnaeus, 1758)	šilonosa raža	rear (LIPEJ, 1999)
Raja asterias Delaroche, 1809	zvezdasta raža	rather common (MAVRIČ *et al.,* 2006)
Raja clavata Linnaeus, 1758	raža trnjevka	rather common (MAVRIČ *et al.,* 2006)
Raja miraletus Linnaeus, 1758	modropegasta raža	rather common (MAVRIČ *et al.,* 2006)
Raja montagui Fowler, 1910	pegasta raža	rear (LIPEJ, 1999)
Rostroraja alba (La Cépede, 1803)	bela raža	rear (LIPEJ, 1999)
Dasyatis centroura (Mitchill, 1815)	bodičasti morski bič	very rear (LIPEJ, 1999)
Dasyatis pastinaca (Linnaeus, 1758)	morski bič	rather common (MAVRIČ *et al.,* 2006)
Pteroplatytrygon violacea (Bonaparte, 1832)	pelagični morski bič	occasinal visitor (MAVRIČ *et al.,* 2006)
Myliobatis aquila (Linnaeus, 1758)	morski golob	rather common (MAVRIČ *et al.,* 2006)
Pteromylaeus bovinus (Geoffroy St-Hilaire, 1817)	kljunati morski golob	rather common (MAVRIČ *et al.,* 2006)

Table 8. List of species found in four bottom trawl surveys and one biological sampling of catch. The presence of species is indicated with "X".

Duration:	1987-1988	1995-present	1995-present	2002-2007	2006-present
Species	Nat. bottom trawl survey	Nat. bottom trawl survey	MEDITS	AdriaMed	Biol. Sampling of catch
Dasyatis pastinaca (Linnaeus, 1758)	-	-	-	-	**x**
Mustelus mustelus (Linnaeus, 1758)	**x**	**x**	**x**	-	**x**
Myliobatis aquila (Linnaeus, 1758)	**x**	**x**	**x**	-	-
Raja asterias Delaroche, 1809	-	**x**	**x**	-	-
Raja clavata Linnaeus, 1758	**x**	-	-	-	-
Raja miraletus Linnaeus, 1758	**x**	-	-	-	**x**
Scyliorhinus stellaris (Linnaeus, 1758)	-	-	-	-	**x**
Squalus acanthias Linnaeus, 1758	**x**	-	-	-	-
Torpedo marmorata Risso, 1810	**x**	**x**	-	-	-
Total number of species:	**6**	**4**	**3**	**0**	**4**

3.1.5 Recommendations for the enhancement of the Action Plan

Strengthening and improvement of catch sampling.
Although official landing statistics do exist there is some extent of data deficiency particularly regarding data about cartilaginous species. The reasons for data deficiency are unfamiliarity of species recognition among fisherman, underestimation of landing quantities due to cleaning (head, skin and gut off), deficient reporting of discards etc. For better understanding of real extent of cartilaginous fish catch with various types of fishing gears intensification and improvement of catch sampling should take place

3.1.6 References on cartilaginous fishes

Lipej, 1999, Hrustančnice (Chondrichthyes). *In*: Kryštufek, B. in Janžekovič, F., (eds.). Ključ za določanje vretenčarjev Slovenije., DZS, Ljubljana, 18-46.

Lipej, L., Makovec, T., Soldo, A., Žiža, V. 2000. Records of the Sandbar shark *Carcharhinus plumbeus*, (Nardo, 1827) in the Gulf of Trieste (Northern Adriatic). *Ann, Ser. hist. nat*. 10(2), 199-206.

Lipej, L., Makovec, T., Orlando Bonaca, M., Žiža, V. 2000. Occurrence of the Basking shark, *Cetorhinus maximus* (Günnerus, 1765), in the waters off Piran (Gulf of Trieste, Northern Adriatic). *Ann, Ser. hist. nat*. 10(2), 211-218.

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Štirn, J, A., Bolje, 1989 Fondi pridnenih rib in drugih užitnih organizmov obalnih vod SFRJ v Tržaškem zalivu. Zaključno poročilo. Raziskovalna naloga. Droga Portorož in IBU, MBP, Ljubljana, Piran, 243 p.

3.2 Croatia (by Alen Soldo and Nedo Vrgoč)

Figure 18. Map of Croatia

3.2.1 Coastal characteristics

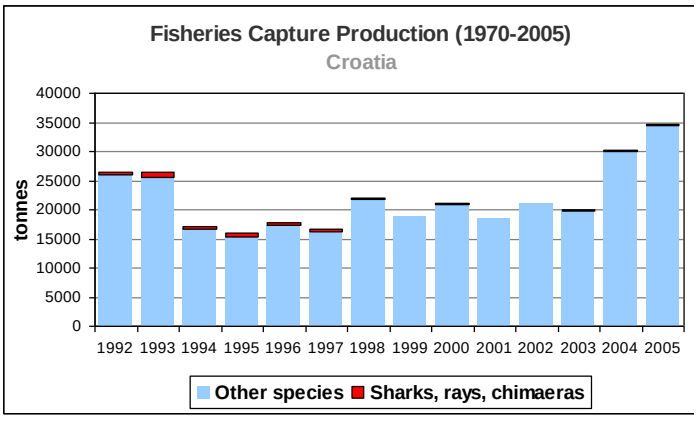
Croatian coastal extension is about 6,000 km; it comprises more than 1,000 islands, which account for nearly 9% of the total Mediterranean coastline. The total surface of the coastal and territorial sea is approximately 31.000 Km2. Hence, Croatia declared an Ecological and Fisheries Protection Zone in the Adriatic which total surface is nearly 25.000 km2 (not applied to EU countries). Along the Adriatic Sea coast there are 718 large and small islands, 389 cliffs and 78 reefs.

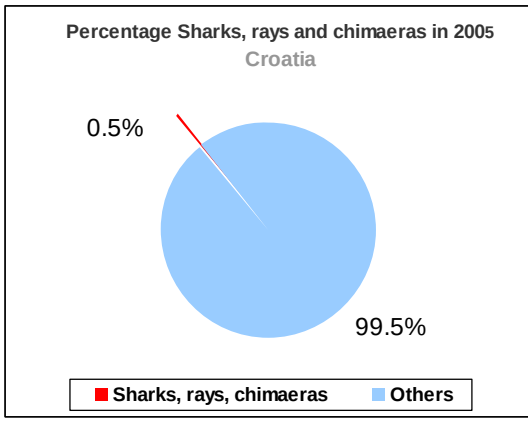
3.2.2 Marine fisheries with some notes on cartilaginous fishes

The Marine Fisheries Act distinguishes between commercial, subsistence, recreational and sports fishing. Subsistence fishermen, sport and recreational also, are not allowed to put their catch on the market and are subject to authorisations limiting the type of gear, equipment and the quantity of their catch up to 5 kilos per day.

Of fishing gear used world-wide, with respect to the method of fishing, 14 groups may be distinguished: grappling and wounding, hooks and lines, traps, filter nets, trawls, surrounding nets, liftnets, falling gear, gill nets, entangling nets, gill nets and entangling nets, barrier gear, seine nets and harvesting machines. All of them are in using in Croatian fishing. Of all the mentioned groups, 55 types and sub-types of nets and other gear types are nowadays used in the Croatian part of the Adriatic Sea

Hence, having in mind the commercial importance of the Adriatic fishing, distribution, spreading and structure of its renewable stocks, position and methods of fishing, along with fishing vessels and gear, the distinction has been made between bottom, pelagic and coastal fishing.





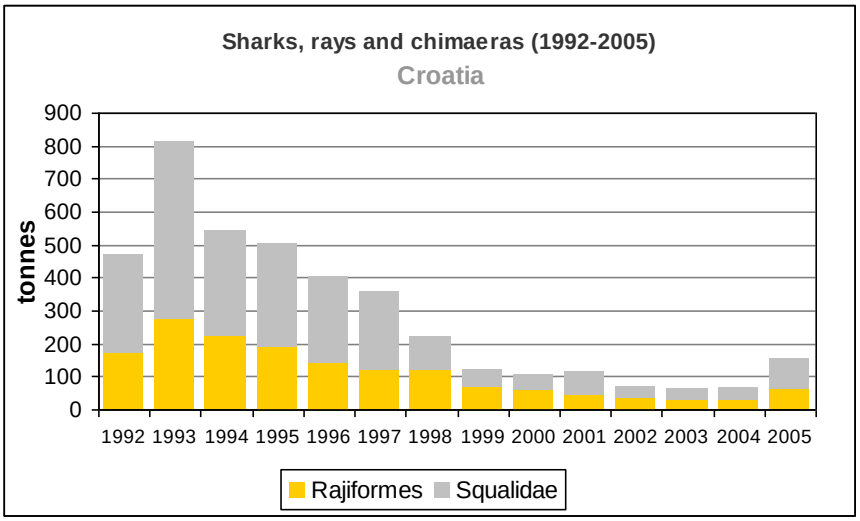


Figure 19. Croatian fisheries capture production with reference to cartilaginous fishes (FAO-GFCM Capture Production 1970-2005)

Croatia's domestic fisheries production in 2005 was approximately 35000 tonnes. Cartilaginous fishes represent less than 1% of the total landing declared, about 150 tonnes. Cartilaginous species in Croatian fisheries statistics are lumped together in Rajiformes (65 tonnes in 2005) and Squalidae (91 tonnes in 2005).

Most of the chondrichthyan species are not target species in the Adriatic Sea but they are caught mainly as bycatch by longlines and other fishing gear used in tuna, small pelagic fish and sword fisheries. Smaller chondrichthyan species, especially small sharks, ray and skates are also often and commercially important species of trawls. In certain areas during some seasons dogfish and hound sharks are targeted with gillnets.

On contrary to commercial fisherman, during recent decade, sport and recreational fisherman have started to target large sharks in big game fishing (tresher shark, blue shark and porbeagle). Fishermen involved in that activity have observed rapid decline of targeted species in their catches during last few years.

3.2.3 Protected areas and fishing regulation in Croatia

According to the fishing law, Croatian Fishing Sea is divided in inner waters (channel area) and open sea (territorial waters and Fisheries Ecological Protected Zones). Fishing regulation measures are different in the different areas, for example mesh sizes of the bottom trawl nets is 40 mm in the open sea, while in the inner sea it is 48 mm. There is also a limitation of the engine power in both zones. It is forbidden to give new licences especially for bottom trawls in inner sea.

Bottom trawl fishery is totally forbidden 1 nautical mile from the coast. For the island in the open sea it is 2 or 3 nautical miles. In the majority area of inner sea, bottom trawl fisheries is allowed half year and only two days per week and during day time, about 30% operation territorial waters are totally forbidden to trawl fisheries throughout the year and the 10% is forbidden 100-200 days per year.

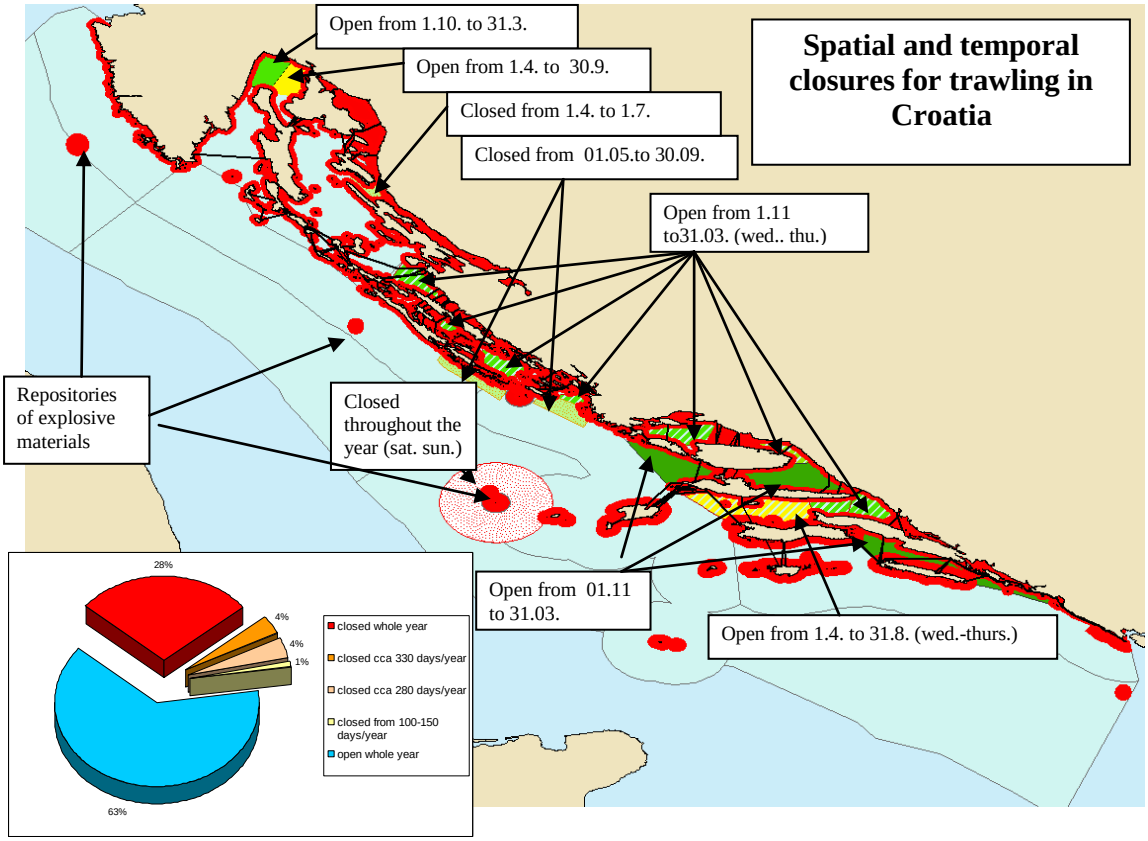


Figure 20. Fishing regulation in Croatia

Current Croatian fishery legislation doesn't have any regulations for shark conservation and management, so chondrichthyan catches and bycatch are not reported in the eastern Adriatic. However, Ministry of Culture, under Ordinance on Proclamation of Wild Taxa as Protected or Strictly Protected has proclaimed basking shark *Cetorhinus maximus,* great white shark *Carchadon carcharias* and giant devil ray *Mobula mobular* as strictly protected species within waters under croatian jurisdiction.

3.2.4 Fishing fleet

Croatian legislation distinguishes between fishing vessels (defined as longer than 12 meters and having a gross tonnage of more than 15GT) and boats (not complying with both criteria but used for commercial purposes). According to the data from 2005 there are 330 fishing vessels and 2174 boats (Croatian Ministry of Agriculture - Fisheries and Rural Development, 2005). However, at the moment in Croatia there is a revision of licences and fleet register, data about fleet segmentation and numbers of licences in different fisheries gears are not fully reliable.

3.2.5 Trawl surveys

Table 9. The most important demersal resources surveys organized by the Institute of Oceanography and Fishery in Split (IOF).

<table>
<tr><td colspan="2">Bottom trawl survey (Zei, 1940)
Period: 1938-1940
Area covered: Channel region of the Northern Adriatic</td></tr>
<tr><td colspan="2">Bottom trawl survey (Zei and Sabioncello, 1940)
Period: 1938-1940
Area covered: Channel region of the Northern Adriatic</td></tr>
<tr><td colspan="2">Bottom trawl survey – Ekpedition “Hvar” (Soljan, 1977)
Period: 1948-1949
Area covered: Whole open Adriatic Sea</td></tr>
<tr><td colspan="2">Bottom trawl survey (Kirincic and Lepetic, 1955))
Period: 1950-1951
Area covered: Northern Adriatic</td></tr>
<tr><td colspan="2">Bottom trawl survey (Županović, 1961)
Period: 1957-1958
Area covered: Channel region of the Central Adriatic</td></tr>
<tr><td colspan="2">Bottom trawl survey (Jukic, 1975; Županović and Jardas, 1989)
Period: 1956-1971
Pomo/Jabuka Pit</td></tr>
<tr><td colspan="2">Bottom trawl survey (Jukic and Piccinetti, 1981)
Period: 1972, 1974, 1975
Area covered: Central and open Adriatic Sea</td></tr>
<tr><td> 

Figure 21. Position of the hauls in the Medits Trawl Survey in Croatia.</td><td>Mediterranean Trawl Survey Programme (MEDITS)
Period: 1996 to present
Methodology: according MEDITS protocol
Fishing gear: MEDITS bottom trawl
Area covered: Whole Adriatic Sea
Number of stations: 60</td></tr>
<tr><td colspan="2">Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea (FAO-AdriaMed) – GRUND extension
Period: 2001 to present
Methodology: according GRUND protocol
Fishing gear: GRUND bottom trawl (“tartana fanese”)
Area covered: Eastern Adriatic Coast
Number of stations: 42</td></tr>
</table>

3.2.6 List of Chondrichthyan fishes of the Croatian Adriatic Sea

In the Adriatic 28 species of sharks, 23 species of batoids and one chimaeras have been recorded so far, with all of them recorded in the Croatian waters. A total of 24 species were also recorded during the Medits trawl survey.

Table 10. List of Croatian cartilaginous fish species, with common names and presence in MEDITS.

FAMILY	SPECIES	local names	Medits (1996 - 2006)
HEXANCHIDAE	*Heptranchias perlo*	volonja sedmoškrgaš	
	Hexanchus griseus	glavonja šestoškrgaš	
ECHINORHINIDAE	*Echinorhinus brucus*	pas zvjezdaš	
SQUALIDAE	*Squalus acanthias*	Kostelj	✓
	Squalus blainvillei	Kostelj vlastelin	✓
CENTROPHORIDAE	*Centrophorus granulosus*	kostelj dubinac	✓
ETMOPTERIDAE	*Etmopterus spinax*	kostelj crnac	
OXYNOTIDAE	*Oxynotus centrina*	prasac	✓
DALATIIDAE	*Dalatias licha*	drkovna	
SQUATINIDAE	*Squatina oculata*	sklat žutan	
	Squatina squatina	sklat sivac	
ODONTASPIDIDAE	*Carcharias taurus*	psina zmijozuba	
	Odontaspis ferox	psina zmijozuba	
ALOPIIDAE	*Alopias vulpinus*	lisica	
CETORHINIDAE	*Cetorhinus maximus*		
LAMNIDAE	*Carcharodon carcharias*	velika bijela psina	
	Isurus oxyrinchus	psina dugonosa	
	Lamna nasus	atlantska psina	
SCYLIORHINIDAE	*Galeus melastomus*	mačka crnousta	✓
	Scyliorhinus canicula	Mačka bljedica	✓
	Scyliorhinus stellaris	mačka mrkulja	✓
TRIAKIDAE	*Galeorhinus galeus*	butor	
	Mustelus asterias	pas mekuš bjelopjeg	✓
	Mustelus mustelus	pas mekuš crnopjeg	✓
	Mustelus punctulatus	pas mekuš crnopjeg	✓
CARCHARHINIDAE	*Carcharhinus plumbeus*	pas tupan	
	Prionace glauca	modrulj	
SPHYRNIDAE	*Sphyrna zygaena*	mlat	
PRISTIDAE	*? Pristis pectinata*	pilan	
RHINOBATIDAE	*Rhinobatos rhinobatos*	ražopas	
TORPEDINIDAE	*Torpedo marmorata*	Trnjevaca, trn	✓
	Torpedo nobiliana		✓
	Torpedo torpedo	drhtulja	
RAJIDAE	*Dipturus batis*	Volina mrkulja	
	Dipturus oxyrinchus	Volina klinka, klinka	✓
	Leucoraja circularis	raža smeđa	✓
	Leucoraja fullonica	raža	
	Raja asterias	raža zvjezdopjega	✓
	Raja clavata	Raža kamenica	✓
	Raja miraletus	Raža modropjega,	✓
	Raja polystigma	raža crnoziga, raža	✓
	Raja radula	raža tuponoska	
	Raja undulata	raža vijošarka	
	Rostroraja alba	Volina balavica,	✓
DASYATIDAE	*Dasyatis centroura*	Viza, žutulja	✓
	Dasyatis pastinaca	žutuga	✓
	Pteroplatytrygon violacea	žutuga ljubičasta	
GYMNURIDAE	*Gymnura altavela*	leptirica	
MYLIOBATIDAE	*Myliobatis aquila*	Golub kosir	✓
	Pteromylaeus bovinus	golub čukan	✓
MOBULIDAE	*Mobula mobular*	golub uhan	
CHIMAERIDAE	*Chimaera monstrosa*		✓

Three years ago, Croatia compiled a list of the endangered species (Crvena lista). This list is being revised and extended in a new book that will be published next summer as book of endangered species (Crvena knjiga).

3.2.7 References on cartilaginous fishes

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3.3 Bosnia and Herzegovina (by Alen Soldo)

Figure 22. Map of Bosnia and Herzegovina

Bosnia and Herzegovina has only 20 km (12 Nm) of coastline along the Adriatic Sea, situated between Croatian territories. Therefore, marine fishery is not developed. Data shows data total annual catch of Bosnia and Herzegovina is only 1 ton. Hence, there is no real fishing fleet but just few small boats practising artisanal fisheries.

3.4 Montenegro (by Aleksandar Joksimovic)

Figure 23. Map of Montenegro

3.4.1 Coastal characteristics

The total length of Montenegrin coast is 293,5 km, with a shelf area (to 200 m) of about 3 700 km². The length of the continental coastline is 281,9 km, 176,2 km are open sea, the coastline of Boka Kotorska Bay is 105,7 km and the remaining 11,1 km belongs to several uninhabited islets. North-western area (Herceg Novi-Budva) is a rocky area with relatively high deep (behind 3 NM more 120 meters). The remaining coast (Budva-Bar-Ulcinj) and especially in Bojana mouth river is muddy and sandy.

3.4.2 Marine fisheries with some notes on cartilaginous fishes

Development of marine fishing in Montenegro during the period between Second World War and 1990s was insignificant. However, since 1992-93 there was a rapid increase in number of vessels. In 1997-98 there were 196 registered vessels intended to be used for professional fishing. During the decade, there was a period of intensive exploitation of demersal resources. There is no doubt that such an activity led to disturbance of natural state and decrease of fish population numbers at sea. Catch per hour in trawling decreased from 60 to 20 kg/h. The estimated biomass (1700 tons) was half of that estimate in 1973 (3400 tonnes). Data were also used to estimate the biological Maximum Sustainable Yield (MSY) of these resources, which is 602 tons per year, and the optimal fishing effort of 1190 days per year (Regner and Joksimović, 2000, 2001).

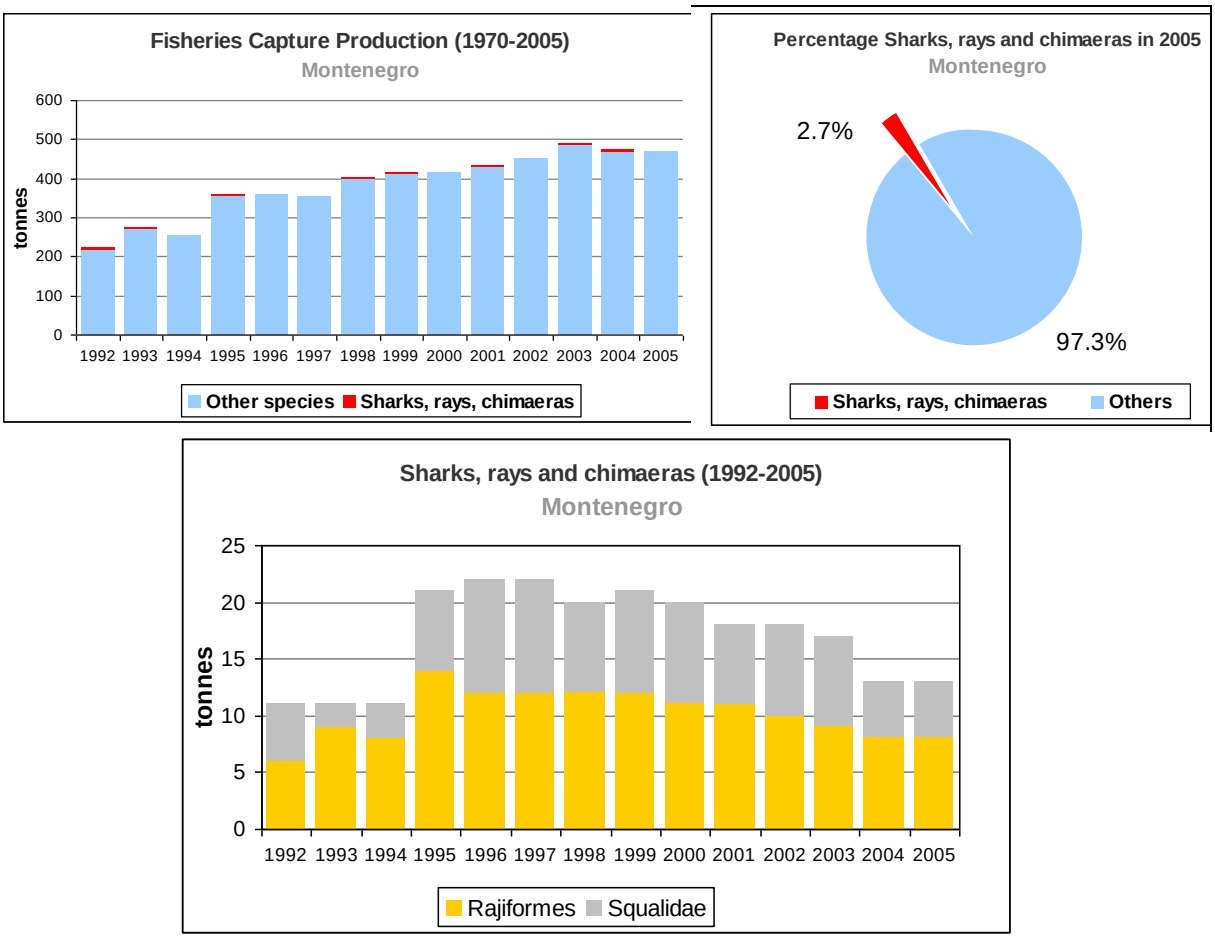


Figure 24. Montenegrin fisheries capture production with reference to cartilaginous fishes (FAO-GFCM Capture Production 1970-2005)

Montenegro's domestic fisheries production in 2005 was approximately 470 tonnes. Cartilaginous fishes represent less than 3% of the total landing declared, about 13 tonnes. Cartilaginous species in Montenegrin fisheries statistics are lumped together in Rajiformes (8 tonnes in 2005) and Squalidae (5 tonnes in 2005).

3.4.3 Fishing fleet

In Montenegro, in 2002, about the 85% of the registered fishing vessels were constituted by fishing boat less then 6 m LOA operating with artisanal gears (gillnets, trammel nets, beach seine, short bottom longlines, traps, etc.). Trawlers and coastal purse seine represent not more then 15%. The approximate structure of catch by gear in 2002 was 17,3% from trawlers; 33,08% from purse seines and beach seines for small pelagic fish; and 49,62% from artisanal gears.

Table 11. Registered fishing vessels in 2002

Vessel type	N°	LOA	Total GRT
Trawls	16	9,5 – 25	419,64
Purse seining and beach seining	11	7,36 on average	21,19
Boats with artisanal gears (trammel nets, gillnets, pots, longlines, traps)	169	4,5 on average	279,89

Table 12. Comparation of calculated and existing CPUE monitoring data of demersal resources in the Montenegrin sea waters from 1948 to 1998, (Regner and Joksimović, 2000).

VESSEL	"Hvar"	"Bios"	"Gorica"	"Gorica"	"Emanuello de Giosa"	Rest of vessels
Engine power (ks)		360	180	180	350	118 - 515
Year of build	1948/49	1961	1973	1978/79	1986	1998
Number of hauls	8	27	15	-	18	13
Toatal number of hour	15	27	30	927	55.5	35.14
CPUE (kg/hour)	40.78	50.38	63.17	32.17	56.06	20.23
CPUE (kg/hour*ks)	0.185	0.140	0.157	0.180	0.160	0.078
Number of active vessels	/	1	1	1	1	12 + 13*

* In 1998 with 12 vessels and 13 small boats were active (length less than 14 metres).

3.4.4 Trawl surveys and national monitoring programmes

In the autumn/winter 2004, and winter 2007 Montenegrin territorial and adjacent international waters were included in the demersal trawl survey organized by FAO - AdriaMed project in the Eastern Adriatic. In 2004 and 2007, 16 and 5 species of elasmobranchs were recorded respectively.

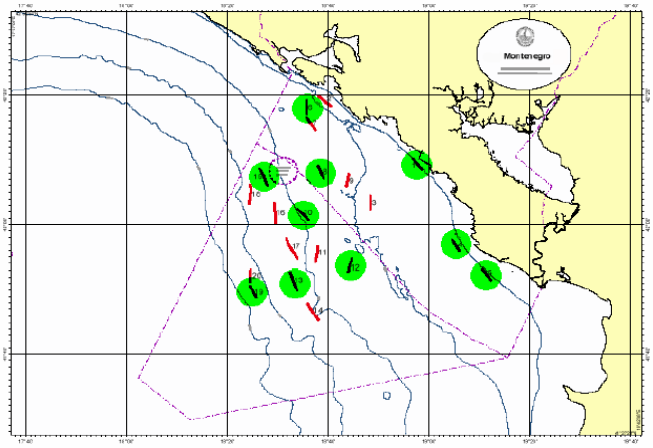


Figure 25. Position of the hauls in the Medits Trawl Survey 2007 in Montenegro.

Table 13. List of chondrichthyan fishes and their abundance indexes in AdriaMed Trawl surveys.

	AdriaMed - 2004			**AdriaMed -2007**		
Species		kg/km2	N/km2		kg/km2	N/km2
Chimaera monstrosa	x	17,28	30,58			
Galeus melastomus	x	24,62	158,23	x	8,93	43,00
Oxynotus centrina	x	1,33	18,69			
Raja miraletus	x	23,60	44,95	x	3,52	9,78
Raja alba	x	3,37	22,47			
Raja asterias	x	7,89	12,17			
Raja clavata	x	5,13	14,43	x	8,45	38,48
Raja montagui	x	6,95	8,95			
Raja polystigma	x	2,59	14,78			
Raja oxyrhynchus	x	0,98	11,68			
Scyliorhinus canicula	x	128,65	2121,12	x	33,95	301,95
Scyliorhinus stellaris	x	1,17	3,43			
Squalus blainvillei	x	24,19	28,22			
Torpedo nobiliana	x	2,02	22,47			
Torpedo marmorata	x	5,75	12,17	x	0,35	1,96
Etmopterus spinax	x	2,41	31,91			

Since 1997 Montenegro has a national monitoring system recording catches from bottom trawls, comparing results from two different periods, elasmobranchs catches show a reduction of about 10%.

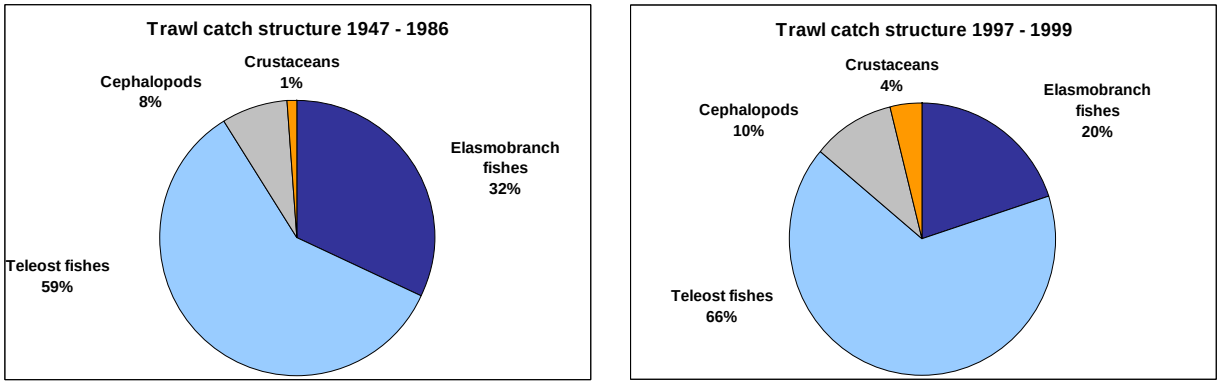


Figure 26. Comparison of catch structures in two periods of Montenegrin national monitoring system.

Table 14. Percentage of chondrichthyan species in total catch (Regner and Joksimović, 2000).

Species	Local names	%
Centrophorus granulosus	Kostelj	0.395
Dipturus oxyrinchus	Raža	1.063
Raja asterias	Raža	0.228
Raja clavata	Raža	0.615
Raja miraletus	Barakula	2.378
Raja polystigma	Raža	0.775
Rostroraja alba	Raža	0.106
Scyliorhinus stellaris	Mačka	0.076
Scylliorhinus canicula	Mačka bljedica	11.197
Squalus acanthias	Kostelj	2.476
Squalus blainvillei	Kostelj	1.063
TOTAL		**20.373**

3.4.5 References on cartilaginous fishes

Regner, S. i A. Joksimović, 1998. Big white shark, *Carcharodon carcharias* (Linnaeus, 1758), in Montenegrin coast. *Bionet Glas*, 7:3-4.

4 CONSERVATION

During the last few decades significant progress have been made on behalf of the scientific community and of environmental and fishery policy-makers, addressing the issue of marine biodiversity, conservation and sustainable fisheries. Such conclusions have brought the environment and fishery sectors to a common point of view that requires integration of these two sectors on a national and regional level. The policies and guidelines affecting Mediterranean biodiversity developed so far are summarised in the activity of the various international conventions.

The main action is the "Convention for the protection of the marine and coastal environment of the Mediterranean" which is often referred to as the Barcelona Convention[1].

The convention is composed of 6 Protocols dealing with distinct aspects of marine protection: among these there is the SPA (Specially Protected Areas) and Biodiversity Protocol. Moreover, the Convention establishes a series of framework activities for the years 1996-2005 which include the sustainable management of marine resources through policies based on the precautionary principle, and the FAO Code of Conduct for Responsible Fisheries.

The Protocol for Specially Protected Areas and Mediterranean Biodiversity[2] specifies that each member state shall protect, preserve and manage its threatened and vulnerable flora and fauna species. Each member shall identify and compile inventories of the components of its biodiversity that need to be preserved. Member states shall adopt strategies, plans and programs for the conservation of biodiversity and for the sustainable use of marine and coastal resources by incorporating such activities in the member state's relative political strategies.

The concept of conservation of biodiversity and management of marine resources through responsible fishery practices has led to a change in the political environmental strategies regarding fisheries. In 1997, an appeal to FAO from CITES, highlighted the lack of data of precise shark catch statistics on a worldwide level and identified the vulnerability of shark species to intense and circumscribed fishing activities. As a response, in 1998 FAO produced guidelines for an International Plan of Action for the Conservation and Management of Sharks and Rays, called IPOA - Sharks (FAO, 1998; FAO, 2000). The plan requests UN-member countries to develop, on a national scale, and in agreement with neighbouring countries, specific assessment and management plans for the sustainable fishing and conservation of shark stocks within their national waters.

In the European union considering that "sharks are fish species whose conservation falls within the domain of the Common Fishery Policy", aspects concerning shark fishing and management should be addressed by conservation measures dictated by the EC for implementation within EU countries. To this effect, the EC has prepared a draft proposal Plan of Action discussed at the COFI-FAO meeting held in Rome in February 2001. Today an other EC proposal is in progress.

The European Community Plan of Action encourages research programs aimed to the assessment of the conservation status of cartilaginous fish in the Mediterranean through enactment of a common methodology by all the Mediterranean countries.

A proposal for the request of a Mediterranean Action Plan was made during the April 2000 and February 2001 meetings of the SAC working group on the environment. This proposal was discussed and accepted during the meeting of the National Focal Points to the SPA

[1] www.unepmap.org
[2] www.rac-spa.org.

Protocol (Valencia 23-26 April 2001). Finally an important action has done during the RAC-SPA meeting held in Rome on 10-13th September 2002.

Considering the concerns and national obligations directed at the conservation of marine biodiversity and the enactment of sustainable fishing practices, it appears crucial that concerted action be undertaken at a regional level to manage and conserve the cartilaginous fish species present within the Mediterranean basin. Such concerted action should stem within the frameworks of those institutions whose mandate involves policies (EEC, UNEP/MAP as specified by the Barcelona Convention, the GFCM/FAO), referring to the Mediterranean basin.

Finally the IUCN is currently assessing global and regional extinction risk for all species of sharks and their relatives, including Mediterranean populations. This list is updated annually, with new information and may be consulted on www.redlist.org. The Red List has no legal standing, but is widely used to monitor changes in the status of biodiversity and to set conservation and management priorities. Regional networks of experts are involved in assessing and reassessing the Red List status of species, drawing upon information gathered by stock assessments and research projects within the region. Recently IUCN has published an overview of the conservation status of the chondrichthyans fishes of the Mediterranean basin (Cavanagh et al, 2007).

5 RECCOMENDATIONS AND RESEARCH OBJECTIVES

5.1 Recommendations

- According to the shared properties of chondrichthyan populations, common protocols in whole Adriatic for data collection and analysis are essential to assure not only information sharing but also a correct assessment of this resource. Respecting that, fishery regulation and protection measure should be agreed and harmonized between all countries participating in fisheries in the Adriatic Sea.

- The improvement of catch sampling and species-specific recording is required. For this reason, a training course for species identification may be needed.

- Information on fisheries, fishing gear and ground fishing are essential in order to estimate the fishing effort associated to the catch of these species and for setting appropriate management measures.

- Knowledge of life-history data is needed for the application of demographic models. At the same time, information on the temporal and geographical distribution at species level is essential in definition of critical habitats such as mating grounds, spawning beds and nursery areas. This could be based on data from national research programmes already existing and based on the data recorded within the international commissions or programmes like GFCM (General Fisheries Commission for the Mediterranean), ICCAT (International Commission for the Conservation of Atlantic Tunas), MEDITS (MEDIterranean Trawl Surveys), MEDLEM (MEDiterranean Large Elasmobranchs Monitoring).

- The success of the Action Plan requires the cooperation of the research organization and academic institution of both eastern and western side of the Adriatic Sea. Furthermore the FAO-AdriaMed project as regional projects operational in this area should be involved. In fact, since 1999 the FAO-AdriaMed Project has created and maintained a coordinated communications network between experts in the field, has promoted the application of standard methodologies for the collection organisation and treatment of data as well as the evaluation of biological resources.

- Increase the awareness of the status of elasmobranchs in commercial and recreational fishers with the aim of increase at least their cooperation in data collection.

5.2 Research objectives

The evaluation of biodiversity and conservation status of the cartilaginous fishes living in the Eastern Adriatic Sea could be implemented through the following issues:

I. Define a common protocol for the evaluation of biological parameters (morphometrics, sex, identification of maturity status, feeding, growth etc,), within the Adriatic countries so as to apply demographic and assessment models to some species identified as priority;

II. Identify areas of special interest (mating, spawning and nurseries grounds) and areas or species under particular fishing pressure through the collection of information on temporal and geographical distribution and abundance of cartilaginous fishes present throughout the Adriatic Sea;

III. Improve the catch and landing sampling by promoting better identification of species of sharks and rays in existing monitoring programme and through enhanced reporting by fishers;

IV. Increase public awareness in Adriatic by the education and the knowledge about the presence and types of shark species and their importance to sustainable ecosystems.

6 OBJECTIVE I

6.1 Biological parameters

6.1.1 Reproduction

Application of demographic and assessment models to chondrichthyans populations requires a quantitative approach to the study of reproduction. The parameters needed, irrespective of model complexity are essentially the following:

- *Sex ratio at birth*. It can be determined by counting embryos or neonates of each sex, although this is characteristically 1:1.

- *Size or age at maturity*. Proportion of the female population in mature condition at any time and the age or size of the animals (maturity ogive).

- *Relationship between fecundity and maternal age or size.* It requires the knowledge of the growth parameters and the fecundity.

- *Relationship between the proportion of the female population contributing to annual recruitment and the age or size of animals (maternity ogive)*. This is very complex to evaluate as it require knowing the reproductive cycle and its duration (ovarian cycle duration and periods of gestation).

Reproductive modes

The Reproductive modes evolved in Chondrichthyes could be divided into two major categories based on fetal nutrition: lecithotrophy, where the entire development of the embryo is supported solely by the yolk; and matrotrophy, where at least part of the fetal development is augmented by additional maternal input of nutrients. In addition, reproductive modes may be further divided by whether embryonic development is external to the mother's body (oviparity) or internal (viviparity) (Hamlett, 2005).

Table 15. Chondrichthyans modes of reproduction (Hamlett, 2005)

		Lecithotrophy	*Matrotrophic*
Oviparity	Single	+	
	Multiple	+	
Viviparity	Yolk-sac	+	
	Limited Histotrophy		+
	Lipid Histotrophy		+
	Carcharhinid Oophagy		+
	Lamnid Oophagy		+
	Placental		+

Reproductive system

Females have paired or single ovaries and paired oviducts. Each oviduct is differentiated into a funnel-shaped ostium, anterior oviduct, oviductal gland, uterus, cervix and urogenital sinus which is common to both reproductive tracts. The ovary consists of follicles, small with little or no yolk in juveniles they enlarge through vitellogenesis accumulating yolk. Following ovulation, oocytes, move through the oviduct to the oviductal gland where they are fertilized and then could be encapsulated in egg cases depending on the reproductive mode.

Males have external paired claspers articulated at the bases of the pelvic fins that become calcified during the growth. The internal organs include two elongated testes embedded in epigonal glands, genital ducts (efferent ductules, epididymis, ductus deferens and seminal

vesicle), Leydig gland and the alkaline gland. The spermatogenesis process occurs diametrically, across the width of the testis toward the efferent ductules located medially.

Maturity definition

Female and male maturity should be defined following standard criteria. Hereunder the tables for the assessing of the maturity stages in use in the MEDITS programme. The table proposed for oviparous species has been officially adopted during a Medits co-ordination meeting (Kavala, Greece, 2006). The table for viviparous is also the result of discussion during a Medits co-ordination meeting (Kavala, Greece, 2006), but it is still in progress.

Table 16. Maturity stages for oviparous

SEX	GONAD ASPECT	MATURATION STATE	STAGE
F	Ovary is barely discernible with small isodiametric eggs. Distal part of oviducts is thick-walled and whitish. The nidamental glands are less evident.	**IMMATURE / VIRGIN**	**1**
M	Claspers are small and flaccid and do not reach the posterior edge of the pelvic fins. Sperm ducts not differentiated. Testis small and narrow.		
F	Whitish and/or few yellow maturing eggs are visible in the ovary. The distal part of oviducts (uterus) is well developed but empty. The nidamental glands are small.	**MATURING**	**2**
M	Claspers are larger, but skeleton still flexible. They extend to the posterior edge of the pelvic fins. Sperm ducts well developed eventually beginning to meander.		
F	Ovaries contain yellow eggs (large yolk eggs). The nidamental glands are enlarged and oviducts are distended.	**MATURE**	**3a**
M	Claspers extends well beyond the posterior edge of the pelvic fin and their internal structure is generally hard and ossified. Testis greatly enlarged. Sperm ducts meandering over almost their entire length.		
F	Ovary walls transparent. Oocytes of different sizes, white or yellow. Nidamental glands large. Egg-cases more or less formed in the oviducts (Extruding Stage).	**MATURE/EXTRUDING-ACTIVE**	**3b**
M	Claspers longer than tips of posterior pelvic fin lobes, skeleton hardened with axial cartilages hardened and pointed. Sperm ducts largely. Sperm flowing on pressure from cloacae (Active Stage).		
F	Ovary walls transparent. Oocytes of different sizes, white or yellow. Oviducts appear much enlarged, collapsed and empty. The nidamental glands diameter are reducing.	**RESTING**	**4**
M	Claspers longer than tips of posterior pelvic fin lobes, skeleton hardened with axial cartilages still hardened. Sperm ducts empty and flaccid.		

Adult specimens

Table 17. Maturity stages for viviparous

SEX	GONAD ASPECT	MATURATION STATE		STAGE
N	The specimens aren't sexed.	**NOT DETERMINED**		**0**
F	Ovaries small, gelatinous or granulated. Eggs not yet differentiated or evenly small and granular. Uteri thread-shaped	**IMMATURE / VIRGIN**		**1**
M	Claspers undeveloped, sticks. Gonads tiny, thread-like and whitish. Sperm ducts straight			
F	Ovaries enlarged walls transparent. Eggs differentiated to various sizes. Uteri thread-shaped become wide posteriorly	**MATURING**	**Ovarian Stage**	**2**
M	Claspers formed but soft, flexible. Testes enlarged. Sperm ducts meandering			
F	Ovaries large well rounded. Eggs enlarged, all about the same size so that they can be counted and measured easily. Uteri widened	**MATURE**		**3a**
M	Claspers fully formed and stiff. Testes well rounded, reddish and filled with flowing sperm. Sperm ducts tightly coiled			
F	The eggs pass from the oviduct to the uterus	**MATURE/EXTRUDING-ACTIVE**		**3b**
M	Glans of claspers often dilated and swollen. Sperm flowing from cloacal papilla under pressure applied to belly and/or present in clasper grooves			
F	Uteri well filled and rounded with unsegmented yolk content (candle)	**DEVELOPPING**	**Uterine Stage**	**4a**
F	Uteri well filled and rounded with segmented content of yolk balls. Embryos small, unpigmented and with large yolk sacs, but can be counted.	**DIFFERENTIATING**		**4b**
F	Embryos fully formed and pigment, yolk sacs obviously reduced. Embryos can be counted, measured and sexed easily	**EXPECTING**		**5**
F	Uteri empty but still widened considerably in contrast with immature and maturing. Ovaries at resting stage similar to immature or maturing stage	**RESTING**		**6**

Fecundity

The fecundity of elasmobranchs species is often determined by simply counting the number of eggs and embryos within the uterus of viviparous species or by counting the number of developing eggs in the ovary of oviparous species. However, when fecundity is estimate some difficulties should be taken into account. Example, in viviparous species, number of pups actually surviving to gestation may be considerably smaller than the initial number of ovulated eggs, many individuals might abort some eggs during the stress of capture, so the differences in ovarian and uterine fecundity should be taken into consideration. In oviparous, a difficulty consist due to the extended breeding season observed in many species, so eggs continuing to develop throughout the year and this may lead to an underestimation of eggs produced. Furthermore, a positive linear relationship between fecundity and length, reported in many species, should be evaluated.

Reproductive cycle

Reproductive cycle may be seasonal or annual, in many oviparous species, or annual, biennial, triennial in viviparous species. In the case of viviparous species, the ovarian cycle and gestation may run concurrently, and take place over an annual cycle or a biennial cycle, or consecutive, so there could be a one-year of gestation and oocytes maturing the following year, giving rise to biennial or triennial cycle. A method for studying the reproductive cycle is fully described by Hamlett, 2005.

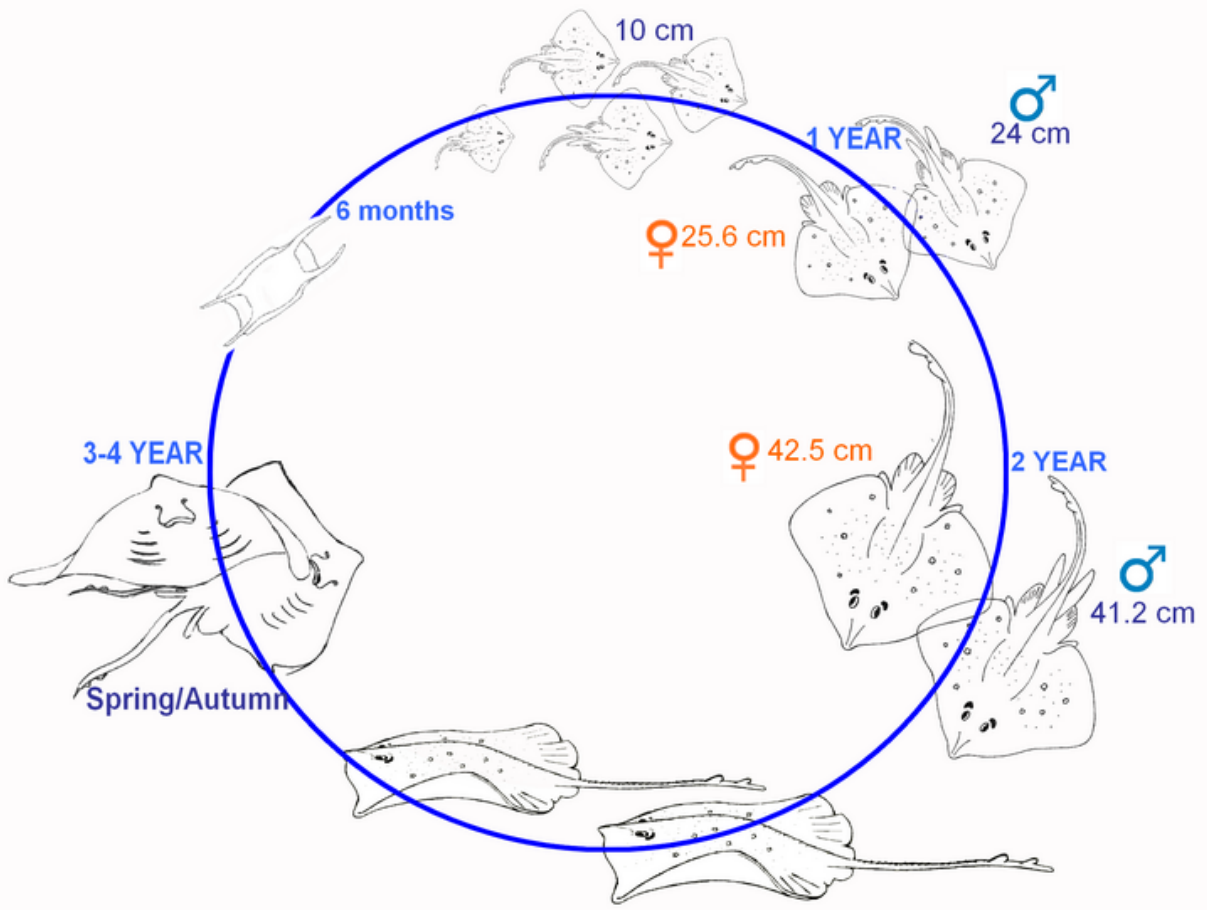


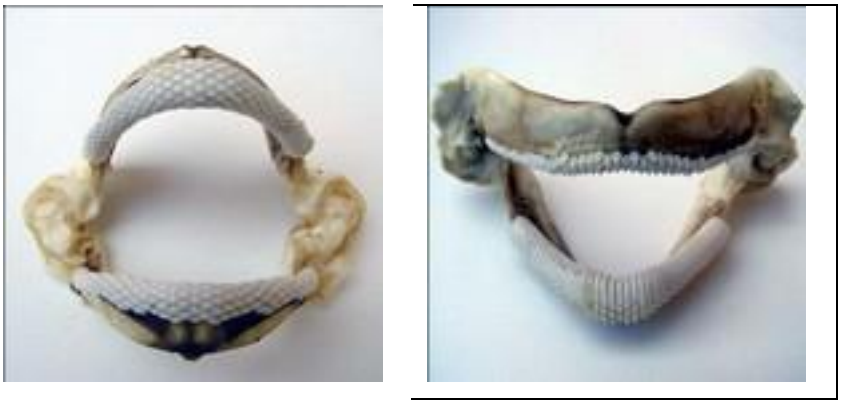
Figure 27. Life cycle of *Raja asterias* (Serena, 2008)

6.1.2 Diet

The alimentary canal in elasmobranchs could be divided into four mayor parts: headgut, (mouth and pharynx); foregut (oesophagus and stomach), midgut (duodenum and spiral intestinum) and hindgut (rectum and cloaca). The food moves from the month into the stomach, which is J shaped and used for storing and some initial digestion of the food. The next part of the gut, the intestine, is extremely short length in comparison to other vertebrate. This is achieved by use of a spiral valve with multiple turns within a single short section of gut. The spiral valve takes three main forms: a true spiral winding around a central column, a series of interconnecting cones or funnels, or a cylindrical scroll valve attached to the wall of the intestine but free in the centre. The length of the valve and the number of turns it contains depends upon the type of food typically eaten.

Elasmobranchs have multiple rows of teeth along the edge of their upper and lower jaws. New teeth form in a deep groove just inside the month. Not only do the shapes of teeth vary depending upon their position in the jaw, they may also change with age, for feeding on different prey, or with sex. Large mature male could have very worn teeth that may be important in courtship and mating to holding their mate.

Figure 28. Month of females (left) and males (right) of *Raja clavata*

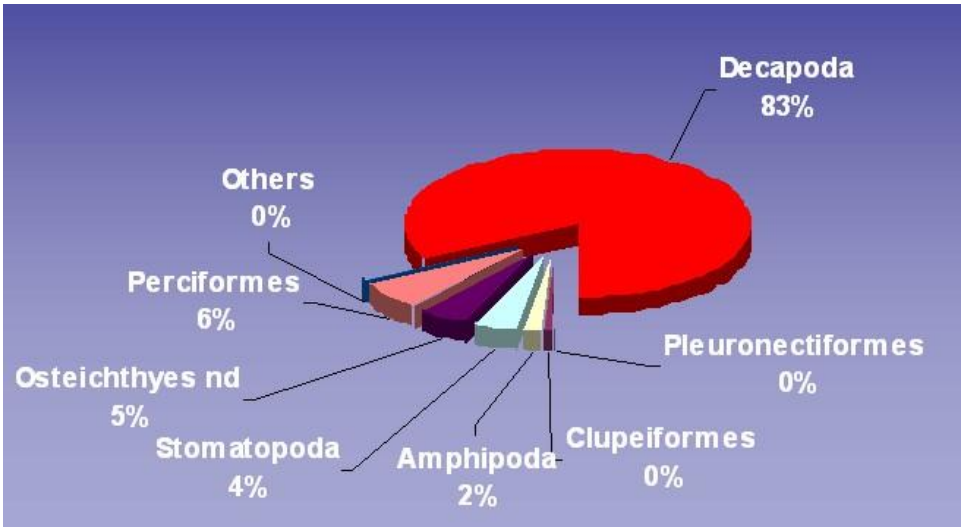


The analysis of the stomach contents allows investigating the alimentary diet. This information is needed to understand the ecological function of the predacious fishes like sharks and rays, in the marine ecosystem, hence its implication in the fisheries and conservation. The diet should be studied following the method of the stomach content analysis. A combination of several indices is needed for a reliable study of the diet. In the table below the parameters frequently used in the diet studies are summarized.

Table 18. Diet parameters

Parameter	Formula	Explanation
Vacuum index (VI)		The percentage of empty stomachs in the samples analyzed.
Percentage of prey item in number (%N)	%N = 100 x (ni / Nt)	the ratio expressed in percentage between the number of individuals of a prey item i (ni) and the total number of preys (Nt)
Percentage of prey item in weight (%W)	%W = 100 x (wi / Wt)	It is the ratio expressed in percentage between the weight of individuals of a prey item i (wi) and the total weight of preys (Wt)
Frequency of occurrence of prey item (%O)	%O = ni / Nt	The ratio between the number of observations of a prey item i (ni) and the total number of full stomachs analyzed (Nt)
Index of relative importance (IRI)	IRI = %Oi (%Wi + %Ni)	This index has been proposed as a standardized measure in dietary analysis. It is calculated with the following equation:

Figure 29. Index of Relative Importance in *Raja asterias* (Cuoco *et al*., 2005)



6.1.3 Growth

Age and growth of living fish is estimated by interpreting the growth zones in some calcified structures. In elasmobranchs, vertebral centra (Cailliet *et al*., 1983), spines (Holden and Meadows, 1962), caudal thorns (Callagher and Nolan, 1999) and neural arches (McFarlane *et al*., 2002) are used to gather information on age estimation and growth rate.

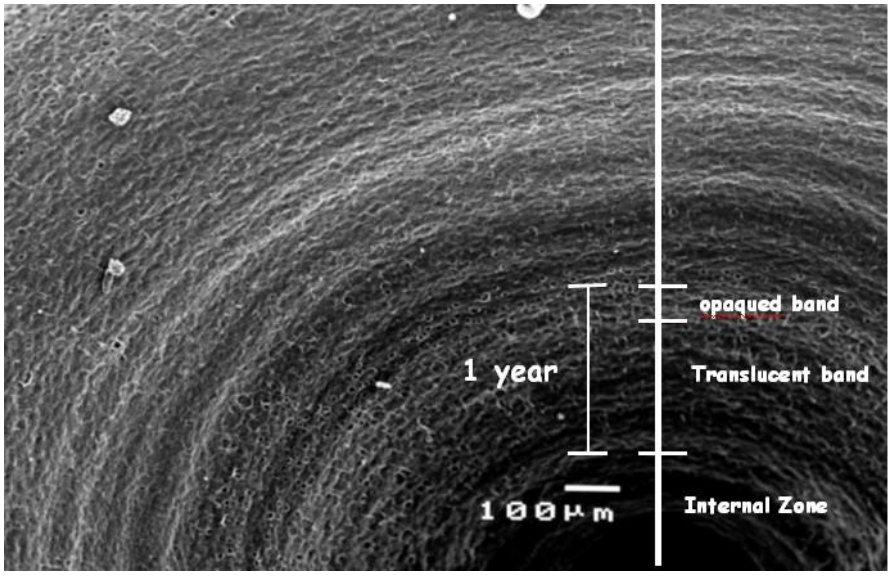
In vertebral centra, the growth pattern consists of a series of concentric incremental zones on the vertebra; the zones are the result of two kinds of concentric marks. Cailliet *et al*., (1983) defined a “ring” as the narrowest kind of concentric mark and used the term “band” to refer to wider concentric marks that may be composed of groups of rings. In general, the opaque bands (wide bands) represent faster growth during the summer period, and the translucent bands (narrow bands) represent slower growth during the winter-spring period. For a review of techniques currently used in Mediterranean for preparation and reading of spines and vertebrae of cartilaginous fishes, it is recommended Rizzo *et al*., 2006.

Obtaining the absolute age of individual fish (complete validation) is the ultimate goal of every ageing study, yet it is the frequency of growth ring formation for which validation is typically attempted. It is generally accepted that these growth zones are deposited annually, but few studies have been attempted to validate the temporal periodicity of growth increment formation (Cailliet, 1990).

The distinction between validating absolute age and validating the periodicity of growth ring formation is important (Cailliet, 1990; Campana, 2001). Validation can be achieved via several methods such as chemically tagging wild fish, mark-recapture studies of known-age individuals and bomb carbon dating. The latter two can also be used to validate absolute age.

A number of models and variations of models exist for estimating growth parameters in fishes, of which the von Bertalanffy (1938) is the most commonly applied.

Figure 30. Vertebra centra in *Raja asterias* (Bono *et al*., 2005).



7 OBJECTIVE II

7.1 Distribution and abundance of cartilaginous fishes

Within the biogeographical distribution of elasmobranchs there may be specific areas or habitat important for certain parts of their life, such as mating grounds, spawning beds and nursery areas. Bottom trawl surveys can provide good spatial information on a species' general distribution and relative abundance. Data describing the distribution and relative abundance of fish in their various life-history stages can be used to recognise and chart these important areas. Whereas nursery areas for coastal species could be easily identify, if in inshore areas juveniles are present at high densities, the distribution of juvenile deep-water sharks is usually poorly known. In addition the comprehension of the geographical relationship between the nursery and the recruitment areas is a vital component for the fisheries management.

Data from Trawl Survey should be used to produce presence-absence maps, which help to delineate distribution limits of the less common species, and quantitative distribution maps only for the most common shark and rays species, that indicate also concentrations. At least the spatial analysis should be coupled with the analysis of temporal trends in relative abundance for the most common species.

8 OBJECTIVE III

8.1 Enhancement of identification

Problem in the identification of sharks and rays are commonly encountered. The high pattern variability of the Rajidae makes it difficult the identification at species level. In the enhancement of the identification a training course addressed to researchers, fisheries observators and junior scientists should be organized.

The activities of the training course could be related to theoretical contributions and practical issues like the following:

- Overview of the background knowledge on elasmobranch fisheries assessment and management techniques;
- Conservation and long-term dynamics of cartilaginous fish in the Mediterranean Sea. Their decline in biodiversity;
- Elasmobranch taxonomy and field techniques for identification based on the "Field identification guide to the sharks and rays of the Mediterranean and Black Sea" (Serena, 2005).
- Large elasmobranch data collection based ad example on MedLem protocol (see annex);
- Use of standard protocols for specimen collection, preservation and cataloguing.

This course should be organized with the cooperation of national and international organization operational in the area. The main output expected is the improvement of the capacity-building at regional level in the fields of taxonomy and monitoring methods of cartilaginous fish in Adriatic Sea. Likewise the enhancement of national landing statistics thought species-specific reporting is envisaged. Finally, this course could be proposed again in other Mediterranean countries.

9 OBJECTIVE IV

9.1 Public awareness

Conservation awareness should be enhanced through the public knowledge about species of sharks and rays present in the Adriatic Sea, their importance within the ecosystem and the risks to their survival. Commercial and recreational fishers should be also encouraged to reporting the catch or rare species and to follow the practice of catch and release.

A way to increase the interest and to give easy information is the publication of posters. RAC/SPA already published posters for Mediterranean monk seal, sea turtles and cetaceans. The poster for sharks and rays could be contemporary a tool for identification and for public knowledge of the distinctive characteristics of this species. It should be exposed not only in research institutes but in harbours and landing places, fish markets and coast guards offices.

10 TIMETABLE

The programme should start as soon as possible and last at least 2 years so that the biological cycles of the studied species could be investigated correctly.

Priority should be given to the definition of the sampling strategy, which should be detailed and scheduled in function of the human and material resources available.

During the first year the training course should be organized in order to guarantee the standardization of data collection in the different countries.

Regular reports should be provided to RAC-SPA: a technical report every 6 months and the draft scientific report 6 months after the end of the programme.

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APPENDICES

APPENDIX A : Report of the Meeting to Prepare the Proposal for a Research Programme on Chondrichthyan Fishes of Slovenia, Croatia, Bosnia & Herzegovina and Montenegro

(19th -20th May 2008 Split, Croatia)

Figure 31. Participants - Meeting 19th -20th May 2008 Split, Croatia

Agenda

MONDAY 19TH

morning 9.00 am

- Presentation of the draft report
- Discussion on how to implement the document

afternoon 14.30 pm

- Review of the national contributions for the Action Plan implementation process in the eastern Adriatic
- Practical work on data available and improvement of the national contributions: local names; priority cartilaginous species; landing sites, etc.

TUESDAY 20TH

morning 9.00

- Discussion on recommendations toward implementing the Action Plan for the conservation of cartilaginous fishes in the eastern Adriatic.

afternoon 14.30

- Finalization of the report
- Proposal for the Action Plan implementation in the eastern Adriatic

A meeting for the coordination and preparation of the "RAC/SPA *CHONDRICHTHYAN FISHES OF SLOVENIA, CROATIA, BOSNIA&HERZEGOVINA AND MONTENEGRO: PROPOSAL FOR A RESEARCH PROGRAMME"* was held at Centre of Marine Studies University of Split, Split, Croatia, from 19 to 20 May 2008.

The meeting was attended by Alen Soldo (Centre of Marine Studies University of Split, Croatia), Nedo Vrgoč (Institute of Oceanography and Fisheries, Croatia), Aleksandar Joksimovic (Institute of Marine Biology, Montenegro), Bojan Marčeta (Fisheries Research Institute of Slovenia), Fabrizio Serena and Monica Barone (Environmental Protection Agency – Tuscany Region, Italy).

Mr Fabrizio Serena opened the meeting and expressed his gratefulness to the national experts for their participation. Indeed, he considered this occasion fundamental for the present and future collaboration in the eastern Adriatic Sea among the colleagues coming from different countries.

Mr Fabrizio Serena reminded the main aim of RAC/SPA, consisting in assistance to the Mediterranean countries in the implementation of the protocol concerning Specially Protected Areas and Biodiversity in the Mediterranean and its related action plans. In particular the objective of this meeting was the "*Action Plan for the Conservation of the Chondrichthyans Fishes in the Mediterranean*". This protocol was approved and ratified at the XIII Conference of Contracting Parties to the Barcelona Convention at Catania, Italy, in November 2003. Particular attention was given to the Mediterranean species of shark, rays, skates and chimaeras.

The protocol of this Action Plan aimed at promoting some objectives like the improvement of scientific knowledge by research and scientific monitoring in each country. Some priorities are identified as develop training to guarantee capacity-building at national level, mainly in the taxonomy, biology, ecology, monitoring methods and stock assessment fields.

Implementation measures are requested especially for fisheries management. Because in official statistics the elasmobranchs species are grouped, it is vital to collect precise fisheries statistics, mostly on catches and landings at species level and data on fishing efforts as well.

Moreover implementing a permanent monitoring of fisheries where chondrichthyans are target or by-catch species is useful for the conservation or sustainable exploitation of these species. This monitoring could be done through surveys, landing-site observation and the examining of logbooks.

The conservation activities of the elasmobranchs can be guaranteed through an action conducted by the Contracting Parties of Barcelona Convention. The Parties should stimulate the national authorities to facilitate the coordination between the different ministries of environmental and fisheries. For this reason it has been suggested to the experts that it will be extremely important to inform each RAC/SPA Focal Points.

During the meeting the contents of the final report (see appendix 1) were discussed. In particular the general aspects regarding the first chapter of the index were presented. The taxonomic list of the cartilaginous fishes occurring in the eastern part of the Adriatic Sea was validated by the national experts and the different local names were taken into account.

After that participants concentrated on the specific aspects of the different countries. A standard file has been provided to the national experts allowing them to insert the information requested. This file was compiled partially especially for general characteristics of the country, such as its geographical map and the coastal characteristics.

The information requested concerned a description of the marine fisheries, vessels and gears in use and a brief description of the trawl surveys carried out in each country. In

addition national consultants inserted in the country section a list of publication about cartilaginous fishes in their country.

A long discussion on the opportunity to consider the elasmobranchs species as by-catch took place. In particular two different visions emerged: one considering the elasmobranchs species as important catch, then not by-catch, and the second considering this species as by-catch commercially important. At the end participants agreed that in the Mediterranean basin this concept could assume a different meaning then that in the Atlantic area and a more standardized definition is needed.

It was discussed about the catches in the Adriatic Sea. In this area the demersal fishery takes place on the entire continental shelf and on a part of the continental slope in the southern Adriatic. Most of the fishing activity is carried out by bottom trawlers of various size and engine power while the use of fixed gear is usually limited to the area unsuitable for trawling.

The experts of each country were asked to give some recommendations for the enhancement of the Action Plan for the conservation of the cartilaginous fishes

In the present situation, considering also that the stocks are shared, it is very difficult to exactly define the level of exploitation and the current state of the demersal stocks in the Adriatic, because there are no reliable commercial catch and effort statistics. Indeed, as happen in the other parts of the Mediterranean basin, the elasmobranchs are landed species by species but recorded in a single group. This is a problem for analyse a landing data set for elasmobranchs. For this reason we consider to arrange better the statistical sheet that the operators can be use in order to obtain a right information. Furthermore participants agreed on the necessity of consider the common and shared properties of the elasmobranchs populations in view of future fisheries regulations and stated that all countries in Adriatic Sea should be involved.

These last problematic aspects can be added in the paragraph of the recommendations as priority tool for data collection and analysis. Regarding recommendations, the discussion has been very interesting especially for the following items:

- Shared stock;
- Catch sampling and species-specific recording;
- Knowledge of life-history data;
- Temporal and geographical distribution at species level;
- Information on fisheries, fishing gear and ground fishing;
- Increase the awareness of the status of elasmobranchs in commercial and recreational fishers;
- The importance of common protocols for data collection (see Medits protocol, MedLem, Sireno protocol; etc.).

Regarding the last recommendation, participants talked about their experience in the use of the MedLem and Medits databases. It was agreed on the insertion in the final report of an example of output from the MedLem project in Adriatic. Participants were also informed that the link to the MedLem database is now available on the new FAO-GFCM web site.

Adoption of the Time Table:

21st - 25th May 2008	Report finalization
26th May 2008	Report will be send to national experts
27th – 28th May 2008	Report will be send back to the coordinator
30th May 2008	The final report will be send to RAC/SPA (Tunis)

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APPENDIX B : MEDLEM data collection field sheet

MEDLEM data collection field sheet

ARPAT

ICRAM

MEDiterranean Large Elasmobranchs Monitoring

13 may 2008

10

FAO -- GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN
SCIENTIFIC ADVISORY COMMITTEE

SUB-COMMITTEE
ON
SEA ENVIRONMENT AND ECOSYSTEMS

MEDLEM PROGRAM

MEDiterranean Large Elasmobranchs

Monitoring

MEDLEM PROGRAM
(MEDiterranean Large Elasmobranchs Monitoring)

In all the seas of the world, the cartilaginous fish species are exploited for their fins, skin, jaws or meat. Sometimes they are directly targeted in commercial and recreational fisheries while in other cases they are caught incidentally as by-catch. In many areas of the world a decline in cartilaginous fish species landings has been observed while fishing effort has generally increased. This especially applies to the fisheries that target shark fins. Moreover, most countries report statistics related to sharks without making a distinction between species or, in worse still, they are not recorded at all. As a result, it is impossible to recognise the species in multi-specific fishery. Due to an inadequate collection of statistics on landings, it is difficult to estimate and monitor fishing mortality.

Because of their life history characteristics, sharks and rays are especially susceptible to over-exploitation and it is very difficult to restore depleted population. Very often species have restricted distribution, small population size, dependence on mating, spawning, nursery and breeding grounds or specific habitats.

The fishing methods used to catch cartilaginous fish species in the Mediterranean are highly varied: the two most efficient gears for sharks are gillnets and longlines, while a frequent method for catching batoids in general and some smaller sharks like smoothhound, catsharks, etc. is the bottom trawl that is commonly performed throughout the Mediterranean area. Large elasmobranchs individuals are also captured with bottom longlines targeting hake. The drifting longlines set near the surface, with tuna and swordfish as targets, also capture some species.

The gear that mostly contributed to the catch of cartilaginous fish species, was the drift net, and in the past, was widely utilised throughout the Mediterranean area. Fortunately nowadays their use is forbidden in many countries, such as Italy and more European Countries. It is advisable that the use of this gear be prohibited and extended to all Mediterranean countries in order to achieve a definite solution to the problem.

No official practice of "finning" is reported in the Mediterranean Sea so far, but mortality through discarding from trawl nets, gillnets, purse seines and longlines is significant. However in the past, the fishing activity with the greatest incidence in cartilaginous fish species catches was the tuna trap. Some years ago, these fishing structures were widely distributed all around the Mediterranean area. In countries such as Spain, France, Turkey and particularly along the Italian coasts the use of the tuna trap was due to the presence of the prevailing migration routes of tuna, directed towards the rich waters of the Liguro-Provençal basin but also in the Adriatic Sea.

Finally, we cannot neglect the role of recreational fishing that has recently grown in popularity and which causes concern. Following the development that occurred in the Unites States and in Australia, the number of angler associations has also notably increased in the Mediterranean, mainly in the Northern Adriatic and in the Tyrrhenian but also in other countries such as France and Spain.

MEDLEM is a monitoring program on the captures and sightings of the large cartilaginous fishes occurring in the Mediterranean Sea. This program directly links up with the FAO IPOA-SHARKS and it has been submitted to the discussion of the SAC Sub-Committee on Marine Environment and Ecosystems of the GFCM (Barcelona, 6-9 May 2002) as "subproject Basking shark". In the context of this Sub-Committee there is a continuous updating of information on incidental catches of protected species and on by catch of large migratory sharks in the commercial fisheries. In particular, during the last meeting in Tunis (27 - 28 March 2003), the news on the basking shark that we dispose at the Mediterranean level were updated.

In the Mediterranean area three species of elasmobranchs: the basking shark (*Cetorhinus maximus*), the giant devil ray (*Mobula mobular*) and the great white shark (*Carcharodon carcharias*) are those that most require protective measures. Actually, although they are not a direct target of any Mediterranean fisheries, they have been included under a number of conventions: Specially Protected Areas and Biological Diversity in the Mediterranean (all three are on Appendix II), Bern Convention and, in the case of the basking shark, on Appendix II of the Convention on International Trade in Endangered Species (CITES).

In order to contribute to the knowledge and conservation of these sharks it is important to establish a common procedure to collect data about the specimens that may be accidentally captured or in the cases of sightings and stranding in the Mediterranean Basin.

In the following sheets we propose a common protocol to collect field data, to take samples and to measure the different body part of the sharks.

The MEDLEM program and its field data sheet has been widely distributed among many Mediterranean research centres. They, in agreement with it, have included their institute logo on the front page of the project and are listed in the following page. This fact expresses the willingness of many countries and organisation to cooperate on this subject and to conform in the collection of data. Recently also IUCN (International Union for Conservation of Nature and Natural Resources-) and EEA (European Elasmobranch Association) endorsed the project showing a great interest and a positive appreciation on of the concept. The first data collected with this project (for a great part represented by bibliography information) was from Spain, France, Tunisia, Algeria, Greece, Croatia and Italy. Up to now 2574 records have been inserted in a dedicated database held in the ARPAT offices of Livorno and they will be soon available by consultation on the web. A great part of these data (548) regarding basking shark from the moment that the specific program about this species (subproject basking shark) was updated in Tunis in 2003 with numerous data coming from different Mediterranean countries.

Another important aspect of this project is the collection of scientific papers related to elasmobranches in the Mediterranean area. About 400 bibliographic references are actually listed in a specific set of the project database.

OBSERVER

Name_____

Address_____

_____Telephone_____

e-mail_____

NOTES

Animal: living ☐ dead ☐ putrefy ☐

Meteo/Sea state ☐

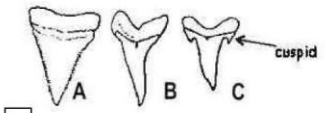
Brief description of the event:_____

_____

_____

Biological observation:

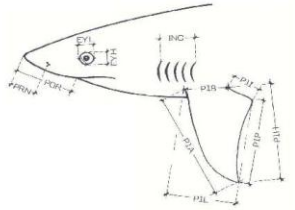
Teeth shape

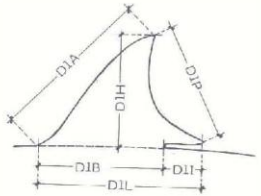


Notched margin ☐

Smoothed margin ☐

Teeth photos YES ☐ NO ☐





Head

EYL = eye length ☐

EYH = eye height ☐

POR = preoral length (snout-mouth) ☐

PRN = prenarial length (snout-nostril) ☐

ING = intergill length (1st-5th gill) ☐

Pectoral fin

P1A = pectoral anterior margin (origin-apex) ☐

P1L = pectoral length (origin-free rear tip) ☐

P1P = pectoral posterior margin (apex-free rear tip) ☐

P1H = pectoral height (apex-insertion) ☐

P1B = pectoral base (origin-insertion) ☐

P1I = pectoral inner margin (insertion-free rear tip) ☐

Dorsal fin

D1A = first dorsal anterior margin (origin-apex) ☐

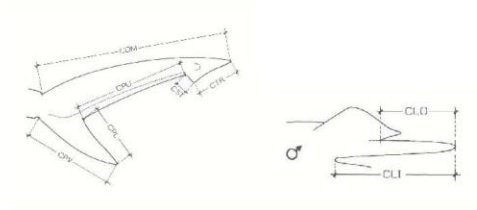
D1B = first dorsal base (origin-insertion) ☐

D1L = first dorsal length (origin-free rear tip) ☐

D1I = first dorsal inner margin (insertion-free rear tip) ☐

D1P = first dorsal posterior margin (free rear tip-apex) ☐

D1H = first dorsal height (apex-middle point of the base) ☐



Caudal fin

CDM = dorsal caudal margin (posterior margin of upper origin of precaudal pit-posterior tip)

CTR = terminal caudal margin

CST = subterminal caudal margin

CPU = upper postventral caudal margin (subterminal notch-posterior notch)

CPL = lower postventral caudal margin (posterior notch-ventral tip)

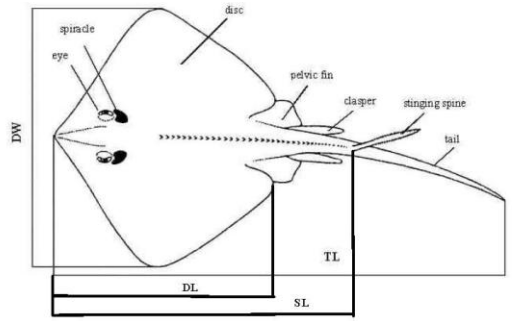
CPV = preventral caudal margin (ventral tip-posterior margin of lower origin of precaudal pit)

Clasper

CLI = clasper inner length

CLO = clasper outer length

Technical terms and measurements for batoids



TL = Total length

DW = Disc width

DL = Disc length

SL = Snout-Sting length

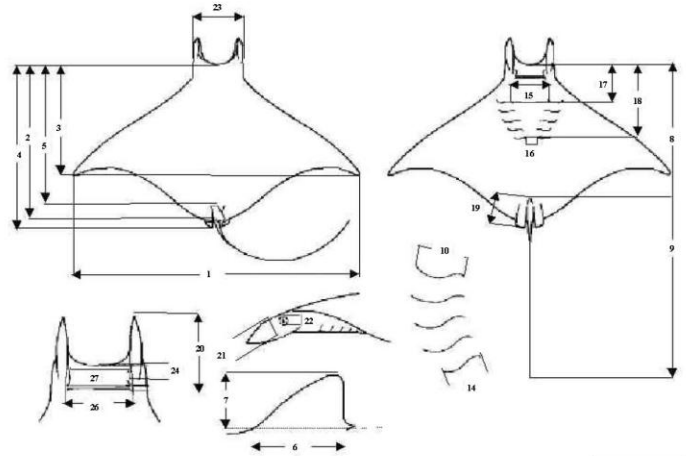
POB = Pre-orbital length

POR = Pre-oral length

PAN = Pre-anal length

CL = Clasper length

Specific technical terms and measurements for *Mobula* genera



1 = Disc width (between tips of wings)

2 = Disc length (median point between horns –posterior margin of pectoral fin)

3 = Distance median point between horns-dorsal - line in the maximum width of body

4 = Distance median point between horns –posterior margin of pelvic fin

5 = Distance median point between horns – origin of dorsal fin

6 = Dorsal fin base length (origin to posterior margin)

7 = Dorsal fin high (perpendicular from the tip to the base)

8 = Distance median point between horns – anterior margin of anus

9 = Tail length (posterior margin of anus – tip of tail)

10 = 1º gill length

11 = 2º gill length

12 = 3º gill length

13 = 4º gill length

14 = 5º gill length

15 = Distance between 1º gills (inner margin of the 1ºleft and right gills)

16 = Distance between 5º gills (inner margin of the 5ºleft and right gills)

17 = Distance median point between horns – transversal line between 1º gills openings

18 = Distance median point between horns – transversal line between 5º gills openings

19 = Pelvic fin length (anterior anus margin - pelvic fin posterior margin)

20 = Cephalic fin length (tip of cephalic fin - margin of mouth, where the margin of inferior jaws mix with border of cephalic fin)

21 = Cephalic fin width (pre-orbital process perpendicular to the ventral margin of cephalic fin)

22 =Eye diameter

23 = Cranial length (maximum dorsal width between pre-orbital process)

24 = Pre-oral length (median point between horns – median point between posterior margin of nostrils)

25 = Head length (tip of cephalic fin – posterior margin of spiracle)

26 = Mouth width (measured between the melting point of inferior jaws with border of cephalic fin)

27 =Distance between nostrils (inner)

28 = Distance between external margin of the 1º upper teeth row

29 = Distance between external margin of the 1º lower teeth row