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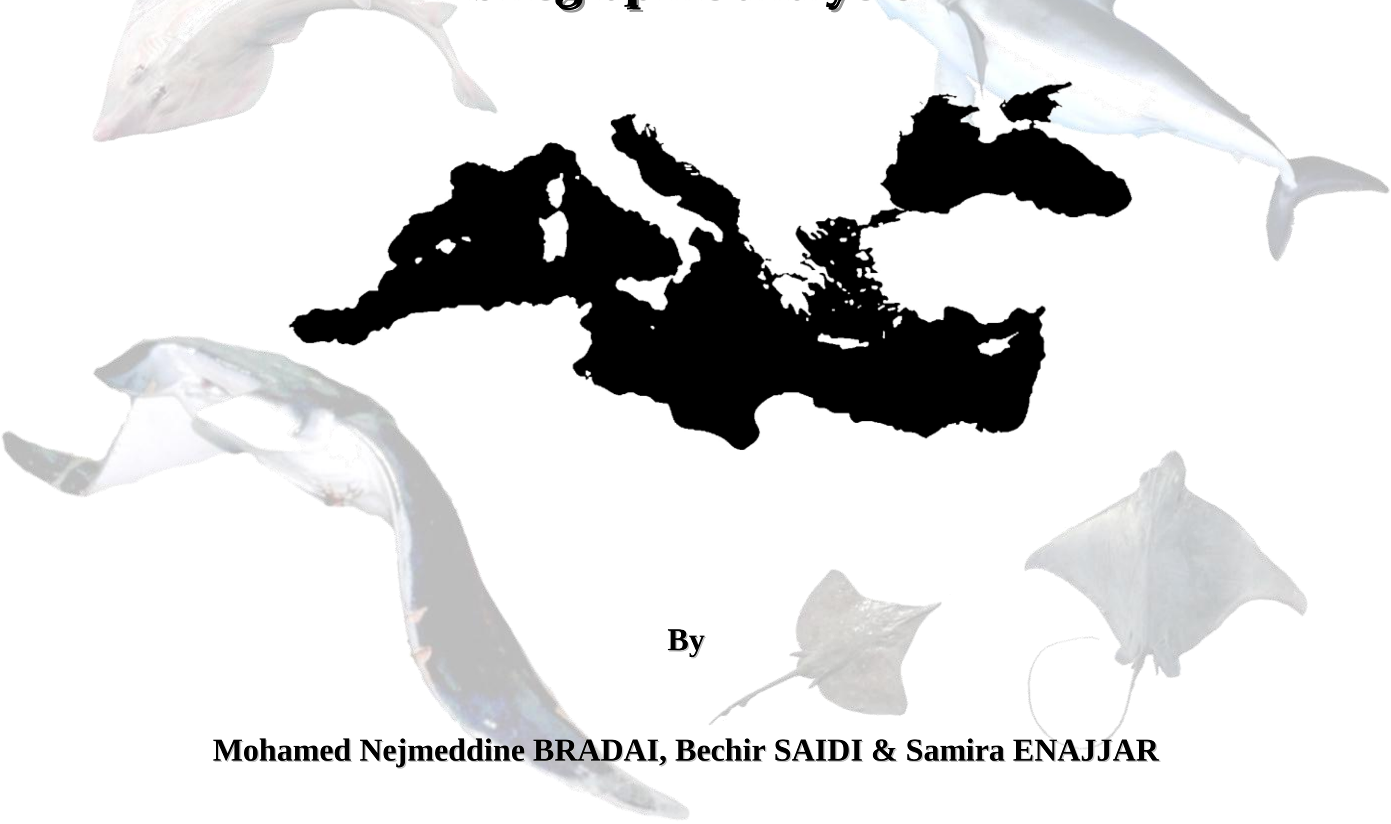
Viale delle Terme di Caracalla, 00153 Rome, Italy. Tel: + 39 0657055730. www.gfcm.org

Elasmobranchs off the Mediterranean and Black Sea:

Status, ecology and biology
Bibliographic analysis



By

Mohamed Nejmeddine BRADAI, Bechir SAIDI & Samira ENAJJAR

Institut National des Sciences et Technologies de la Mer

INSTM

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Preparation of this document

In its forty-four session (Athens, Greece, 12-17 April 2010), the GFCM Commission endorsed the programme of work on elasmobranchs species proposed by the SAC and recommended to the SCMEE to Implement in the 2010 intersession the programme, including an expert meeting and training course. In this frame, a first transversal expert meeting on Elasmobranches in the Mediterranean and Black Sea was proposed to be organised at Sfax, Tunisia from 20 to 22 September 2010.

This document was elaborated as working document for this meeting.

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Warmest thanks are also adressed to all participants to the first transversal expert meeting on Elasmobranches in the Mediterranean and Black Sea (Sfax-Tunisia, 20 - 22 September 2010).

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Elasmobranchs off the Mediterranean and Black Sea: Status, ecology and biology Bibliographic analysis

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Background

In the Mediterranean region, elasmobranches are characterized by their diversity (49 sharks and 36 rays). The region is known to be an important habitat for cartilaginous fish and is thought to encompass unique breeding grounds for species such as the White Shark (*Carcharodon carcharias*) and Thornback Ray (*Raja clavata*).

Elasmobranches constitute an important by-catch of commercial fisheries targeting bony fishes, rare are fisheries targeting sharks, but usually almost all specimen bycatch are marketed. Elasmobranches represent about 1-2 % of the total landings. These landings increased from 10,000 to 25,000 tonnes between 1970 and 1985, and then slowly decreased to 10,000 tonnes in 2000. Subsequently, reported landings declined to 7,000t nowadays

Going back in the history, it has been demonstrated that sharks in the Mediterranean Sea have declined by more than 97 percent in number and "catch weight" over the last 200 years. They risk extinction if current fishing pressure continues (Ferretti et al., 2008). The last 200 years have seen a dramatic decline of large predatory sharks in the Mediterranean Sea. This loss of top predators could hold serious implications for the entire marine ecosystem, greatly affecting food webs throughout this region.

There is evidence that the elasmobranches of the Mediterranean are declining in abundance, diversity and range due to the intense fishing activity primarily in response to the rapidly increasing demand for shark fins, meat and cartilage. However, this direct fishing mortality is not the only impact on elasmobranches populations. There are fishing impacts on habitats through disturbance of biotic communities and substrates. Shipping and underwater exploration, construction, mining, and electrical installation also affect habitats, and increasing ambient sound, light, electromagnetic fields, and chemical contamination stimulate the sensory systems of these fishes.

Their biological characteristics (low fecundity, late maturity and slow growth rates) make also elasmobranches vulnerable to fishing pressure. Overfishing, habitat degradation and slow recovery rates are potential factors that lead to such dramatic declines especially in areas such as the Mediterranean Sea where fishing has long been a way of life and continues to be intense. Some species are already threatened.

Among the 85 species known in the Mediterranean, only 71 were assessed in the frame of the IUCN red list. More than 40% are vulnerable and endangered to critically endangered

(Cavanagh and Gibson, 2007).

In addition, there is a lack of aggregated knowledge on the biology and fishery of elasmobranches in many parts of the Mediterranean. 18 species of the 71 evaluated ones are deficient data (DD) (Cavanagh and Gibson, 2007).
Taking into account the vulnerability of elasmobranches fishes and in frame of a protection and stock management strategy of this group, many action plans were elaborated on this issue

(FAO IPOA-shark, the Action Plan for the conservation of the cartilaginous fishes in the Mediterranean (UNEP-RAC/SPA, 2003), the EC Action Plan for the Conservation and Management of Sharks…). In this way, the GFCM organized a transversal working group on bycatch/incidental catches (Italy, September 2008) and a transversal workshop on selectivity improvement and by-catch reduction (Tunisia, September 2009) where elasmobranches were well concerned.

These last meetings concluded that there is a lack of knowledge on the biology and fishery of elasmobranches in many parts of the Mediterranean and strongly encouraged more studies on population dynamics (population size, structure and demographics) on species of conservation concern (also in terms of fishery management) in parallel to mitigation measure in those cases where protected species are involved.

The above mentioned workshop held in Tunisia suggested to setup a medium term working programme to identify and fill gaps in the current knowledge that exist in elasmobranches fisheries, in order to assess and manage the Mediterranean stocks. This program should identify the activities to be carried out including the organisation of a specific expert meeting on the elasmobranches during 2010. This bibliographic document is elaborated as a work document for this expert meeting on the status of elasmobranches in the Mediterranean and Black Sea (Sfax-Tunisia, 20-22 September 2010) to implement this programme in the frame of the intersessional period activities of the Sac Advisory Committee (SAC) of the General Fisheries Commission of the Mediterranean (GFCM).

Knowledge on elasmobranchs in the Mediterranean and Black Sea compiled in the present document are based on analysis of 595 bibliographic references. Recommendations to fill gaps in order to protect and manage elasmobranches stocks are also proposed.

I- The main characteristics of the region

The Mediterranean

The Mediterranean is the largest (2,969,000 km2) and deepest (average 1,460 m, maximum 5,267 m) enclosed sea on Earth. It is surrounded by Africa, Europe, and Asia. The Mediterranean Sea connects through the Strait of Gibraltar to the Atlantic Ocean in the west and through the Dardanelles to the Sea of Marmara and the Black Sea in the northeast. In the southeast, the Suez Canal links the Mediterranean to the Red Sea and the Indo-pacific region.

A shallow ridge at 400 m depth, between Sicily Island and Tunisian coasts, divides the sea into two main sub regions: the western and the eastern basins.
The climate in the region is characterized by hot, dry summers and cool, humid winters. The annual mean sea surface temperature shows a high seasonality and important gradients from west to east and north to south. The basin is generally oligotrophic. The biological production decreases from north to south and west to east and is inversely related to the increase in temperature and salinity. The Mediterranean has narrow continental shelves, a large part of the Mediterranean basin can be classified as deep sea and includes some unusual features: (1) high homothermy from 300–500 m to the bottom, where temperatures vary from 12.8 °C–13.5 °C in the western basin to 13.5°C–15.5°C in the eastern, and (2) high salinity of 37.5–39.5 psu. The recent marine biota in the Mediterranean Sea is primarily derived from the Atlantic Ocean, but the wide range of climate and hydrology has contributed to the co-occurrence and survival of both temperate and subtropical organisms.

The Mediterranean region has been inhabited for millennia, and ecosystems have been altered in many ways. Therefore, impacts of human activities are proportionally stronger in the Mediterranean than in any other sea of the world. Its coasts support a high density of inhabitants, with 200 million tourists per year, the region contributes notably to global economy and trade; more than 1% of world landings come from Mediterranean fisheries. Therefore, combined natural and anthropogenic events shaped the biodiversity of the Mediterranean Sea in the past and are likely to continue to do so (Coll et al., 2010).
The Mediterranean is known to encompass a high diversity of elasmobranches and many very important habitats that are threatened nowadays.

The Black Sea
The Black Sea is one of the world’s most isolated seas and the largest anoxic plan of water on the world (87 per cent of its volume is anoxic). The total surface area of the Black Sea is 423,000 km2 and it is surrounded by Turkey, Bulgaria, Romania, Ukraine, Russia and Georgia **(Fig. 1).** On the north-east, the Black Sea is connected to the Sea of Azov and to the Sea of Marmara on the south-west. The maximum depth is 2212 m. The most striking characteristics of the Black Sea are the high level of hydrogen sulphide (H2S) and the presence of a permanent halocline between 150 and 200m.
The average surface salinity is about 18-18.5 per mille during winter, and increases by 1.0-1.5 per mille in summer. The mean annual surface temperature varies from 16°C in the south to 13°C in the northeast and 11°C in the northwest. Seasonal fluctuations in temperature are registered until 50 m depth; the temperature of the deeper water remains constant throughout the year (9°C at a depth of 1,000m). The gradual increase of temperature during the history (last 10,000 years) has facilitated the penetration of Mediterranean species in the Black Sea. Today, 80% of total fauna in the Black Sea are Mediterranean origin (Ozturk, 2010).

Figure 1: Map of the Mediterranean and black Sea (Coll et al., 2010)

II- Analysis of bibliographic data

A very thorough literature search led us to collect **595** references, dealing with elasmobranches, of which the majority of articles published in reputable scientific journals. These references were classified as follows by period, topic, species or group of species and geographic area. The exhaustive list of references is shown in **appendix 1**

The chronology of appearance of publications shows that interest on elasmobranches research is relatively recent. It was starting in the last of the 1990s when landings decreased and some species became threatened **(Fig. 2)**

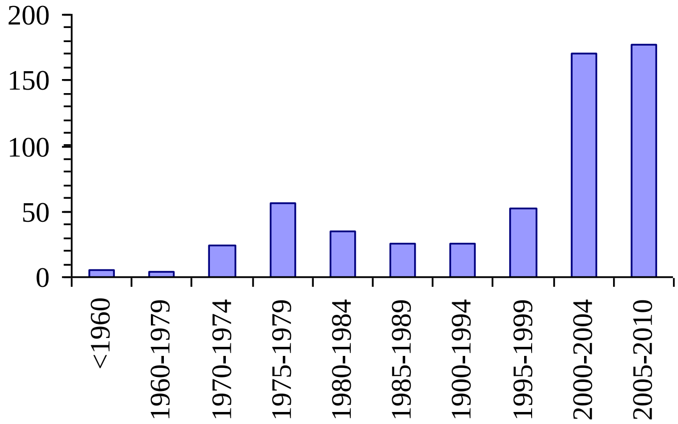

Figure 2: Temporal distribution of the number of published papers dealing with elasmobranchs in the region.

The distribution of available papers by areas is as follows:

- **Black Sea** (**38 papers):**

15, 17, 193, 211, 227, 229, 230, 231, 232, 233, 234, 249, 255, 265, 266, 269, 277, 285, 301, 308, 342, 367, 371, 372, 373, 435, 444, 458, 467, 483, 484, 485, 503, 504, 516, 546, 549 and 554

❖ **Marmara Sea (7 papers):**

340, 348, 349, 354, 355, 358, and 572

❖ **Western Mediterranean: (347 papers)**

7, 8, 10, 13, 14a, 16, 18, 19, 21, 22, 23, 24, 25, 26, 27, 35, 36, 37, 38, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 56, 60, 60a, 60b, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 111, 112, 113, 114, 115, 116, 118, 119, 120, 121, 122, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165,167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 181, 185, 187, 188, 189, 190, 191, 192, 193, 194, 200, 202, 203, 205, 206, 209, 211, 212, 213, 214, 219, 220, 222, 225, 226, 235, 237, 244, 245, 247, 248, 256, 257, 266, 266b, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 285, 286, 287, 288, 290, 291, 293, 301, 304, 305, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 375, 381, 383, 384, 384a, 386, 387, 396, 397, 398, 399, 410, 411, 412, 413, 414, 415, 415a, 416, 417, 418, 419, 420, 421, 422, 423, 424, 426, 427, 428, 429, 430, 431, 435, 436, 437, 438, 439, 440, 441, 442, 443, 447, 450, 451, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 471, 472, 473, 474, 475, 475a, 476, 477, 478, 479, 480, 483, 498, 503, 504, 505, 506, 507, 508, 509, 509a, 509b, 510, 511, 512, 513, 514, 515, 516, 517, 518, 533, 538, 539, 540, 541, 542, 543, 544a, 545, 546, 549, 550, 554, 559, 560, 561, 562, 563, 564, 565 and 566.

❖ **Central Mediterranean: (201 papers)**

7, 11, 14, 19, 19a, 34, 39, 42, 43a, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 110, 116, 117, 123, 136, 137, 141, 166, 179, 180, 182, 183, 184, 186, 193, 196, 197, 198, 199, 201, 204, 207, 208, 209, 210, 211, 215, 216, 217, 218, 221, 223, 224, 226, 228, 235, 236, 238, 239, 240, 241, 195, 242, 243, 246, 249, 250, 251, 252, 253, 254, 258, 259, 260, 261, 262, 263, 264, 266, 266a, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 280, 285, 289, 292, 301, 307, 308, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 361, 362, 365, 370, 370a, 374, 376, 377, 378, 379, 380, 382, 385, 387, 388, 389, 390, 391, 392, 393, 394, 395, 401, 405, 406, 414a, 414b, 425, 427a, 432, 433, 434, 435, 451, 452, 453, 458, 468, 467, 469, 470, 483, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 499, 500, 501, 502, 503, 504, 516, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 534, 535, 536, 537, 544, 546, 549, 553, 554, 555, 556, 557, 558, 560, 573, 575 and 576.

❖ **Eastern Mediterranean: (99 papers)**

1, 2, 3, 4, 5, 6, 9, 12, 20, 28, 29, 30, 31, 32, 33, 40, 41, 193, 211, 266, 267, 269, 277, 281, 282, 283, 284, 285, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 306, 308, 324, 325, 326, 339, 341, 343, 344, 345, 346, 347, 350, 351, 352, 353, 356, 357, 367a, 458, 359, 360, 363, 364, 366, 368, 369, 400, 402, 403, 405, 406, 407, 408, 409, 435, 445, 446, 448, 449, 454, 467, 481, 482, 483, 503, 504, 516, 546, 547, 548, 549, 551, 552, 554, 567, 568, 569, 570, 571 and 574.

The distribution of available papers by species or group of species is as follows:

- **Batoids (180 papers):**

1, 2, 3, 4, 5, 6, 8, 12, 21, 29, 30, 33, 36, 37, 38, 39, 40, 46, 48, 53, 60a, 60b, 61, 63, 65, 67, 73, 74, 75, 76, 77, 78, 79, 80, 82, 83, 86, 87, 88, 89, 90, 91, 93, 94, 95, 96, 97, 98, 99, 100, 101, 104, 108, 109, 112, 113, 114, 117, 118, 121, 123, 126, 129, 130, 131, 132, 135, 143, 144, 145, 146, 147, 148, 152, 153, 154, 155, 156, 159, 160, 164, 166, 175, 177, 179, 180, 181, 182, 183, 184, 186, 187, 191, 192, 195, 198, 212, 213, 215, 220, 229, 230, 253, 254, 257, 258, 259, 260, 261, 262, 263, 264, 265, 267, 286, 287, 292, 298, 299, 318, 319, 320, 321, 322, 325, 326, 329, 330, 332, 337, 341, 361, 362, 367a, 372, 380, 386, 389, 389, 398, 401, 412, 413, 428, 429, 430, 431, 432, 433, 434, 439, 452, 453, 455, 459, 461, 466, 468, 474, 479, 484, 485, 499, 503, 505, 506, 507, 509, 509a, 509b, 512, 551, 555, 565, 566, 567, 568, 570, 572, 574.

- **Sharks (278 papers) :**

7, 9, 11, 15, 17, 20, 22, 23, 24, 25, 26, 27, 28, 34, 35, 43, 44, 47, 49, 50, 51,55, 57, 59, 60, 62, 64, 66, 68, 70, 72, 84, 85, 92, 102, 103, 105, 106, 107, 110, 111, 119, 120, 122, 125, 127, 133, 136, 137, 138, 139, 140, 142, 149, 149a,150, 157, 158, 161, 162, 165, 167, 168, 169, 170, 171, 173, 174, 176, 178, 185, 188, 189, 190, 194, 196, 197, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 214, 216, 217, 218, 219, 221, 222, 224, 225, 226, 227, 231, 232, 233, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 250, 251, 252, 255, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 283, 284, 288, 289, 290, 291, 293, 294, 302, 304, 305, 310, 313, 314, 315, 316, 317, 323, 324, 328, 331, 334, 335, 336, 340, 342, 345, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 367, 367a, 368, 369, 370, 371, 373, 374, 375, 376, 377, 378, 379, 384, 387, 388, 390, 391, 392, 393, 394, 395, 399, 402, 403, 404, 405, 406, 407, 408, 409, 411, 414, 416, 417, 418, 419, 420, 423, 424, 425, 426, 427, 437, 438, 441, 442, 443, 447, 450, 460, 465, 470, 475, 476, 477, 478, 480, 481, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 500, 508, 510, 513, 514, 520, 521, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 538, 539, 540, 541, 542, 543, 548, 550, 552, 553, 556, 557, 561, 562, 563, 564, 573, 575.

- **Batoids and sharks (115 papers)**

10, 13, 14, 16, 18, 19, 31, 32, 41, 42, 45, 52, 54, 56, 58, 69, 115, 116, 71, 81, 124, 128, 134, 141, 151, 163, 172, 193, 211, 223, 228, 234, 248, 249, 256, 279, 280, 281, 282, 295, 296, 297, 300, 303, 306, 307, 308, 309, 311, 312, 327, 333, 338, 339, 343, 344, 346, 363, 364, 365, 366, 381, 382, 383, 385, 396, 397, 400, 410, 415, 421, 422, 435, 440, 444, 445, 446, 448, 449, 451, 454, 456, 457, 458, 462, 463, 464, 467, 469, 471, 472, 473, 482, 498, 501, 502, 504, 511, 516, 518, 519, 522, 535, 536, 537, 544, 545, 546, 547, 558, 559, 560, 569, 571, 576.

- **GFCM priority species**

  Prionace glauca (7 papers): 224, 245, 246, 291, 315, 405 and 406.
  Isurus oxyrinchus (4 papers): 102, 201, 202 and 519.
  Lamna nasus (3 papers): 390, 529, 539.
  Squatina squatina (1 papers): 165.
  Rostroraja (Raja) alba (2 papers): 79 and 89.

- **Some endangered species**

Carcharodon carcharias **(**26 papers): 22, 26, 59, 197, 199, 201, 219, 236, 237, 239, 243, 270, 271, 272, 274, 289, 349, 359, 414, 419, 493, 527, 529, 530, 541 and 452.

Cetorhinus maximus (14 papers): 43, 59, 136, 345, 351, 377, 387, 513, 514, 529, 530, 531, 575 and 427.

Mobula mobular **(**7 papers): 53, 126, 177, 198, 318, 436 and 499.

II- 1 Mediterranean and Black Sea species

All cartilaginous fishes belong to the Chondrichthyes class comprising sharks, batoids (skates, stingrays, guitarfishes and sawfishes) and chimaeroid fishes and including about 60families, 189 genera and about 1,200 living species (Compagno *et al*. 2005) . The chimaeras fall in Subclass Holocephalii and the sharks and rays in Subclass Elasmobranchii. We deal in this document with this former subclass named generally elasmobranchs. Elasmobranchs are divided into sharks (Squalii, Pleurotremata) and rays (Batoidea, Hypotremata),
In all convention and action plans, the term "sharks" is used to refer to the Chondrichthyan or cartilaginous fishes, which comprise elasmobranches (sharks and batoids) and chimaeras.

According to Compagno (2001), Compagno *et al*. (2005) and Serena (2005), the chondrichthyan fish fauna is relatively diverse with an estimated 80 species (approximately 7% of total living chondrichthyans), comprising 45 species of sharks from 17 families, 34 batoid species from nine families and one species of chimaera. In this document we give a new list after critical analysis of the literature and taking in count new published data on the systematic of elasmobranches. In total we consider 86 species of elasmobranchs thought to occur in the Mediterranean Sea. This number comprises 49 species of sharks from 17 families and 37 batoids species from 9 families **(Appendix 2)**. Photos of some of them were presented in **coulour plates** in the end of the document.

Among the 86 species 13 species (7 sharks and 6 batoids) were recorded in the Black Sea (3 rays are doubtful). Three species are relatively common; the thornback ray *Raja clavata* and the common stingray *Dasyatis pastinaca* having no commercial importance due their low market demands and the spiny dogfish *Squalus acanthias* witch is more common **(Appendix2)**
However, it should be noted that several species of elasmobranchs have been reported in the Marmara Sea which is with the Black Sea and Sea of Azov in the same FAO sub-area: Black Sea sub-area. These species are following records made by kabasakal (2003 and 2009) and Kabasakal and Karhan (2007): *Echinorhinus brucus*, *Oxynotus centrina*, *Alopias superciliosus*, *Carcharodon carcharias*, *Scyliorhinus stellaris*, *Galeus melastomus*, *Mustelus asterias* and *Mustelus mustelus.*

II-1-1 Status of some problematic species

For some species, taxonomic status is doubtful, valid for certain ichthyologists and invalid for others or synonyms of other species. We try in this section to review the status of these species taking into account new works and observations.

Squalus megalops

Squalus megalops has been recorded in the western Mediterranean by Muñoz-Chápuli *et al. (*1984) and Muñoz-Chápuli and Ramos (1989). *Squalus megalops* (Macleay, 1881) has been recorded from many localities of the eastern Atlantic and Indo-west Pacific (Compagno, 2005). However, its presence in the Mediterranean Sea was considered doubtful by many authors. Last and Stevens (1994) suggested that the southern Australian *S. megalops* was probably distinct from nominal *S. megalops* in other parts of the world and appeared to be endemic to Australia.

Besides the longnose spurdog *Squalus blainvillei* (Risso, 1827) occurring in the Gulf of Gabès (southern Tunisia, central Mediterranean), a short snout spurdog of the *Squalus megalops-cubensis* group was identified in this area. Morphometrical and meristic data along with genetic analysis (DNA Inter Simple Sequence Repeats markers and molecular Barcoding methods) support the assignation of this short snout spurdog to *Squalus megalops* (Macleay, 1881) (Marouani et al., *in press*). The presence of this species in the Mediterranean is well confirmed. It seems also that *S. megalops* is more common than *S. Blainvillei*.

The tortonese'stingray *Dasyatis tortonesei Capapé(1975)*;

Dasyatis tortonesei Capapé, 1977, has been considered synonym of *D. pastinaca* by Tortonese (1987). Formerly considered dubious by Compagno (1999), is often confused with *D. pastinaca*. Probably a distinct *Dasyatis* species lives in the Mediterranean but with nomenclature problem and currently under investigation (Serena, 2005). The species *D. tortonesei* is then not considered valid in the Field identification guide to the sharks and rays of the Mediterranean and Black Sea.

Parasitological studies in the gulf of Gabes distinguish monogeneans specific to *D. pastinaca* and to *D. tortonesi* described by Capapé (1977); *Heterocotyle capapei*, monogenean gill of *D. tortonesei* and *Heterocotyle pastinacae* for *D. pastinaca* (Neifer et al., 1998 and 2000). Cestods fauna in spiral intestine of the two species are also different (Zayan and Neifer, comm. Pers).

Besides anatomic carachteristics and genetic, parasitology studies are in fact a very usefull tool for systematic of elasmobranches (Ball et al., 2003 ; Beveridge et al;, 2004; Essafi, 1975; Euzet, 1959; Euzet et Radujkovic, 1989; Ktari et Maillard, 1972; Maillard,1966; Mokhtar-Maamouri et Zamali,1981 et 1982 ; Neifar et al., 1998 et 1989; Neifar, 2001; Tazerouti, 2007)

Further investigations in the gulf of Gabes demonstrated the presence of the two species on the basis of clear differences in morphometric, meristic and anatomic characteristics (Bradai, pers.comm.)

In this document we consider *D. tortonesi* as valid species.

The Marbled stingray *Dasyatis marmorata* (Steindachner, 1892)

The Marbled stingray *Dasyatis marmorata* (Steindachner, 1892) *is* closely related to *D. pastinaca* (Linnaeus, 1758) and, therefore, the two species are often confused and misidentified. According to COWLEY & COMPAGNO (1993), these species can be distinguished by the ratio between the disk length and disk width. In addition, the species differ in coloration: the dorsal surface of *D. pastinaca* is grayish-green to olive brown, conspicuous bright blue blotches and branching lines on a golden background on the dorsal surface of the other species.

Dasyatis marmorata was reported for the first time in the Mediterranean in the Gulf of Gabès (southern Tunisia) by MAURIN & BONNET (1970) as *D. pastinaca* var. *marmorata*. This occurrence was confirmed under the same taxon by QUIGNARD & CAPAPÉ (1971).

In another hand, a closely related species Dasyatis *chrysonota* is found in Gulf of Guinea (Fowler 1936), Angola (Krefft 1968) to South Africa (Cowley &Compagno 1993).

Referring probably to earlier taxonomical papers (see COWLEY & COMPAGNO, 1993) such as FREDJ & MAURIN (1987) and CAPAPÉ & DESOUTTER (1990), QUIGNARD & TOMASINI (2000) considered (*D. chrysonota* = *D. marmorata*) a valid species.

On this consideration, many records of this species as *Dasyatis chrysonota* were reported in the Mediterranean; off the coast of Israel (eastern Mediterranean) (Golani and Capape, 2004) and in the Lagoon of Bizerte (North-eastern Tunisia, central Mediterranean) (El Kamel et al., 2009)

In the Field identification guide to the sharks and rays of the Mediterranean and Black Sea., FAO Species Identification Guide for Fishery Purposes, Serena (2005) gave the name *Dasyatis chrysonota marmorata (*Steindachner, 1892) and wrote that this name is an interim solution . It may become *D. marmorata* after DNA studies.

Considering photos of *D. chrysonata* off the Africa (East Atlantic) (Seret, pers.comm.), a difference seems to be clear between this Atlantic species and *D. marmorata*. In the Field identification guide to the sharks and rays of the Mediterranean and Black Sea (Serena, 2005), the schema of the called *Dasyatis chrysonota marmorata* represents *D. chrysonata* and the photo is of *D. marmorata*. Differences interest mainly the body shape and the dorsal coloration.

Considering tail spine characteristics of stingrays, Schwartz (2007) distinguished *D. chrysonata* and D.c. *marmorata*

In conclusion at this bibliographic analysis and following further discussions with colleagues, *Dasyatis marmorata* is a species of West African and Mediterranean (Seret, in press - Dasyatidae, in FAO species identification guide for Fishery Purposes, The Living Resources of the Eastern Central Atlantic). *Dasyatis chrysonota* is a South African species. There are several distinctive features (colour and morphology). However, a genetic study should formally reaffirm the validity of *D. marmorata* and redefine the two species (Seret, pers.comm.).

In this document, we consider only *D. marmorata* and all records of *D. chrysonata* in the Mediterranean as *D. marmorata*. Further investigations should be undertaken.

Glaucostegus halavi(Forsskäl, 1775)

The species was recorded firstly by Vinciguerra (1884) in the gulf of Tunis but following morphologic description given by the author, it was *Rhinobatos cemiculus* (Quignard & Capapé, 1971). Tortonese (1951) recorded it also in Egyptian waters but it was not confirmed (Ben-Tuvia, 1966). Later a single specimen was recorded from the gulf of Gabès (Tunisia) (Ben Souissi et al., 2007). This record seems to be doubtful and a reconsideration of the specimen in question is necessary. It is not considered in this document.

Centrophorus granulosus* et *Centrophorus uyato

This genus needs revision worldwide (Daley *et al.* 2002, Lloris and rucabado, 1998).

Isurus paucus (Family **LAMNIDAE)**

It is caught in Algeria (Hemida, 2000; Hemida and Capape, 2002). It will be considered in the list

Carcharhinus melanopterus (Family CARCHARHINIDAE)

Carcharhinus melanopterus is an Indo-Pacific species present in the Red Sea (Gohar & Mazhar, 1964) and seems to have colonized the south-east Mediterranean. Branstetter (1984) and Fischer et al. (1987) considered questionable its presence in the western basin. The species is very rare in the gulf of Gabes where it is reported for the first time by Quignard & Capapas (1971). The capture of a male specimen of one meter long in the Gulf of Gabes, in December 1993, confirms the previous observations of blacktip shark in the south Tunisia (Bradai et al., 2002).

***G*aleocerdo cuvier** (Family CARCHARHINIDAE)

Very rare tropical Atlantic species; Its occurrence in the Mediterranean was doubtful, but two substantiated records were reported in the Mediterranean, first off Malagá, Spain (Pinto de la Rosa, 1994), then in Messina, Italy (Celona, 2000). It is considered in the list.

Two other doubtful species of carcharinidae family *C. leucas* and *C. longimanus*, recorded in the Mediterranean, were considered as not valid (Serena, 2005). They are not included in the present list.

PRISTIDAE

Sawfish was once common in the Mediterranean and Eastern Atlantic, but has now been probably extirpated from Europe and the Mediterranean. Populations depleted because of the destruction of littoral and freshwater habitats and its vulnerability to coastal gill-net fisheries. Only historical records exist.

***Torpedo (Torpedo) alexandrinis* Mazhar, 1982** and ***Torpedo (Torpedo) fuscomaculata* peters, 1855** (F. Torpedinidae)

These two species are not considered as valid species (Serena, 2005). They are not considered in this document

***Raja africana* Capape, 1977**.
Validity of this species is questioned in Compagno's 1999 checklist and Serena (2005). We consider it in the list and further investigation should be undertaken.

***Raja rondeleti* Bougis, 1959** (Rondelet's skate)
The taxonomic status of this species is doubtful (Serena, 2005). It is not considered in the list. It is necessary to point out also the two following remarks:

- Moreno & Hoyos (1983) record the presence of a new species *Carcharhinus acarenatus* in the Mediterranean but Compagno (1984) put it in Synonymy with *C. Brachyurus*.

- De Maddalena and Dell Rovere (2005) report the First Mediterranean record of the pigeye shark, *Carcharhinus amboinensis* (Müller & Henle, 1839) in the North-west Ionian Sea on the basis of jaws measurements. We don't consider it in our list.

II-1- 2 Mediterranean endemic species

Endemism of chondrichthyans in the Mediterranean is low, with only four batoid species (Maltese skate *Leucoraja melitensis*, speckled skate *Raja polystigma*, rough ray *R. radula* and giant devilray *Mobula mobular*) that could be considered endemic (Serena 2005). Within the Mediterranean, the distribution of chondrichthyan fishes is not homogenous (Serena 2005).

II-1-3Alien species in the Mediterranean

8 chondrichthyan alien species were recorded in the Mediterranean, five sharks and three batoids:

- ***The Bignose shark Carcharhinus altimus (Springer, 1950).***

This tropical Atlantic species was recorded first on Moroccan coast, Alborán Sea (Moreno and Hoyos, 1983); One record in Levantine waters (Golani, 1996), now frequent in Algerian waters (Hemida and Labidi, 2001). It is considered as established (on the basis of at least three distinct published records well spread out in time and space.)

- ***The Silky shark Carcharhinus falciformis (Bibron, in Müller & Henle, 1839).***

Tropical Atlantic species, recorded first in Alborán Sea (Moreno, 1987). Subsequently, it was caught in eastern Algerian waters (Hemida and Labidi, 2001) and in Tunisia (Bradai et al., 2004).

- ***The Tiger shark Galeocerdo cuvier (Peron & Lesueur, in Lesueur, 1822).***

Very rare tropical Atlantic species; only two substantiated records in the Mediterranean, first off Malagá, Spain (Pinto de la Rosa, 1994), then in Messina, Italy (Celona, 2000).

- ***The Milk shark Rhizoprionodon acutus (Rüppell, 1837).***

Very rare tropical Atlantic species; only a single specimen recorded in the Mediterranean in Gulf of Taranto, Ionian Sea (Pastore and Tortonese, 1985).

- ***The Great hammerhead Sphyrna mokarran (Rüppell, 1837).***

Very rare, only a single specimen recorded in the Mediterranean in Camogli, Ligurian Sea, Western Mediterranean (Boero and Carli, 1977), introduced probably via Gibraltar.

- ***The honeycomb whipray Himantura uarnak (Forsskael, 1775).***

Established indo-pacific species, introduced Via the Suez Canal first from Israel (Ben Tuvia, 1955); successive records in Mersin, Turkey (Ben-Tuvia, 1966), Lebanon (Mouneinne, 1977), Egypt (El Sayed, 1994), Turkey (Basuta *et al.*, 1998).

- ***Glaucostegus halavi(Forsskäl, 1775)***

Only a single record from the gulf of Gabès (Tunisia) (Ben Souissi et al., 2007) is known. This record seems to be doubtful and a reconsideration of the specimen in question is necessary.

- ***Torpedo(Torpedo) sinuspersici***

Lessepsian species reported in the Mediterranean, in the Levantine sea by Saad et al. (2004)

II-2 Spatial distribution

Spatial predicted patterns of species richness in the Mediterranean Sea based on the AquaMaps model [80, and File S2] show that concentration of rays and sharks occurred in coastal waters especially in the waters of Tunisia and Libya **(Fig. 3)**.

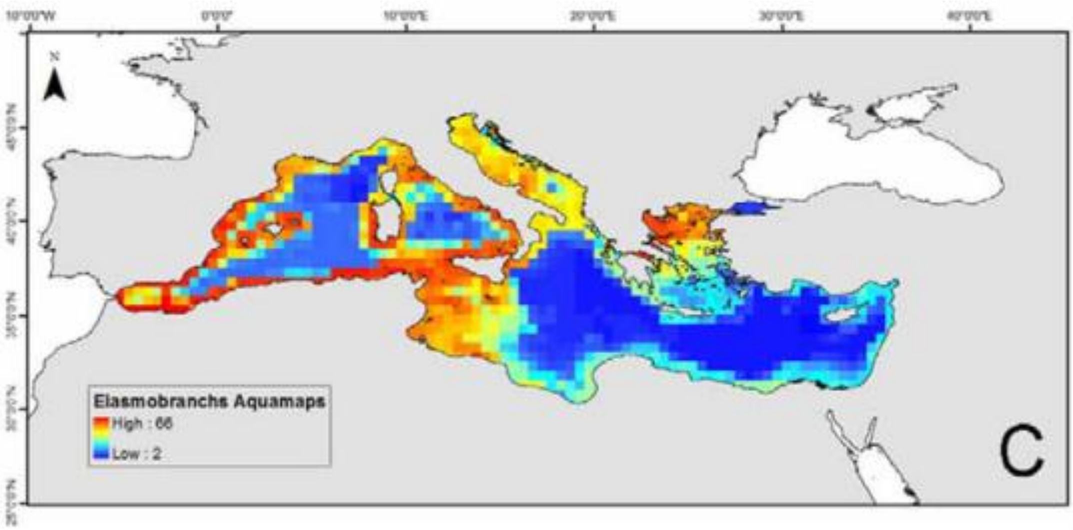

Figure 3: Spatial predicted patterns of species richness in the Mediterranean Sea based on the AquaMaps model [80, and File S2]. (C) elasmobranchs (n = 74). map was generated without imposing a probability threshold. Colors express species occurrence from blue (little or no occurrence) to red (highest occurrence). The size of the cell is 0.560.5degree (Coll et al., 2010).

Within the Mediterranean, the distribution of elasmobranch fishes is not homogenous (Serena, 2005). Some areas are considered critical habitat for elasmobranches. For example, Tunisian waters provide a nursery area for great white shark *Carcharodon carcharias*, the sandbar shark *Carcharhinus plumbeus* and probably for many other species (saidi, 2008 and Enajjar, 2009). Some species have a restricted range within the Mediterranean, for example a small population of the smalltooth sand tiger shark *Odontaspis ferox* seems resident in a particular area off Lebanon (Canavagh & Gibson, 2007). In the Adriatic Sea, the presence of cartilaginous fish species is scarce especially in the northern part. The basking shark is a rather rare but constantly present species in the eastern Adriatic Sea. However, over the period 2000-2002 their occurrence in that area highly increased (Soldo et al., 2008). Besides its oceanographic characteristics that may limit biodiversity, this area was populated more recently than other parts of the Mediterranean. A total of 52 species of cartilaginous fish have been recorded in the Adriatic Sea. Only 10 species are widely distributed. Some bathyal species of the group inhabit exclusively the central and southern parts of this sea (Serena, 2005). In the Black Sea the number of cartilaginous fish species is lower. The Black Sea fauna is composed of Mediterranean species and most of the organisms present are eurythermic and euryhaline. Thirteen elasmobranchs species are assumed to live in the Black Sea (Serena, 2005). However, it should be noted that several species of elasmobranchs have been reported in the Marmara Sea which is with the Black Sea and Sea of Azov in the same FAO sub-area: Black Sea sub-area.

Precisions on spatial distribution of some species

- Carcharhinus obscurus

The species is an occasional transient within the Mediterranean, it was recorded in Malta (Fergusson and Compagno, 2000), the Gulf of Gabès (Saïdi, 2008), in Syria (Saad *et al*., 2004) and in Palestine (Golani, 2005). Based on the capture data, the species may occupy a wider range than supposed.

- Carcharhinus brachyurus

The species was not cited along the oriental basin. It's occurrence in the Mediterranean Sea may be confined only in the occidental basin. It was recorded in Algerian coast (Hemida *et al*., 2002) and in Balearic Islands (Moery & Massuti, 2003).

***- Carcharhinus taurus*.**

The occurrence of the species seems to be restricted to occidental basin. However, the species is probably disappearing from the area (Fregusson *et al*., 2000).

- Echinorhinus brucus

In the oriental basin, the species occurred only on the north coast of the Mediterranean Sea. It was recorded in the Sea of Marmara (Kabasakal, 2003). The species was not observed along the southern coasts of oriental basin.

- Isurus paucus

The species is rare in the area. It is accidentally caught.

- Squatina aculeata* and *S. Squatina

These two species occurred along all Mediterranean coasts. However we think these squatinidae are disappearing from several areas

- Squalus acanthias

The species occurs along the occidental basin coasts and only along the north coast of oriental basin of the Mediterranean Sea. The species is abundant in Black Sea (Avsar, D. 2001; ADEMÜRHAN S. A. & SEYHAN K. 2006).

- Centroscymnus coelolepis

The occurrence of this species may be restricted to the north occidental basin. According our investigations and also in the literature: no mention of this species along the North African coasts.

- Alopias superciliosus

The species may occupy all the Mediterranean Sea. It was observed in Syria (Saad *et al.*, 2004), the Ionian Sea and Levantine basin (Megalofonou *et al*., 2005; Golani, 2005).

- Rhinobatos cemiculus / R. rhinobatos

These two species are common off the south coasts of the Med but no observed along the north ones (no recorded in MEDITS campaigns) (Bertrand *et al.*, 2000; Baino *et al.*, 2001).

-Dasyatis marmorata

CAPAPÉ (1989) suggested that in southern Tunisian waters, *D. marmorata* undergoes competitive pressure from related dasyatid species. Consequently, it inhabits restricted areas in the Gulf of Gabès, entering a closed hyperhaline lagoon, the Bahiret el Biban (CAPAPÉ & ZAOUALI, 1992, 1993, 1995). Nowadays, this species extends it distribution area (Enajjar, 2009; El Kamel et al., 2009; Golani et Capapé, 2004)

II-3 Critical habitats

Critical habitats should be identified for conservation porpoises. In fact, a big lack of knowledge on critical habitats of this group was noted in the Mediterranean and Black Sea. However, some mapping of nursery areas and spawning ground for some species being carried out by some countries.

Some areas are considered critical habitat for chondrichthyans. For example, Tunisian waters provide a nursery area for white shark *Carcharodon carcharias*. Aggregations of basking shark *Cetorhinus maximus*, have been observed in the northern Balearic region, the Northern Adriatic and the Tyrrhenian Sea (Walker *et al*. 2005). Tunisian waters provide a nursery areas for great white shark *Carcharodon carcharias* (Centre of Tunisia) and for the sandbar shark *Carcharinus plumbeus* (Bradai et al., 2005) (gulf of Gabes - south of Tunisia). This area seems to be also a nursery for many other elasmobranches (Saidi, 2008 and Enajjar, 2009). However, a large knowledge on the presence of juveniles, gravid females and other biological parameters (i.e. size at first maturity) are srongly needed to identify a nursery area in order to make solid conclusions to restrict the areas to be protected, eventually in order to create MPAs, since the Gulf of Gabès is the most fished area in Tunisian waters.

II-4 Status of the species

Among 71 Mediterranean species, assessed in the frame of the IUCN red list (2007 regional assessment), 42. 25 % are vulnerable and endangered to critically endangered, 18.31 % are Near Threatened (NT) and 25.35 % are Data Deficient (DD) **(Tab.l).** The status of all species assessed is represented in **appendix III**

This assessment shows clearly the vulnerability of elasmobranchs and the lack of data on this fish group.

Table 1: IUCN red list of Mediterranean elasmobranchs species (Gibson *et al.,* 2007).

IUCN red list categories	Number of species
Critically Endangered (CE)	**13**
Endangered (E)	**08**
Vulnerable (VU)	**09**
Near Threatened (NT)	**13**
Least Concern (LC)	**10**
Data Deficient (DD)	**18**
Not Evaluated (NE)	**0**
Total number of species	**71**

II-5 Elasmobranches fisheries

II-5-1 FAO Statistics

Elasmobranchs fish species are exploited for their fins, skin, jaws or meat. Sometimes they are directly targeted by commercial and recreational fisheries while in other cases they are incidentally caught as bycatch. In Mediterranean Sea, elasmobranchs fish catches represent only 1.1% of the total landings (Serena, 2005).

In many areas of the world such as the Mediterranean Sea, a decline in cartilaginous fish species landings has been observed while fishing effort has generally increased. The catches during the last 30 years show an increasing trend; 24,000 tonnes attained in 1983 and since then a regular decrease are observed. The present elasmobranchs productions are about 7000 tonnes annually **(Fig. 4)**. Sharks represent 1.3 times the production of batoïdes **(Fig. 4)**.

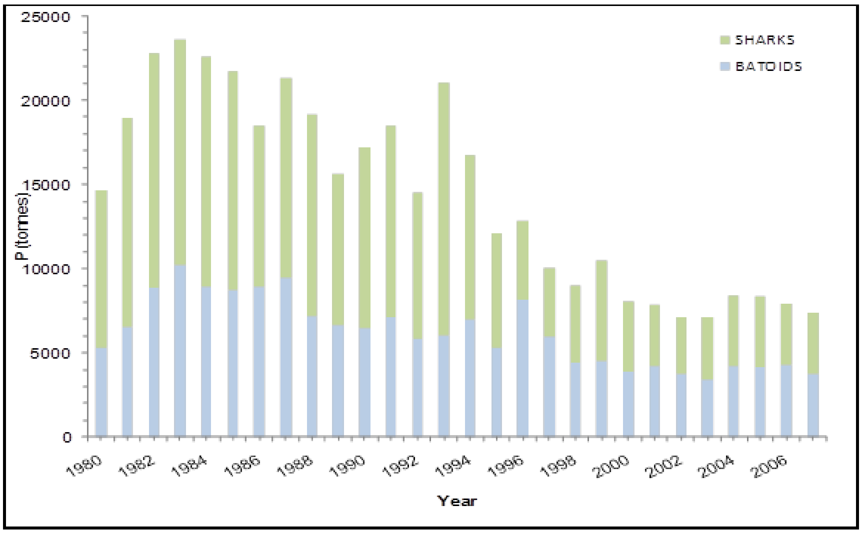

Figure 4: Mediterranean and Black Sea trend of elasmobranchs catches in the last 30 years

Countries report generally shark statistics without distinction between species or, worse still, the species are not recorded at all. Moreover, FAO data only report official landings and therefore bycatch returned to the sea is not included. About 50% of the estimated global catch of elasmobranchs fish species is gathered as bycatch and these are not mentioned in official fishery statistics.

In the way to improve statistics, the workshop on selectivity improvement and bycatch reduction (Tunis, Tunisia, 23-25 September 2009) suggested that a protocol should be developed to collect and promote the collection of basic data on species of conservation concern. The aim of the protocol is to collect data which can then be fed into existing databases. The data collection is notably aiming to characterise and assess captures of species of conservation concern including unwanted species and size classes. The data is required by operational unit in order to fit into the GFCM Task I data matrix.

Triakidae and the group Rajiiformes (without distinction of species) represents on average 70% and 87 % respectively of sharks and batoïdes captured during the last 30 year in the Mediterranean and the Black Sea **(Figures 5 and 6)**.

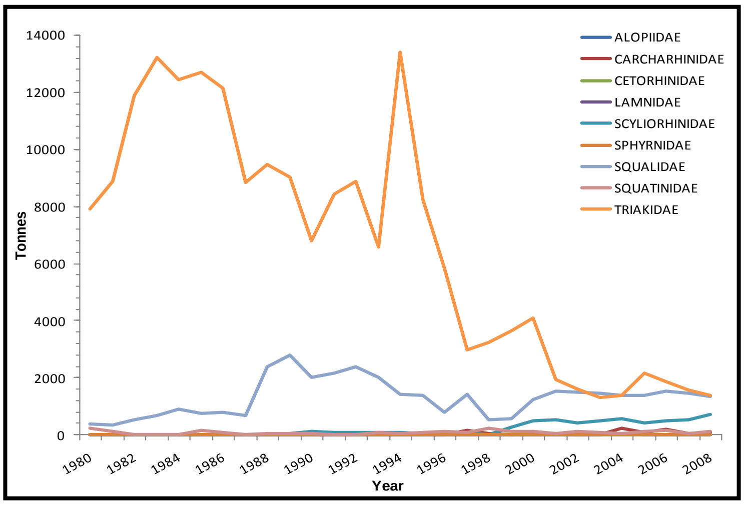

Figure 5: Mediterranean and Black Seas trend of catches of sharks in the last 30 years

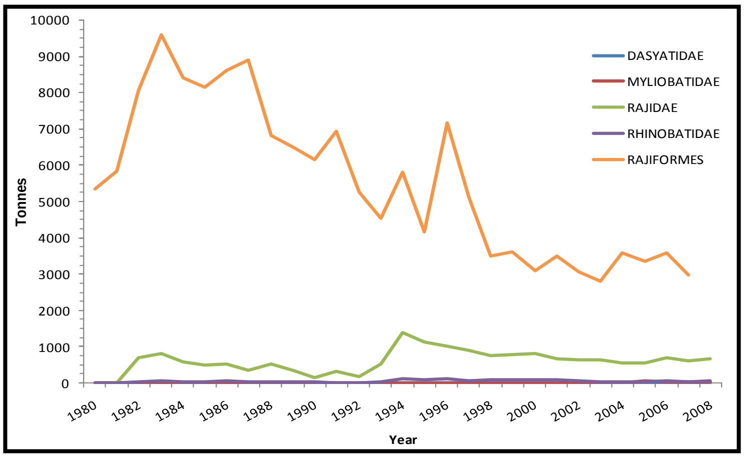

Figure 6: Mediterranean and Black Seas trend of catches of batoïdes relatives in the last 30 years

The major elasmobranchs fishing countries within the Mediterranean are Italy, Turkey and Tunisia; they contributed on average with 76 % in the production of elasmobranchs during the last 30 year **(Fig. 7)**.

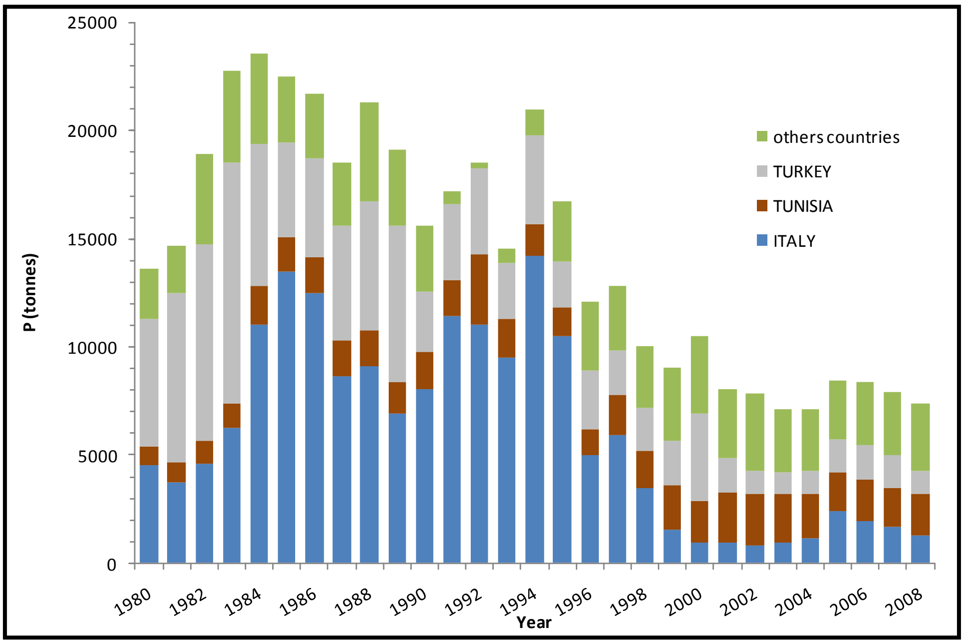

Figure 7: Contribution of Italy, Turkey and Tunisia in the Elasmobranchs production in the the Mediterranean and the Black Sea from 1980 to 2008.

Low production characterises priority species of the GFCM (*Rostraraja alba*, *Isurus oxyrinchus*, *Lamna nasus*, *Prionace glauca* and *squatina squatina*); it's about 250 tonnes for *Prionace glauca* and don't exceed tens of tonnes annually for the others species. Statistic information for *Mobula mobular* and *Carcharodon carcharias* are absent **(Fig. 8)**.

Raja clavata seems to be among the few species that their production is increasing. It's in relation with the new habit of fishing ant not in relation with the good status of the exploitation of the population **(Fig. 8)**.

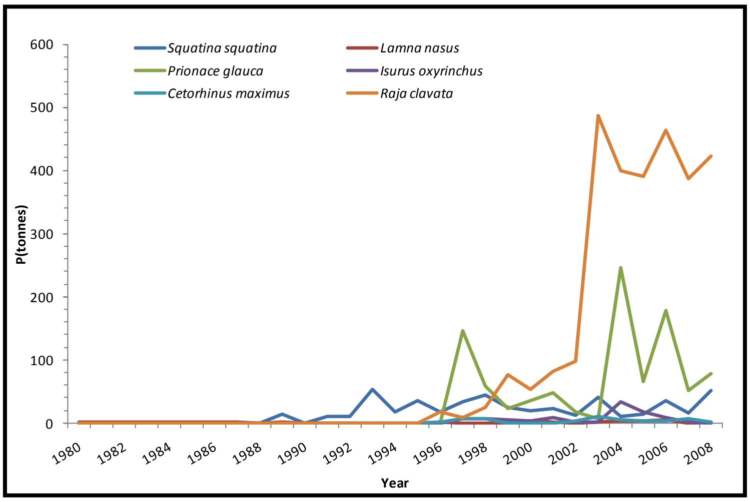

Figure 8: Landings evolution of some elasmobranchs species in the Mediterranean and the Black Sea Between 1980 and 2008.

II-5-2 Fishing gears

In the Mediterranean, almost no elasmobranchs are subject to directed fisheries, but elasmobranchs constitute part of the bycatch in most local artisanal fisheries.

Catches of elasmobranchs primarily derive from two different fisheries: the pelagic artisanal fishery with longlines and gillnets, where smoothhounds are the most common group, and the demersal trawl fishery, where rays and catsharks constitute the main groups among elasmobranchs. In both cases elasmobranchs represent only a bycatch, being the longline fishery directed to swordfish or tunas and the trawl fishery to various assemblages of finfish, shrimps and cephalopods.

II-5-3 Elasmobranches Bycatch

II-5-3-1 Introduction

In recent years, the Bycatch has become one of the issues to be considered in any development of fisheries. Indeed, in addition to their biological and ecological impacts, incidental catches are also a loss of biological resources (Hall et al., 2000). In 1994, FAO estimated that 27 million tons of marine products caught are not landed and are non-target species and particularly discards. This is mainly due to the low selectivity of fishing gear used.

The Bycatch of juveniles of commercial species may adversely affect the future stock and catch levels (Hall et al., 2000). On the other hand, the ecological consequences of Bycatch are worrisome when it comes to endangered species such as marine mammals, seabirds, turtles and elasmobranchs. These groups of species are very sensitive given their particular biological characteristics (Musick et al. 2000; Gilmen et al., 2006). The Bycatch can induce imbalances between top predators and prey and consequently affect biodiversity (Hall et al., 2000).

The biology of elasmobranchs, late sexual maturity, long life cycle, low fecundity, long lifespan and the fact that they are at the top of the food web, making them more vulnerable to fishing than most teleosts (Stevens et al ., 2000).

Elasmobranchs of the Mediterranean are mainly coastal species (80%) and most benthic fauna, and this is likely to be affected by fishing activities, concentrated mainly in coastal areas. Several species (12 species) are pelagic. The species of depths (15 species) are particularly benthic. Target fishing of these species is unusual in these waters. Only a few species of elasmobranch are targeted. In the Mediterranean, more than 100,000 sharks are taken as incidental catch each year. The incidental catch of these species are highly variable in time and space and using the techniques of fishing. However, the magnitude of these catches and discards is not well documented.

To this end, the incidental capture of elasmobranchs by commercial fisheries has been subject to a special attention for a better knowledge of targeted and incidental catch of sharks and conservation of populations (IPOA-Shark (FAO, 1999), In this part of the document dealing with elamobranchs bycatch, we analyse the available bibliographic data on this issue in the Mediterranean and Black Sea. Results are given following geographic fishing areas, fishing gears and species or groups of species.

II-5-3-2 Bycatch definitions

There are several definitions of what bycatch or incidental catch is:

- "that portion of the catch returned to the sea as a result of economic, legal or personal consideration plus the retained catch of non-target species" (McCaughran 1992).
- "Animals other than the target species which are unmarketable because they are too small or for some other reason" (Alverson et al., 1994).
- "that portion of the capture that is discarded at sea dead (or injured to an extent that death is the most likely outcome) because it has little or no economic value or because its retention is prohibited by law" (Hall, 1996).
- all catches of sharks and rays in fisheries targeting other species (Bonfil, 2005)

In simpler words, these definitions say respectively that bycatches are:
All discards plus retained non-target species
Discards of non-target species
All dead discards

General definitions were proposed in the frame of the SAC activities:

- "*The total catches of unwanted animals including vulnerable and endangered species. By-catch of commercial species should be reported as associated species.''* (Report of the ninth session of the Sub-Committee on Statistics and Information (SCSI), Antalya - Turkey, 13–16 October 2008). This definition was reported in the draft glossary of scientific terms of interest for the SAC.

- "*The part of the catch taken together with the [authorised] target species. In a broadcontext, this includes all non-targeted catch including (by-product), discards, illegal and species of conservation concern* (GFCM/SAC selectivity workshop 2009)".

In this document, we opt for the Bonfil definition. This definition is specific for elasmobranches.

II-5-3-3 References dealing with bycatch

96 papers were identified and analyzed in the context of this topic. They cover many aspects and approaches to fisheries. These references are:
8, 10, 14, 17, 18, 19, 42, 45, 58, 60, 136, 140, 189, 193, 198, 218, 223, 224, 225, 226, 229, 244, 245, 246, 247, 248, 255, 258, 266, 271, 277, 278, 279, 280, 288, 290, 291, 292, 307, 308, 309, 311, 313, 338, 339, 357, 365, 366, 370, 382, 383, 385, 386, 387, 396, 397, 404, 407, 408, 409, 411, 412, 415, 422, 438, 440, 444, 448, 451, 452, 453, 454, 469, 473, 475, 479, 481, 483, 486, 488, 496, 498, 501, 505, 512, 517, 518, 533, 534, 536, 537, 545, 548, 549, 550 and 559.

The chronology of appearance of publications shows that interest in the incidental catch is relatively recent **(Fig. 9)**

- **Before 1990 (7 papers):** 17, 45, 225, 245, 280, 412 and 475.

- **1990s (14 papers):** 10, 60, 247, 248, 271, 311, 313, 339, 440, 505, 512, 517, 534 and 537.

- **From 2000 to 2004 (35 papers):** 18, 19, 136, 140, 189, 198, 218, 226, 244, 246, 291, 292, 309, 338, 357, 382, 383, 385, 396, 397, 408, 411, 415, 438, 444, 454, 469, 473, 488, 498, 518, 533, 536, 545 and 559.

-From 2005 to 2010 (40 papers)
8, 14, 42, 58, 193, 223, 224, 229, 255, 258, 266, 277, 278, 279, 288, 290, 307, 308, 365, 366, 370, 386, 387, 404, 407, 409, 422, 448, 451, 452, 453, 479, 481, 483, 486, 496, 501, 548, 549 and 550.

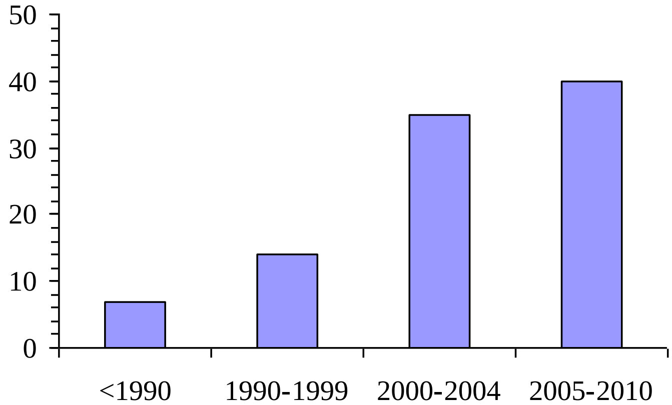

Figure 9: Temporal distribution of the number of published papers dealing with elasmobranch bycatch in the region.

Papers dealing with fishing gears are as follows:

- **Trawls** (50 papers): 8, 10, 18, 19, 42, 58, 136, 140, 189, 218, 223, 258, 271, 277, 279, 292, 307, 308, 311, 313, 338, 339, 356, 366, 370, 382, 357, 385, 386, 387, 396, 397, 415, 444, 454, 469, 473, 481, 483, 486, 488, 496, 498, 505, 512, 518, 534, 537, 545 and 549.
- **Longline** (34 papers): 60, 224, 226, 229, 244, 245, 246, 247, 271, 280, 290, 291, 308, 339, 357, 383, 404, 407, 408, 411, 412, 438, 440, 444, 451, 452, 453, 475, 479, 483, 533, 536,548, 549
- **Drifnets** (6papers) **:** 483, 248, 266, 308, 517 and 550
- **Gillnets and Trammel nets** (3 papers): 483, 422 and 536.
- **Purse seine** (1paper): 288
- **Tuna trap** (4 papers): 45, 271, 309 and 559

The distribution of available papers by areas is as follows:

- **Black Sea** (4 papers): 17, 229, 255 and 444.

- **Western Mediterranean** (51 papers): 8, 9, 18, 19, 42, 45, 60, 136, 140, 189, 225, 226, 247, 248, 266, 277, 278, 279, 288, 290, 291, 308, 309, 311, 313, 383, 386, 387, 396, 397, 411, 412, 415, 422, 438, 440, 451, 473, 475, 479, 483, 498, 505, 512, 517, 518, 533, 545, 549, 550 and 559.

- Central Mediterranean (43 papers): 14, 19, 42, 58, 136, 140, 198, 218, 244, 245, 246, 259, 266, 271, 277, 278, 280, 290, 292, 307, 338, 339, 357, 370, 385, 386, 387, 404, 408, 409, 452, 453, 469, 483, 486, 488, 496, 501, 518, 534, 536, 537 and 549.

- Eastern Mediterranean (15 papers): 223, 224, 365, 366, 382, 404, 407, 408, 409, 448, 454, 481, 483, 548 and 549.

II-5-3-4 Interaction elasmobranches / fishing gears

All cartilaginous fishes are caught accidentally in most fishing gear in the Mediterranean (Cavanagh et Gibson, 2007) **(Fig.10).** It seems that trawlers, longlines and nets pose the major threat.

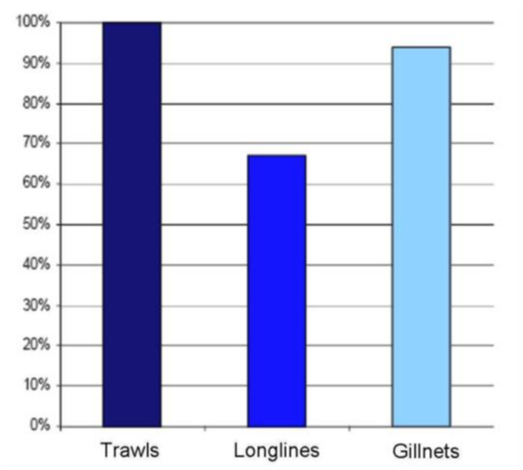

Figure 10: Percentage of elasmobranch species (n=71) within the Mediterranean, for which bycatch in trawls, longlines and nets, pose a major threat (Cavanagh et Gibson, 2007).

- **Trawling bycatch**

Mediterranean trawling uses various techniques suitable for production of benthic, demersal and pelagic species. It is practiced by a little over than 10% of the Mediterranean fleet. Trawlers contribute approximately a little over half of the landed catch, which underlines the importance of this activity.

This technique generates several problems: juvenile catches, important discards and negative impact on the environment (Sacchi, 2007). In the Mediterranean, discards constitute over 40% of the catch (Sanchez et al., 2004).

There is no fishery targeting elasmobranchs, but all species are mainly caught by this fishing gear; 62 species are listed in the trawl fisheries in Greece, 62 in Catalonia and 74 in Italian waters (Bertrand et al., 2000). However, demersal species, particularly *Galeus melastomus*, *Etmopterus spinax*, *Scyliorhinus canicula*, *Mustelus sp* and rajidés, are most caught (Baino et al. 2001; Massutí & Morant, 2003). The proportion depends on the landed value of species and regions.

In Balearic Islands, *S. canicula*, *G. melastomus*, *E. spinax* represent 4.91 to 8.24% by weight of total catches (Carbonell et al., 2003). Discards from these species represent 1 to 6.5%. In Alboran Sea, trawlers targeting the red shrimp *Aristeus antennatus*, catch more *G. melastomus* than the target species (Torres et al., 2001).

Among rays, it is noted that *Raja clavata*, *R. radula* and *R. miraletus* are the species most commonly caught in the Mediterranean trawling (Bertrand et al. 2000; Abella and Serena, 2005)

This technique generates occasional catch of pelagic sharks as *Alopias vulpinus*, *Prionace glauca*, *C. carcharias*, *I oxyrinchus* and rarely the basking shark *Cetorhinus maximus*. In the Mediterranean, 5% of the basking shark catches are reported in trawl fisheries (Mancusi et al., 2005). Furthermore this gear generates capture of juvenile white sharks mainly in the central Mediterranean and especially in the Gulf of Gabes, where respectively 30% and 80% of the white shark and the Bluntnose sixgill shark *Hexanchus griseus* are caught by benthic trawlers (Saidi et al., 2007).
For this fishing gear, very often the information concerns a listing of species without an estimate of catch rates by fishing effort. Recently, preliminary information on this issue was reported in the Aegean Sea (Damalas et al., 2010) and in the gulf of Gabes (Hamdaoui, 2010).

Number of individuals for each of the 3 species caught, percentage of total catch and their occurrence as well as abundance indices (mean CPUE) in the 342 hauls of the bottom trawl experimental surveys in the Aegean Sea (Damalas et al., 2010) were as follows:

Raja montagui	Spotted ray	405	0.08%	21.3%	1.7
Scyliorhinus canicula	Small-spotted catshark	10,909	2.21%	67.0%	46.2
Torpedo marmorata	Spotted torpedo	259	0.05%	21.9%	1.3

The study in the gulf of Gabès shows that Elasmobranchs by catch averaged 5.42% of the total landing (1.7% Sharks and 3.7% Rays). Fishes, cephalopods and crustaceans represent respectively 74.15%, 12.32% and 9.4% of the total landings. The CPUE was estimated at 70.10 Kg/Landing (CPUE=23.25 Kg/Landing for shark and 46.75 for rajiforms). The Cpue (Kg/landings) for the major elasmobranch families caught in the gulf of Gabes by bottom trawlers are shown in **table 2** (Hamdaoui, 2010)

Table 2: Cpue (Kg/landings) for the major elasmobranch families

Families	**cpue**
CARCHARHINIDAE	0.8087
TORPEDINIDAE	1.4407
SCYLIORHINIDAE	2.5908
RHINOBATIDAE	5.1687
SQUALIDAE	5.2494
RAJIDAE	14.0726
TRIAKIDAE	15.0187
MYLIOBATIDAE.	17.7554
DASYATIDAE	19.6659

By catch varied greatly, not only in terms of weight, but also in the number of species. The abundance indices (CPUE) was estimated for the rare species; *Raja alba* (0.1 specimens/landing), *Gymnura altavela* (0.05 specimens/landing), *Heptranchias perlo* (0.05 specimens/landing), *Mustellus asteria* (0.019 specimens/landing), *Carcharodon carcharias* (0.014 specimens/landing).

The West bassin is relatively the most studied zone (Tyrrhenian Sea, Ionian, Aegean and the Balearics). On the south side, apart from the Gulf of Gabes, studies of this kind are practically absent.

The sustained increase in trawl fishing effort appears to have contributed to a decline in biodiversity in the Mediterranean elasmobranch (stock and habitat) (Aldebert, 1997; Peladic-Jukic et al., 2001).

- **Longline fisheries**

Several types of longlines are used in the Mediterranean. Depending on the species targeted demersal or pelagic, there are respectively bottom longline and surface longline. The surface longlines target, according to the hook size and immersion depth, mainly swordfish (*Xiphias gladius*), albacore (*Thunnus alalunga*) and tuna. These lines generate significant bycatch of sharks.

At least 12 species of sharks (*Prionace glauca*, *Isurus oxyrinchus*, *Alopias vulpinus*, *Galeorhinus galeus*, *Lamna nasus*, *Alopias superciliosus*, *Sphyrna zygaena*, *Hexanchus griseus*, *Carcharinus plumbeus*, *Squalus blainvillei*, *Mustelus mustelus*, *Cetorhinus maximus*) are affected by surface longline (Di Natale, 1998; Mejuto et al. 2002; Megalofonou et al., 2005a, b). In addition, bycatch of young white shark (*Carcharodon carcharias*), *Dasyatis violacea* and *Mobula mobular* are also reported in longline fisheries in the Mediterranean (spinning et al. 1986; Garibaldi, 2006; Peristeraki et al., 2007).

Generally, sharks are landed to be sold so that rays are rejected for most at Sea (Di Natale, 1998).

The bottom longlines incidentally bring several demersal species such as *Mustelus sp*, *Squalus sp*., *Torpedo* sp. and some *Rajidae* (Stergiou et al., 2002).

A study of pelagic longline fisheries in several northern Mediterranean areas has shown that sharks represent generally 6.2% by number and 13.5% in biomass in the total catch of these fisheries (Megalofonou et al., 2005b). For the study areas, the catch rate was the highest in Alboran Sea (34.3%) followed by the Adriatic (15.11%). CPUE averaged 0.74 ind/1000 hooks (Megalofonou et al., 2005a, b). CPUE is higher in the Alboran Sea (3.8% ind/1000 hook) and Adriatic (1 ind/1000 hook) than other areas (Megalofonou et al., 2005 b).

The importance of sharks in terms of weight in the catch varies with type of longline, it represents 17.7% and 0.3% respectively in longline fisheries targeting swordfish and albacore (Megalofonou and al., 2005a, b).

Along the coast of Morocco, studies show that shark catches do not exceed 3% of total weight landed by surface longline (Srour and Abid, 2004).

In all areas studied, the blue shark, *P. glauca*, is the species the most represented in the catch of surface longline. It is over 70% of the elasmobranchs catch. It is followed by mako *Isurus oxyrinchus*. It also seems that for all species, individuals captured in the Levantine Basin are larger than those caught in the western basin of the Mediterranean (Megalofonou et al., 2005a, b).
Bottom longline catch especially batoids; in Aegean Sea, the Rajidae (*Raja radula*, *R. clavata* and *R. miraletus*) represent 6 to 19 % of the total catch. These rates vary with the hook size (Stergiou et al., 2002).

It is finally noted that studies of elasmobranch fishery bycatch by hooks are missing on the southern shore of the Mediterranean.

- **Driftnet fisheries**

A drift net is a net held near the sea surface by floats and drifting with the current. It is most often attached only to the fishing vessel. The drift nets in the Mediterranean are used primarily for large pelagic (bluefin tuna, swordfish). Although banned now, few fleets Mediterranean (France, Italy, Morocco, and Turkey) continue to use it. They generate incidental catch of elasmobranchs (EJF, 2007).

Incidental catches of large sharks (*Prionace glauca*, *Carcharhinus carcharias*, *Alopias vulpinus*, *Isurus oxyrinchus*, *Cethorhinus maximus*), the pelagic stingray *Pteroplatytrygon violacea* and the giant devil ray *Mobula mobular* have been cited in various driftnet fisheries (Di Natale et al., 1995; Silvani et al. 1999; Celona, 2004, Tudela et al., 2005).

At the Strait of Gibraltar, the monitoring of Moroccan and Spanish driftnet fisheries reveals that elasmobranchs represent less than 1% of total catches (Silvani et al., 1999).

In Italian waters CPUE was estimated at 0,005 specimen / km for *A. vulpinus*, 0.009 sharks / km for *P. glauca*, 0,001 specimens / km for *C. maximus*, 0.022 individuals / km for *P. violacea* and 0,005 individuals / km for *M. mobular*.

Monitoring of Moroccan driftnet fisheries reveals that in twelve months this fleet catch 20,000-25,000 pelagic sharks (*P. glauca*, *I. oxyrinchus*, *A. vulpinus*) at Alboran Sea and from 62,000 to 92,000 individuals in the straits of Gibraltar (Tudela et al., 2005). In the Ionian Sea, sharks represent 11.3% by mass of drift net catches (Megalofonou et al., 2005). CPUE is 0.04 individuals / km of net.
For the basking shark *C. maximus*, driftnets contribute by about 1% of total catch (Mancusi et al., 2005).

- **Trammel nets and gillnets fisheries**

Trammel nets and gillnets are the nets the most commonly used by small Mediterranean fisheries. These nets are often used at night. The length of set nets depends on the size of the fishing boat.

In the Mediterranean, there is a little use of gillnet targeting sharks. We mention a spring artisanal fishery targeting Hound sharks *Mustelus sp* and Dogfish sharks *Squalus sp* in the north of the Adriatic Sea and one in the Gulf of Gabes targeting *Mustelus sp*, *Carcharhinus plumbeus* and *Rhinobatos sp.* (Bradai et al., 2006). The mesh size varies from one group of species to another. However, these nets bring several other non-target species: species *Scyliorhinus canicula*, *Squalus acanthias*, *S. stellaris*, *Myliobatis aquila*, *Pteromylaeus bovinus Galeus melastomus*, *Centrophorus granulosus Carcharhiuns sp*. *Dasyatis sp* (Costantini et al., 2000, Morey et al., 2006).

Regarding trammel nets, monitoring of fisheries in the Balearic Islands shows the capture of 12 species of elasmobranchs (10 sharks and 2 rays) representing 10% in abundance and 28% in biomass of the total catch. The most common species are *Dasyatis pastinaca*, *Raja radula* and *Torpedo marmorata* representing respectively 48%, 24% and 15% of catches of elasmobranchs (Morey et al., 2006).
In the Aegean, elasmobranchs (mainly Rajidea) represent 6% to 10% by weight of total catches of trammel (Stergiou et al., 2002).
Trammel nets contribute by 30% of the total catch of basking shark in the Mediterranean (Mancusi et al., 2003).

- **Purse seine fisheries**

The purse seine is constituted by a long net made of a series of layers of different mesh sizes with floats on the headline and weights attached to the bottom rope. The codend or "pocket" is located at one end

Although there is little information available in the literature on the bycatch of encircling nets, these nets catch occasionally pelagic sharks and stingrays in fisheries of the bluefin tuna and small pelagic (Hattour et al. , 2000; Farrugio & Fromentin, 2005). In central Mediterranean over 70% of the white shark catches are reported to the purse seine (Fergusson, 1996, Saidi et al., 2005). Other species are also reported in the catch, *Isurus oxyrinchus*, *Cetorhinus maximus* and *Alopias vulpinus*.

- **Tuna trap fisheries**

These fixed fisheries are placed along the coast, on the passage of migratory species, especially bluefin tuna as they approach the shore. These structures were distributed along the Mediterranean coast, mainly from Italy, but today and after the fall of their productions, many have been abandoned. Some, however, currently remain on the main islands of Italy and Tunisia. Incidental catches of sharks are historically reported (Vacchi et al., 2000).

Recent observations show that at least three species of large pelagic sharks are caught in traps. Tey are the white shark *Carcharodon carcharias*, the mako shark *Isurus oxyrhincus* and the thresher shark *Alopias vulpinus*. In the trap of Sidi Daoud, north of Tunisia, the sharks are 0.3 and 2.3% in biomass of total catch (Hatour et al., 2004).

II-5-3-5 Mitigation measures to reduce bycatch

Fishing trawl

The use of Bycatch Reduction Devices (BRD), similar to those used for marine turtles: TED (Turtle EXCLUDING Device) could be effective solutions for the escape of unwanted animals (Ferretti & Myers, 2006).

These exhaust systems placed in front of the codend and involving a rigid grid splitter and an escape preferably oriented toward the bottom have been successfully tested in Australian fisheries. Among these systems, we cite the NAFTED, SUPER SHOOTER TED using for turtles, sharks and rays and the SEYMOUR more suitable for large individuals. These systems are effective in reducing the catch of large animals but also small fish, can therefore represent significant commercial losses

Gillnet

Based on experiences undertaken in North Carolina on the bottom gill nets, it is suggested to increase the tension of nets to reduce catches of sharks. The tension of the net could be increased by increasing the weights and buoyancy by adding more floats. The impact on commercial production should be evaluated

Longlinig

On the basis of experiences gained in several longline fisheries (Gilman et al., 2007), the following recommendations are important:

- Setting longline the day and by depth

In fact the main species of pelagic sharks and stingrays *Dasyatis sp.* are usually taken in surface waters (Williams 1997) and shark activity is generally nocturnal. This recommendation runs counter the conservation of seabirds.

- Avoid attracting sharks and rays

Avoid jettison of waste, viscera and unmarketable fish to not attract night eaters, as are most elasmobranchs.

- Reduce setting time, so that elasmobranchs are attracted in large numbers by the captured preys.

- Avoid certain types of bait may be more attractive than others; several observations made by the professionals have shown that sharks are attracted by more squid than fish. To avoid catching rays and sharks, mackerel or horse mackerel should be used instead of sardines.

Furthermore, the development of artificial bait may contribute favourably to the reduction in catches of sharks and rays (Erickson et al., 2000).

- Reduce the mortality induced by fishing operations

The majority of elasmobranchs caught by longline being alive at the time of retrieval of longlines and should be able to release them immediately if possible. In general, the use of monofilament that sharks can more easily cut is preferable to any other type of synthetic braided fibres or steel (De la Serna et al., 2002)

- repel elasmobranchs baited hooks

Pre-treatment of baits with synthetic substances could keep out carcharhinid without affecting other fish (Tachibana & Gruber, 1988).

- Small magnets in alloy steel, neodymium and boron would be able to keep away small sharks and rays of baited hooks (Gilman, 2007).

Many other management tools and technical procedures could be suggested to reduce bycatch:

- **Size limits:**

Size limits can be legal minimum sizes or legal maximum sizes. They can be an effective management measure where sharks are landed from the fishing gear live and in condition where the survival rate of released animals is high. Hence, they are effective for many species that survive release from hooks, seine nets, and fish traps, but are not effective for many species released after capture by gillnets and trawls where survival rates are low.

- **Reducing effort:**

This limitation reduce the by-catch in the same proportion to the effort reduction and can be obtained by (1) a limited number of licenses to take fish (2) a reducing fishing time (3) restricted capacity of the fleet… These measures are often incompatible with the social objective of providing employment for fishing communities.

- **Regulation of fishing gear:**

Regulation of fishing gear can be used for control of fishing mortality, of impacts on habitats and ecosystems, and of the food quality of fish retained. The regulation is efficient at capturing target species while avoiding small animals to minimize growth overfishing and avoiding large breeding animals to minimize recruitment overfishing of the species.

- **Area and time restrictions**
- **Marine Protected Areas**
- **Fishing area closure**

II-6 Dynamic populations and stock assessment of elasmobranches/ Abundance indices

Population dynamics and demographic of elasmobranch fishes are poorly understood worldwide. The paucity of knowledge is due to the difficulty in studying elasmobranch populations and assessing their sizes and to the lack of basic biological and ecological information for numerous species (mainly age and growth parameters).

In the Mediterranean Sea, there are no standardised studies on elasmobranch population dynamics. However, some assessments, based on abundance indices such as elaborated in the frame of Medits bottom trawl surveys, are avaiabe; various studies give data on species richness, population structure, distributional pattern, mean catch rates, abundance and biomass, mean weight for many species.

References inventoried on this issue are: 8, 19, 255, 278, 279, 292, 313, 338, 370, 397, 444, 469, 473, 476, 478 and 510 **(Appendix I)**. These references concern the north of the Mediterranean.

Among all species, *Galeus melastomus*, *Scyliorhinus canicula*, *Etmopterus spinax*, *Squalus acanthis*, *Raja asterias* and *Raja clavata* are the more studied. Biomasses and abundance indices (Kg/Km^2 or individuals/Km^2) are relatively important for four species: *Etmopterus spinax*, *Scyliorhinus canicula*, *Galeus melastomus* and *Raja clavata*. These species were abundant everywhere in the studied area (European coasts, North Mediterranean (Baino et al., 2001; Baino & Serena, 2005; Bertrand et al., 2000; Rey et al., 2004). Series of data based on Medits programme are too short to identify specific trends in species abundances (Bertrand et al., 2000). This programme should be extended to the entire region.

Indices of abundance expressed in CPUE are developed in the bycatch section of this document.

Landings sturture

There is evidence that the elasmobranches of the Mediterranean are declining in abundance and diversity. Their biological characteristics (low fecundity, late maturity and slow growth rates) make them vulnerable to fishing pressure mainly on juvenile stages. A big proportion of landed specimens are generally juvenile. The following studies illustrate clearly this issue.

The size composition of the most bycaught species varies with gears types. Trawls tend to catch more juvenile specimens than longline. Figure11 shows landings structure of *Mustelus mustelus* in trawling and longline fisheries of the Gulf of Gabès. Trawl catch consists mainly of immature individuals while longline catches more mature ones.

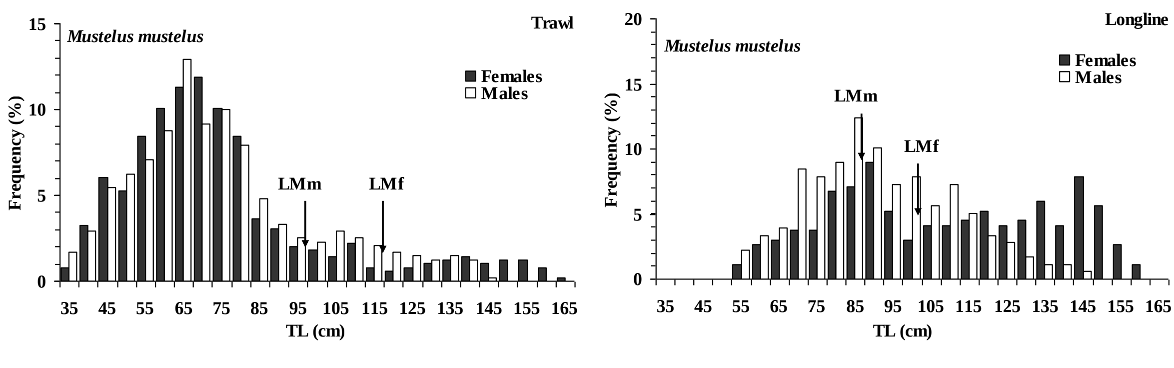

Figure 11: Size distribution in trawl and longline landings of *Mustelus mustelus* in the gulf of Gabès. LMm and LMf: Size at first maturity respectively of males and females (Saidi, 2008).

In Italian waters, trawl captures different stages of demersal species. All immature individuals of *S. canicula* are discarded while some immature individuals of *R. clavata* are landed. Almost, all specimens of *R. asterias* are immature (Fig. 12)

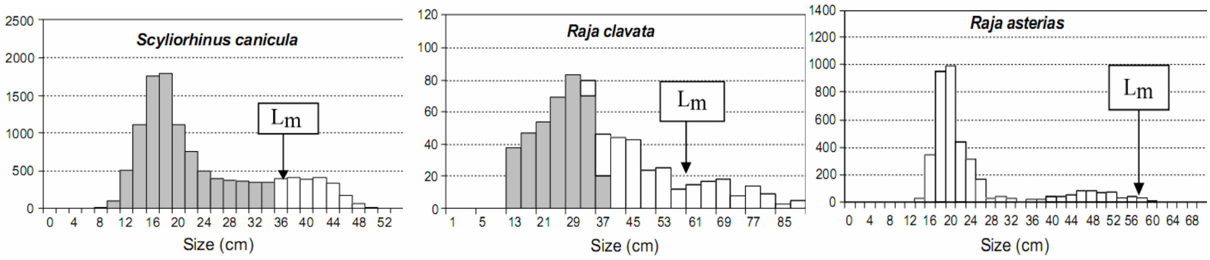

Figure 12: Size distribution in the trawl catches of *S. canicula*, *R. asterias* and *R. clavata* (Abella & Serena, 2005). Dark bars: Discarded fraction; Lm: size at first maturity of females.

In the Gulf of Gabès, gillnet catches of *Glaucostegus cemiculus* consist mainly on adults, whereas juvenile and subadult specimens were more frequent in the trawl fishery (Fig.13).

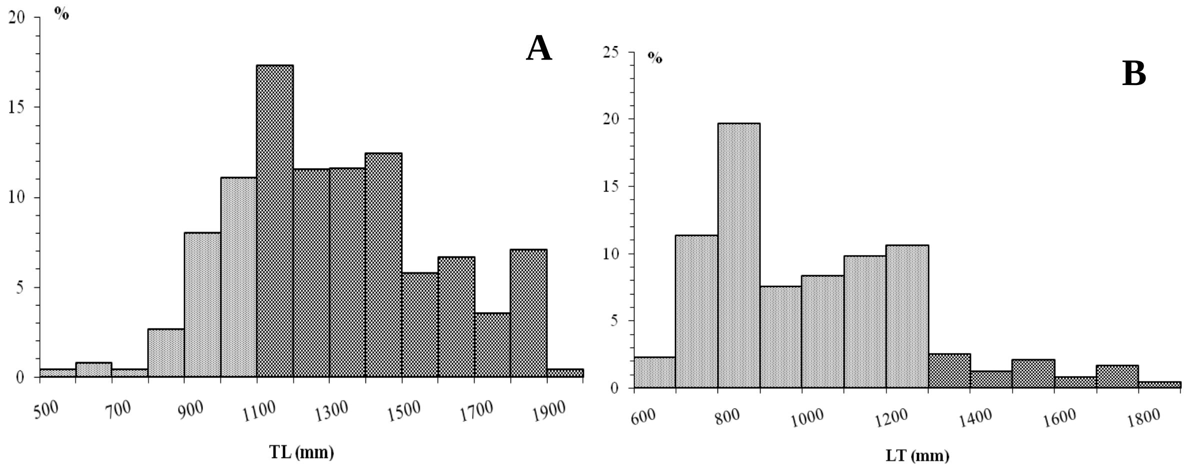

Figure 13: Size distribution in gillnets (A) and trawl (B) landings of *Glaucostegus cemiculus*.

Dark bars indicate the landed mature individuals (Enajjar, pers. comm.).

The length-frequency distribution of large pelagic sharks caught incidentally in the swordfish and tuna fisheries of the Mediterranean Sea show that catch consisted mainly of juveniles (Fig.14).

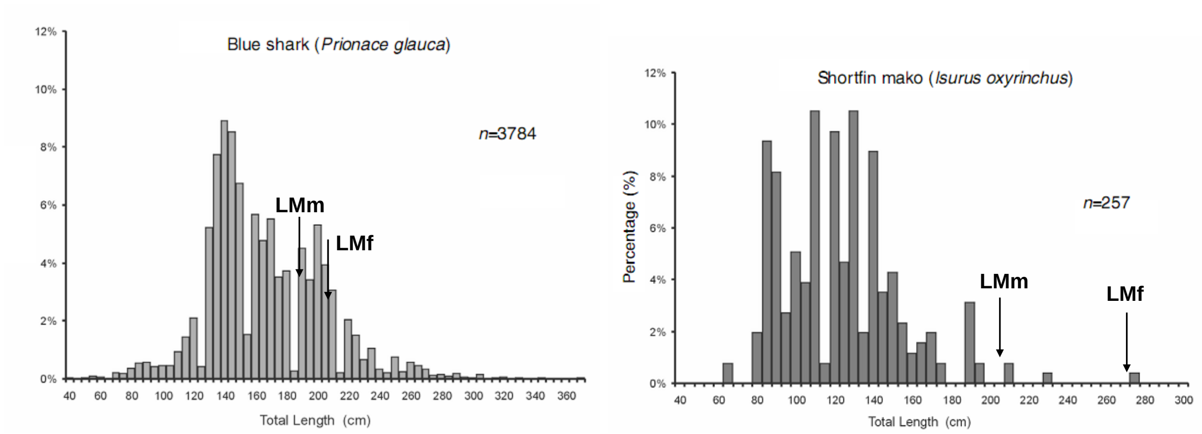

Figure 14: Length-frequency distribution (in percentage by 5-cm size classes) for *Prionace glauca* and *Isurus oxyrinchus* sampled in the Mediterranean swordfish and tuna fisheries during 1998−2000. (Megalofonou et al., 2005)

Size distributions of species show that over 70% of landed specimens are immature (Except for gill net landings).

II-7 Biologic parameters

II-7-1 Reproductive biology

II-7-1- 1 References dealing with the issue

140 references dealing with the biology of the reproduction were inventoried but only 97 papers report detailed data on reproductive parameters, the others give some general information:

3, 4, 6, 12, 15, 20, 21, 24, 49, 63, 64, 65, 66, 67, 76, 77, 78, 79, 84, 85, 86, 90, 91, 92, 93, 95, 97, 98, 99, 100, 101, 103, 107, 110, 111, 117, 118, 123, 124, 125, 127, 133, 134, 137, 138, 139, 142, 143, 147, 148, 149, 150, 152, 153, 154, 155, 156, 157, 160, 161, 163, 165, 167, 169, 170, 171, 172, 173, 174, 175, 178, 180, 182, 183, 184, 186, 187, 188, 191, 194, 195, 204, 208, 213, 218, 227, 230, 232, 240, 241, 258, 259, 261, 263, 275, 302, 305, 312, 314, 322, 325, 326, 329, 350, 352, 367, 367a, 368, 381, 391, 402, 403, 405, 406, 418, 460, 461, 466, 470, 471, 472, 475a, 476, 478, 479, 486, 489, 490, 491, 494, 507, 508, 521, 552, 555, 556, 557, 561, 570 and 576.

About 50% of these papers were published in the latest decade **(Fig. 15)**.

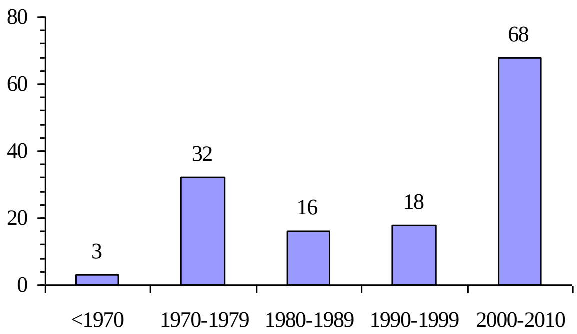

Figure 15: Chronological apparition of papers on the reproductive biology

II-7-1- 2 Distribution of studies as regards the geographic areas

Western Mediterranean (81papers):
21, 24, 49, 63, 64, 65, 66, 67, 76, 77, 78, 79, 84, 85, 86, 90, 91, 92, 93, 95, 97, 98, 99, 100, 101, 103, 107, 111, 118, 124, 125, 127, 133, 134, 137, 138, 139, 142, 143, 147, 148, 149, 150, 152, 153, 154, 155, 156, 157, 160, 161, 163, 165, 167, 169, 170, 171, 172, 173, 174, 175, 178, 187, 188, 191, 194, 275, 305, 312, 322, 381, 418, 460, 461, 466, 475a, 476, 478, 479, 507, 508 and 561.

Central Mediterranean (35 papers):
110, 117, 123, 134, 156, 163, 180, 182, 183, 184, 186, 213, 218, 240, 241, 258, 259, 261, 263, 275, 322, 329, 391, 470, 471, 472, 486, 489, 490, 491, 494, 555, 556, 557and 576.

Eastern Mediterranean (23 papers):
3, 4, 6, 12, 20, 195, 204, 208, 275, 302, 325, 326, 350, 352, 367a, 368, 402, 403, 405, 406, 521, 552 and 570.

Black Sea (5 papers):
15, 227, 230, 232 and 367.

Information on the biology of the reproduction is available for only 43 species, 33 viviparous and10 oviparous. The main reproductive parameters are summarised in **tables 3 and 4**. Studies were carried out mainly in the western Mediterranean and in its central part.

Table 3: Reproductive variables of viviparous elasmobranch species. Litter size corresponds to uterine. PCL: Pre Caudal Length, DW: Disk Width, TL: Total Length.

Scientific name	GSAs	Sex	Size at maturity, (cm TL/DW)	Gestation time (Months)	Reproductive periodicity	Litter size	Size at birth	Reference Number
Heptranchias perlo	12	M F	81-92 85-100	10	annual	6-18		103
Hexanchus griseus	Med	M F	300-354 394	12?	Annual?		55.6-68	24/137/350/352
Mustelus asterias	12	M F	60-75 90-96	12	annual	10-35	28-32?	107
Mustelus mustelus	12/14	M F	96-118 108-123	11-12	annual	4-22	34-42	66/486/490
Mustelus punctulatus	12/14	M F	75-90 87.5-100	11-12	annual	5-30	24.5-30.5 (40-43)	157/491
Galeorhinus galeus	4/12/14	M F	113-126 125-140	12	alternate years	8-41	24-32	125/150
Carcharhinus brevipinna	4/12/14	M F	172 196	13-14?	Annual?	6-10	61-69	139
Carcharhinus limbatus	4/12/14	M F	167 178	12	biannual	6-8	61-65	169
Carcharhinus plumbeus	14	M F	160-166 170-172	12-14	biannual	3-14	50-65	110/494
Prionace glauca	18,19,20,	M	187-203	-	-	-	-	405/406

	21;22, 23,24	F	203-214.7					
Alopias vulpinus	1/3	M F				3-7	117- 155	418
Oxynotus centrina	12/22	M F	60 65	-	annual	10-15	21-24	170/403
Centrophorus granulosus	6/12/23/27	M F	74.5-80 80-85	-	-	1	27.3- 37.2 (PCL)	111/302/ 305/402
Squalus blainvillei	23/14/12 /19/20	M F	40.3-56 52.3-70	-	-	1-6	+19	368/391/460/521
Squalus acanthias	29/23	M F	47-82 51.5-88	22-24	biannual	1-8	28-29	15/204/227 /232/367
Etmopterus spinax	12/10	M F	28-37 34-46	12?	-	5-18	9-11	127/194/ 508/561
Dalatias licha	4/12	M F	74			6	32-39	138
Squatina aculeata	12	M F	120-122 137-143	12	biannual	8-12 (11.1)	30.3-35	133
Squatina oculata	12	M F	71 90	_	_	5-8	_	165
Squatina squatina	12	M F	80 128	_	_	7-18	_	165
Rhinobatos rhinobatos	14/26/24	M F	68-75 69-87	5-12	annual	4-12	22.2-31	6/123/180/ 186/195/258/ 263/326
Glaucostegus cemiculus	14	M F	100-112 110-138	8-12	annual	4-12	35-38	180/183/ 186/258
Dasyatis centroura	12	M F	74-80 66-100	4	?	2-6	-	67/118
Dasyatis pastinaca	26/12/14/24	M F	22-31 DW 24-38 DW	4	2 times/year	3-6	12	12/77/ 259/325/570
Dasyatis tortonesei	12	M F	38 DW 46 DW	4	2-3 times/year	3-8	-	93
Dasyatis marmorata	14	M F	30 DW 32 DW	3-4	2-3 times/year	2-4	11.8	117/182 /184
Pteroplatytrygon violacea	4/12/14	M F	42 DW 45 DW	4-5	1-2 times/year	2-7	-	322
Torpedo nobiliana	12/7	M F	55 90	12	biannual	-	17-22	65/148
Torpedo torpedo	12/14/26/10	M F	18-25 19/26	12	Annual	1-16	8-9.7	3/213/261/466
Torpedo marmorata	26/12/10	M F	25-29 31-39.5	10-12	Three year?	2-19	> 10	3/65/97/213
Pteromylaeus bovinus	12	M F	80 DW 90-100 DW	4-8	annual	2-6	-	156/381
Myliobatis aquila	12/7	M F	50-54 DW 70-73 DW	12	biannual	8-12	21-29 DW	147/175
Gymnura altavela	12	M F	78 DW 68-108 DW	9	annual	2-6	+ 29	67/187

Table 4: Reproductive variables of oviparous elasmobranch species.
DW: Disk Width, TL: Total Length.

Scientific name	GSAs	Sex	Size at maturity, (cm TL)	Fecundity	References
Scyliorhinus canicula	12/7/18	M F	40-44 35-47	38-190	84/167/171/173/489/557
Scyliorhinus stellaris	12	M F	77-79 82	77-109	85/174
Galeus melastomus	12/7/16/1/3/18	M F	36-43 39-46	15-25	149/178/470/476/556
Raja alba	12	M F	91 DW 98 DW	-	79
Raja asterias	12/10/9	M F	51.5-54 56-61	34-112	90/479/507
Raja miraletus	12/26/17/18	M F	28-36.4 30-42.3	10-90	4/153/329/555
Raja melitensis	12/	M F	40 40	10-56	91
Raja radula	12	M F	48 52	-	63
Raja clavata	12/7/29/17	M F	36-48 DW 48-56 DW	108-262	78/143/230/329
Raja polystigma	12	M F	53 63	20-62	86/160

II-8-2 Age and growth

II-8-2-1 References dealing with age and growth

20 references (2, 15, 29, 46, 61, 62, 228, 231, 233, 258, 293, 304, 325, 326, 395, 405, 406, 507, 520, and 570)

II-8-2-2 Species studied

Only 11 species (about 12 % of the Mediterranean elasmobranches fauna) were the subject of such studies. They are: *Dasyatis pastinaca*, *Etmopterus spinax*, *Prionace glauca*, *Rhinobatos rhinobatos*, *Glaucostegus cemiculus*, *Squalus acanthias*, *Squalus blainvillei*, *Raja asterias*, *Raja miraletus*, *Raja clavata* and *Centrophorus granulosus*.

II-8-2-3 Studied areas

Western Mediterranean: 3 papers concerning: *Centrophorus granulosus, Etmopterus spinax* and *Raja asterias*

Central Mediterranean: 5 papers concerning: *Etmopterus spinax, Squalus blainvillei, Glaucostegus cemiculus, Prionace glauca* and *Raja clavata*

Eastern Mediterranean: 4 papers concerning: *Raja miraletus*, *Prionace glauca, Dasyatis pastinaca* and *Rhinobatos rhinobatos*

Black Sea: 2 papers concerning: *Squalus acanthias*

Samples of *Prionace glauca* come from Aegean Sea, the Ionian Sea, the Adriatic Sea and the Levantine basin.

Age and growth data presented in this Section include parameters for the von Bertalanffy growth model (VBGM) (von Bertalanffy 1938) which provides estimates of L∞, the asymptotic or maximum length (or width for some batoids), k, the growth coefficient, and t0, the age or time when length theoretically equals zero **(tabl. 5)**.

Table 5: Von Bertalanffy growth model (VBGM) parameters: L_∞ (mm TL), k (year^{-1}), t_0 (years); t_{max} oldest fish (years), A_{mat} age at maturity (years). Band count method: Vert, vertebral band count; Ext DS, external dorsal spine band count; Int DS, internal dorsal spine band count. GSAs: the number refers to GFCM geographical sub-areas.

Species	GSAs	Methods	Sex	VBGM parameters			t_{max}	A_{mat}	Reference
				$L_{\infty\ (mm)}$	K	t_0			
Centrophorus granulosus	6	Int. DS	M	917	0.107	-9.78	25	8.5	Guallart (1998)
			F	1094	0.096	-5.48	39	16.5	
Etmopterus spinax	10	Vert.	M	394.3	0.19	-1.41	8		Gennari E & Scacco U. (2007)
			F	450	0.16	-1.09	10		
	19/20	Vert.	M+F				7	5	Sion et al. (2002)
Squalus blainvillei	16	Vert.	M	960	0.135	-1.397	8	3.3	Cannizzaro et al. (1995)
			F	1179	0.102	-1.380	8	5.1	
	14	Int. DS	M	91.1	0.14	-1.42	15	4.79	Marouani et al. 2010
			F	105.7	0.11	-1.12	19	7.44	
Squalus acanthias	29	Ext DS	M	1245	0.171	-2.62	27		Demirhan & Seyhan (2007)
			F	1405	0.141	-2.69	38		
	29	Int. DS	M	1280	0.20	-0.3	13		Avsar (2001)
			F	1450	0.17	-0.7	14		
Prionace glauca	18,19, 20, 21;22, 23,24	Vert.	M	402	0.13	-0.62	12	4.9	Megalofonou et al. (2005, 2009)
			F					5.5	
Dasyatis pastinaca	24	Vert.	M	203.13	0.039	-2.00	8		Yeldan et al. (2008)
			F	219.85	0.041	-2.61	12		
			M+F	294.94	0.029	-2.20			
			M+F	121.5	0.089	-1.615	10		Ismen. (2003)
Rhinobatos rhinobatos	24	Vert.	M	121.65	0.310	-0.131	15		Başusta et al. (2008)
			F	154.88	0.134	-1.264	24		

Glaucostegus cemiculus	14	Vert.	M	181.6	0.272	-0.71	10	2.89	Enajjar. (2009)
			F	200	0.202	-0.81	14	5.09	
Raja asterias	9/10	Vert.	M+F	67.45	0.454	-0.23			Serena et al. (2005)/ Bono et al. (2005)
Raja miraletus	26	Vert	M	87.87	0.19	-0.50	15		Abdel-Aziz (1992)
			F	91.92	0.17	-0.25	17.2		
Raja clavata	16	Vert	M	116.7	0.106	-0.412	5.9-6.2	11	Cannizzaro et al. (1995)
			F	126.5	0.098	-0.512	9-9.4	13	

All ageing estimates are invalidated and many are preliminary.

Only one species, *Squalus acanthias* was studied in the Black Sea and not in the Mediterranean and only one species is listed on annex 3 of SPA/BD protocol of Barcelona convention. Ten GSAs, among thirty, are concerned by such studies, species concerned are generally different from a GSA to another.

The organization of a training course on age reading and growth parameters of the main elasmobranches species seems to be very urgent to enhance research on this field. Growth parameters are necessary for stock assessment studies.

II-9-3 Food and feeding habits

Studies of feeding habits are essential to the understanding of the functional role of fish within the ecosystem. Knowing what a species eats can provide information about possible distribution and its position in food webs.

Sharks are considered top predators and may have an important role in the regulation of marine ecosystems at lower trophic levels. Information about the food habits is essential to appreciate the species biology and ecology, since the quality and quantity of food directly affect species growth and their maturation and mortality. In addition, quantitatively describing the diet and foraging habitat and predator-prey interactions of top predators in a community is a key step in ecosystem approaches to fisheries management.

II-9-3 -1 References dealing with the issue

In the Mediterranean and Black Sea, 88 identified published works report information on diet of 35 species : 1, 3, 5, 15, 16, 25, 30, 34, 35, 68, 70, 71, 72, 73, 74, 75, 80, 87, 88, 89, 94, 96, 103, 111, 112, 113, 114, 120, 121, 129, 158, 159, 176, 179, 181, 190, 191, 199, 218, 220, 230, 233, 234, 258, 262, 264, 267, 268, 274, 284, 287, 291, 302, 325, 326, 328, 334, 335, 336, 337, 343, 346, 347, 350, 361, 362, 363, 384, 393, 399, 402, 424, 425, 439, 441, 442, 443, 479, 484, 485, 487, 491, 492, 497, 507, 535, 568 and 570.

More than 55% of papers appeared last decade **(Fig. 16)**.

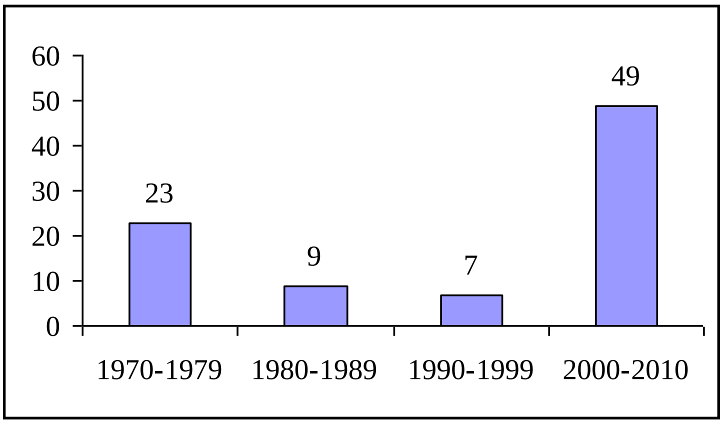

Figure 16: Chronological apparition of papers on diet.

Papers cover all Mediterranean and Black Sea but primarily in the occidental and central areas.

II-9-3 -2 studied areas

Western Mediterranean: 43 papers: 16, 25, 35, 68, 70, 71, 72, 73, 74, 75, 80, 87, 88, 89, 94, 96, 103, 111, 112, 113, 114, 120, 121, 129, 158, 159, 176, 190, 191, 220, 268, 287, 291, 384, 399, 424, 425, 439, 441, 442, 443, 479 and 507.

Central Mediterranean: 23 papers: 34, 179, 181, 199, 218, 258, 262, 274, 328, 334, 335, 336, 337, 361, 362, 363, 393, 487, 491, 492, 497, 535 and 570.

Eastern Mediterranean: 16 papers: 1, 3, 5, 30, 264, 267, 284, 302, 325, 326, 343, 346, 347, 350, 402 and 568.

Black Sea: 7 papers: 15, 230, 233, 234, 264, 484 and 485.

Most species appear to be opportunistic feeding predators, foraging on broad range of prey species **(Tabl. 6)**. However, crustaceans and teleost fishes are the main preys of elasmobranchs. Cephalopods are major prey for *Squalus blainvillei*, *Galeus melastomus*, *Centroscymnus coelolepis*, *Prionace glauca*, *Dasyatis marmorata*, *Pteromylaeus bovines*, *Myliobatis aquila*. Polycheates, sipunculids and echinoderms were of minor importance food; in contrast, *O. centrina* is the only shark species ingesting polycheates. Chondrchtyans are reported to be preys also for various species.
The Giant devilray *Mobula mobular* and the basking shark *Cetorhinus maximus* are mainly planktivorous. It appears that increased basking sharks occurrence is not directly influenced by changes in temperature and salinity. However, obtained data suggest relative importance of copepods, especially of *Calanus helgolandicus*, in relation to the occurrence of basking sharks. (Soldo et al., 2008)
The White shark *Carcharodon carcharias* ingests principally cartilaginous fishes (*Isurus sp*., *Myliobatis aquila*, *Dasyatis sp*.) and bony fishes (*Scomber scombrus*, *Thynnus thunnis*, *Sarda sarda*) and other preys such as marine turtles (*Chelonia mydas*) and cetaceans (*Delphinus sp*.) (Postel, 1958; Capapé, 1975, Bradai, 2000)

Table 6: Diet composition of elasmobranch species from the Mediterranean Sea (xxx: main preys, xx: secondary items, x: accessory item, -: accidental items), Fish: teleost fishes, Mol: molluscs, Cr: crustaceans, other: other invertebrates (echinoderms, sipunculids…).

Species	***GSAs***	***Frequency of Prey***						***Reference number***
		Chon	Fish	Cr	Mol	An	others	
Heptranchias perlo	12	x	xxx	xx	x			103
Hexanchus griseus	22	x	xxx				-	350
Squalus acanthias	29	x	xxx	xx				15/233/234/
Squalus blainvillei	14/22		xxx	xxx	x	-		72/328/347/393
Centrophorus granulosus	12/23/27		xxx	xx				111/302/402
Etmopterus spinax	1/6/10/17/18		xxx	x	x			34/35/268/384/442
Galeus melastomus	1/6/9/10/12	-	x	xxx	x	-	-	35/176/190/268/384/441
Datalis licha	6	xx	xxx	xx	xx			384/399
Centroscymnus coelolepis	6		x	x	xxx		-	190
Oxynotus centrina	7		x	x		xxx	x	120
Carcharhinus plumbeus	14	x	xxx	x	xx	-		492
Mustelus mustelus	6/14/17		xx	xxx	x	-	-	218/334/335/424/497
Mustelus punctulatus	12/14/17		xx	xxx	x	-	-	158/334/336/491
Scyliorhinus canicula	6/11/12/22		xx	xxx	x	-	-	68/284/425/487
Scyliorhinus stellaris	12		xx	xxx	x	-	-	70
Prionace glauca	9	x	x	x	xxx		x	291
Carcharodon carcharias		x	xxx		x		x	274
Rhinobatos rhinobatos	14/24		xxx	xxx	x	-	-	5/30/179/258/262/326
Glaucostegus cemiculus	14		xxx	xxx	x	-	-	258
Dasyatis pastinaca	12/24/29		xx	xxx	x	x		73/325/484/570
Dasyatis tortonesei	12	-	xxx	x	x			94

Dasyatis marmorata	14		x	x	xxx	x	-	181
Pteroplatytrygon violacea	9			xxx				439
Torpedo torpedo	26		xxx	x	-	-	-	3
Torpedo marmorata	7/26		xxx	-	x	-	-	3/129
Pteromylaeus bovinus	14		xxx	x	xxx	-	-	87/113
Myliobatis aquila	12/17		-	-	xxx	-	x	80/113/337
Raja alba	12	x	xxx	x	x			89
Raja asterias	9/10/12		xx	xxx	x	-	-	159/220/479/507
Raja brachyura	11		xxx	xx	x	-		191/287
Raja miraletus	11/12/26		x	xxx	x	-	-	1/121/267/287
Raja melitensis	12			xxx				75
Raja radula	12/26		x	xxx	x	-	-	1/121
Raja clavata	11/12/14/26/29		xx	xxx	x	-	-	1/74/230/264/362/425/485/568
Raja polystigma	12		xx	xxx	x	x	x	96

Although the important number of papers dealing with feeding habits of Mediterranean elasmobranch species, our understanding on the issue remains rudimentary. In fact, most of papers simply describe stomach contents of a particular species in a particular zone and using few samples.

Among papers on dietary composition only 15, concerning 12 species, determine dietary indexes F%, N%, M%, IRI% and study dietary changes in relation to size and/or seasons and sex **(tabl. 7)**.

Table 7: studies calculating dietary indexes F%, N%, M%, IRI% and studying dietary changes in relation to size and/or seasons and sex

Species	GSAs	References
Etmopterus spinax	10/1,6	35/ 268
Galeus melastomus	10/1,6	35/190/268
Centroscymnus coelolepis	6	190
Carcharhinus plumbeus	14	492
Mustelus mustelus	17/6/14	335/424/ 497
Mustelus punctulatus	17/14	336/491
Rhinobatos rhinobatos	26/14	5/258
Glaucostegus cemiculus	14	258
Dasyatis pastinaca	29	484
Raja brachyura	11	191/287
Raja miraletus	11	287
Raja clavata	29	485

There are relatively few investigations comparing diets of sympatric species of elasmobranchs (1 study). In several studies, standard ecological indices of similarity were used to calculate dietary overlap among elasmobranch species, among elasmobranchs and teleosts caught in the same location, or among different size classes of a single species. Such comparisons represent initial attempts to characterize food partitioning and competition among elasmobranchs and co-occurring teleosts. Ecological indices of dietary breadth or diversity have also been calculated for several species of elasmobranchs to examine the degree of feeding specialization.

Rate of consumption, feeding patterns, and the fate of food once ingested have been examined for very few species of elasmobranchs.

II-10 Data on the three common elasmobranches species in the Black Sea

Regarding the lack of information on elasmobranches in the Black Sea and the few species occurred in this region, we summaries knowledge on the three main species; *Raja clavata, Dasyatis pastinaca* and *Squalus acanthias* in some Black Sea countries following the proceedings of the work shop on demersal resources in the Black Sea and Azov Sea edited by Ozturk and Karakulak (2003). Many papers in Russian were not analyzed in this document.

Bulgaria

The thornback ray *Raja clavata* and the common stingray *Dasyatis pastinaca* have no commercial importance due its low market demands in the Bulgarian Black Sea. The mean landings of the thornback ray during the period 1925-2002 was 1,2 tons. The spiny dogfish *Squalus acanthias* is more common, landing for the same period ranged between 0 to 153 tons, 100,0 in 2002 and a mean of 15,3 year.

Ukraine

<u>Picked dogfish</u>.

It inhabits the whole Black Sea shelf at the water temperatures 6-15° C. It undertakes regular migrations in the waters of Ukraine. In autumn feeding migrations are aimed at the grounds of the formation of the wintering concentrations of anchovy and horse mackerel in the vicinity of the Crimean coasts. Reproductive migrations of viviparous picked dogfish take place towards the coastal shallow water with two peaks of intensity in spring and autumn. The autumn migration for reproduction covers more individuals usually.

Most of picked dogfish is harvested in spring and autumn months by target fishing with nets of the mesh size100 mm and with long-lines and during sprat trawl fisheries as by-catch.

To assess the picked dogfish stock, the area coverage technique incorporating the data of trawl surveys, as well as dynamic model of an isolated population, being a combination of Baranov's analytical model and the reproduction model (SHLYAKHOV, 1997; KIRNOSOV A and SHLYAKHOV, 1988) were applied. The results of the picked dogfish stock assessments are given in **table 8**. Picked dogfish in the waters of Ukraine tend to be reduced slowly, although its population is harvested slightly. This is connected with progressive deterioration of reproductive ability of the females, which we have observed since the early 1990s. If in 1970-80s the mean number of yolk ovocytes for one female made up 22, and embryos 14, so by the late 1990s these figures made up, respectively, 19.5 and 12.4. As a result, the abundance of recruits reduces year by year.

Table 8: Commercial stock of picked dogfish in the Black Sea and along the coast of the former USSR and in the water of Ukraine in 1992 -2002 (thousand tons).

years	**Waters of Ukraine, the Russian Federation and Georgia**		**Waters of Ukraine**	
	Trawl survey	**Modeling**	**Trawl survey**	**Modeling**
1992	62.9	60.3	56.9	-
1993	-	57.1	30.2	-
1994	-	52.9	36.0	42.1
1995	-		-	37.6
1996	-		-	32.1
1997	-		-	31.0
1998	-		32.0	30.8
1999	-		-	28.0
2000	-		-	24.3
2001	-		-	22.3
2002	-		-	21.0

Monitoring of non-reported catches of picked dogfish in the waters of Ukraine in 1992-2003 was not carried out, but, according to the data available, their major amount fell on by-catch in sprat trawl fishing; in 1998 its value in the waters of Ukraine was estimated as 0.8 thousand tons, while the official landing of picked dogfish in by-catch made up about 0.2 thousand tons, and total annual catch 1.7 thousand tons. As in the case of turbot, a part of the picked dogfish as by-catch in trawls is released to the sea, not losing viability at this time.

To regulate picked dogfish fishing in the Black Sea the following norms were established:

-minimum commercial fishing size -85 cm (SL);

-allowable by-catch of its juveniles in target fisheries not more than 15% in numbers.

Thornback ray and common stingray. Over the shelf of Ukraine two representatives of Rajiformes *family* thornback ray and stingray occur. Thornback ray does not undertake distant migrations. Its local migrations are spring approaches to the coast in depth 10 -40 m and autumn escapes to the open sea in depth more than 40 m. In summer, in the period of reproduction, and in the early autumn thornback ray is forming commercial concentrations mainly in the coastal waters of Crimea. In the rest periods of a year it distributes by segregations over a large area of the shelf zone.

Stingray is a warm-Ioving fish; therefore distant wintering migrations are typical in autumn, in the waters of Ukraine towards the southern coast of Crimea. With water warming in spring, common stingray comes back to the coastal shallow water for reproduction and feeding. It belongs to viviparous fish; fingerlings are born at temperature more than 15°C. It distributes with maximum density in Kalamitsky and Karkinitsky Bays in depth of 5 -30 m.
Grounds and fishing gears for target fishing of *Rajiformes* are the same as for picked dogfish. By-catch of *Rajiformes* in trawls is inconsiderable and usually it releases to sea completely as these fishes are of little demand at the domestic market. Till the early 1990s totally the whole yield of *Rajiformes* were processed into the minced meat for feeding of poultry and other domestic animals. After 1992 sales of minced flesh as feeds for animals slumped and fishermen lost their interest for harvesting of *Rajiformes*. For recent years in Ukraine there has been observed people's demand for *Rajiformes* as human food. In this connection their fishing becomes to revive.
Till 1993, when the intensity of *Rajiformes* fisheries was high in the waters of Ukraine and catches of thornback ray varied within the range 0.3-0.6 thousand tons, the stock of this species was assessed by VPA method applying the software ANACO produced by FAO (SHLYAKHOV, 1997; SHLYAKHOV and LUSHNIKOV A, 1995). For the subsequent years the intensity of the coastal fisheries became so low that application of this method was incorrect. For some years the stock of thornback ray was assessed by the trawl surveys data, however, due to the under-recording of fishes in small depths these assessments were underestimated **(Table 9)**.

Table 9: Commercial stock (thousand tons) of thornback ray in the Ukrainian Black Sea in 1992 1998.

Years	**stock**	
	VPA	**Trawl Survey**
1992	**2.6**	**1.1**
1993	**-**	**-**
1994	**-**	**0.9**
1995	**-**	**-**
1996	**-**	**-**
1997	**-**	**-**
1998	**-**	**1.0**

Russia
Some data on the biology of dogfish and stingrays are given. All these fish have secondary commercial importance because their annual catches are not big.

The *dogfish squalus acanthias* Linnaeus, 1758 is a small shark (it is up to 2 m long, weight is up to 18 kg), inhabits the whole water column but prefers lower layers. Its main food items are anchovy, kilka and other small fish, especially those which form accumulations. Its annual catch have decreased during last decades, but they do not reflect the state of the stock. The scientific trawl surveys undertaken every year show that the biomass of the dogfish in the north-eastern part of the Black Sea is near 20 th.t and the total admissible catch (TAC) can be estimated as 700 tons.

Rays. There are two species (the thornback ray *Raja clavata* Linnaeus. 1758 and the stingray *Dasyatis pactinaka* Linnaeus, 1758) in the Russian part of the Black Sea. They occupy different ecological niches. Their stocks are about 800 t. Rays are usually caught together with dogfish and flounders. TAC for ray cannot be more than 100 t.

Georgia

Squalidae

Squalus acamthias Linnae-Found in the Black Sea coastal zone of Georgia, in 1090m depth in small groups length about 120-140cm. Its favourable temperature is 6-18°C. Females acquire reproductive abilities at the age of 17, and males at the age of 13-14. The copulation period is spring. The period of pregnancy is 18-22 months. It lays eggs in October November and December in 10-35m depth, mostly 20-30cm long. It feeds on fish and bottom invertebrates.

Rajidae

Raja calvata found in the Black Sea coastal zone of Georgia in small quantities in 10-90m depth. Length up to 90cm. Avoids the temperature higher than 18-19°C. After copulating in March-April on the bottom of 10-40m depth, it lays eggs in instal1ments several tens of eggs. The development of the laid eggs takes 5 months. The length of the appeared fish is about 12-13cm, its width 8 cm. It feeds on fish and bottom invertebrates. It is captured in small amounts.

Dasyatidae

Dasyatis pastinaca found in the Black Sea coastal zone of Georgia in medium quantities, in silty and sandy ground, in 10-80m depth. Length 100 cm. It avoids the temperature lower than 11-12°C. It feeds on fish and bottom invertebrates. Here it is caught in medium amounts.

Romania

Capture evolution of *Squalus acanthias* in Romania costs is shown in **table 10**.

Table 10: Capture evolution of *Squalus acanthias* during 1970 -2002.

	YEARS			**TOTAL**
	1970-1980	1981-1990	1991-2002	
Squalus acanthias	277	532	98	907

III- Conservation measures

Protection currently granted to chondrichthyan fish species in the Mediterranean Sea under various regional and international conventions

III-1 Global instruments

III-1-1 The Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention, 1979)

Three threatened shark species are currently included in the Appendices of the Convention on

Migratory Species (CMS), in recognition of their unfavourable conservation status and need for concerted international conservation measures. Whale shark *Rhincodon typus* was listed on Appendix II in 1999, white shark *Carcharodon carcharias* on Appendices I and II in 2002, and basking shark *Cetorhinus maximus* on Appendices I and II in 2005. Several other highly migratory shark species require concerted international conservation measures may in future be nominated for inclusion in the CMS Appendices.

III-1-2 The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES was established in recognition that international cooperation is essential for the protection of certain species of wild fauna and flora from over-exploitation through international trade. It came into force in 1975, creating the international legal framework for the prevention of trade in endangered species of wild fauna and flora and for the effective regulation of international trade in other species which may become threatened in the absence of such regulation. Three shark species are listed on Appendix II of CITES: basking shark *Cetorhinus maximus*, whale shark *Rhincodon typus*, and white shark *Carcharodon carcharias*, and CITES maintains an active involvement in shark conservation issues under the Resolution on the Conservation and Management of Sharks.

III-1-3 United Nations Convention on the Law of the Sea (UNCLOS)

UNCLOS was adopted in 1982 and came into force in 1994. It provides a framework for the conservation and management of fisheries and other uses of the seas by giving coastal States rights and responsibilities for the management and use of fishery resources within their national jurisdictions (the territorial sea, which can extend up to 12 nautical miles) and enabling the establishment of EEZ.

For stocks that occur within the exclusive economic zones of two or more coastal States, or both within the exclusive economic zone and in an area beyond and adjacent to it, UNCLOS calls upon the coastal States and States fishing in the high seas to seek agreement upon the measures necessary for the conservation and development of those stocks in the adjacent high seas area. Such stocks are likely to include the highly migratory species listed in UNCLOS Annex 1 (*Hexanchus griseus*; *Cetorhinus maximus*; Family *Alopiidae*; *Rhincodon typus*; Family *Carcharhinidae*; Family *Sphyrnidae*; Family *Isuridae*) and other species that fall within the CMS definition of migratory. UNCLOS also calls upon the coastal States and other States fishing highly migratory species to cooperate in ensuring conservation and promoting the optimum utilization of those resources in their whole area of distribution.

III-1-4 United Nations Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA)

UNFSA was established to implement the provisions of UNCLOS pertaining to the conservation and management of straddling and highly migratory fish stocks.

UNFSA, adopted in 1995, ratified in 2001, calls for Parties to protect marine biodiversity minimise pollution, monitor fishing levels and stocks, provide accurate reporting of and minimise by-catch and discards, and gather reliable, comprehensive scientific data as the basis for management decisions. It mandates a precautionary, risk-averse approach to the management of straddling and highly migratory stocks and species in cases where scientific uncertainty exists.

III-1-5 FAO International Plan of Action for the Conservation and Management of Sharks (IPOA–harks)

By 2000, FAO had developed the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) to form part of the Code of Conduct for Responsible Fisheries. The IPOA-Sharks emphasizes that the harvest of chondrichthyan fishes should be biologically sustainable, economically rational, utilizing all body parts of the sharks killed, and managed to ensure biodiversity conservation and maintenance of ecosystem structure and function. Under this action plan, signatory nations are obliged to develop and implement a National Plan of Action for the Conservation and Management of Sharks

III-2 Regional protection instruments

III-2-1 The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982)

The Convention aims to ensure conservation of wild flora and fauna species and their habitats. Special attention is given to endangered and vulnerable species, including endangered and vulnerable migratory species specified in appendices.

The Bern Convention covers most of the natural heritage of the European continent and extends to some States of Africa.

The basking shark *Cetorhinus maximus* and the white shark *Carcharodon carcharias* were listed on Appendix II as s**trictly protected species.**

The following Mediterranean species were listed in Appendices III among protected fauna species:

PLEUROTREMATA

Lamnidae: *Isurus oxyrinchus /Lamna nasus*
Carcharhinidae: *Prionace glauca*
Squatinidae: *Squatina squatina*

HYPOTREMATA

Rajidae: *Raja alba*

III-2-2 Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention, 1976)/ Protocol on Specially Protected Areas and Biological Diversity (SPA &BD, 1995).

This Protocol which has come into force in December 1999 lists the Basking Shark and the Great White Shark along with the Devil Ray as Endangered or Threatened species (Appendix II). Parties signing the protocol must ensure "the maximum protection possible and the recovery of these species". This Protocol recommends that exploitation of five other species is regulated (Appendix III): *Isurus oxyrinchus*, *Lamna nasus*, *Prionace glauca*, *Squatina squatina* et *Raja alba*.

III-2-3 Action Plan for the Conservation of Cartilaginous Fishes (Chondrichthyans) in the Mediterranean Sea

A specific Plan of Action has been developed by the UNEP for the Conservation of Cartilaginous Fish in the Mediterranean. This plan was drawn up in collaboration with the IUCN Centre for Mediterranean Cooperation and the Shark Specialist Group, and adopted by the contracting parties to the Barcelona Convention in November 2003. This is a very significant step, since it is the first regional Plan of Action on sharks drawn up by the United Nations Environment Programme (UNEP).

The objectives, as written in this Action plan, are:

- The general conservation of the chondrichthyan populations of the Mediterranean, by supporting and promoting national and regional programmes for sustainable fisheries of commercial stocks either as they are target and accessory species;
- The protection of selected chondrichtyan species, whose populations are considered endangered;
- The protection and the restoration of critical habitats, such as mating, spawning and nursery grounds;
- The improvement of scientific knowledge by research and scientific monitoring, including the creating of regional standardised databases;
- The recovery of depleted chondrichthyan stocks;
- Public awareness and capacity-building about conservation of chodrichthyans.

The **table 11** summarises species listed in appendixes of main conventions.

Table 11: Mediterranean Elasmobranches currently included in the appendixes of International Conventions

Species	Bern convention	Bonn convention	Barcelona convention	CITES
Carcharodon carcharias	Appendix II	Appendix I Appendix II	Appendix II	Appendix II
Cetorhinus maximus	Appendix II	Appendix I Appendix II	Appendix II	Appendix II
Mobula mobular	Appendix II		Appendix II	
Isurus oxyrinchus	Appendix III		Appendix III	
Lamna nasus	Appendix III		Appendix III	
Prionace glauca	Appendix III		Appendix III	
Squatina squatina	Appendix III		Appendix III	
Raja alba	Appendix III		Appendix III	

III-2-4 EU Action Plan for the Conservation and Management of Sharks

In February 2009 the European Commission adopted the first ever EU Action Plan for the Conservation and Management of Sharks. The aim of the plan is to ensure that effective steps are taken to help rebuild shark stocks wherever they are under threat, if necessary on a precautionary basis, and to set down guidelines for the sustainable management of the fisheries concerned, including those where shark are taken as by-catch. The plan also includes measures to improve scientific knowledge of shark stocks and shark fisheries.

III-3 Other initiatives for conservation

III-3-1 The IUCN Red List of Threatened Species

The IUCN Red List of Threatened Species is a widely-recognised system for classifying species at risk of global extinction. It has no legal standing, but is frequently used by governments and environmental institutions to set priorities and conservation actions.

III-3-2 The IUCN Shark Specialist Group

This group was established by IUCN, as part of its Species Survival Commission in 1991. The SSG was formed to assess and address the conservation needs of sharks. The SSG is currently part way through a programme to complete global assessments for all chondrichthyan species

III-3-3 The Mediterranean Large ElasmobranchsMonitoring (MEDLEM)

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.
17 great cartilaginous fishes are actually concerned by the programme. The definition of "great cartilaginous fishes" is referred to sharks with total length bigger than 100 cm or batoid fishes (rays and skates) with disc width bigger than 150 cm.

18 Mediterranean research centers and organizations cooperate on this subject and conform in the collection of data. The IUCN (International Union for Conservation of Nature and Natural Resources–) and EEA (European Elasmobranch Association) endorsed the project. **11** different countries involved, so far **21** species recorded and **1300** records in the database **24** passwords for the access to the database

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.

III-4 National Species protection status

Legislation on species protection is generally elaborated implementing CITES Convention and/or Bern convention and SPA –Biodiversity protocol of Barcelona Convention (Greece, Italy, Malta, Croatia, Montenegro and Monaco). In this way *Cetorhinus maximus*,*Carchadon carcharias* and *Mobula mobular* benefit of a strict protection. Strict protection is also applied for *Carcharhinus plumbeus* in Turkey. Some species of national interest may be subject to management measures (Malta, Tunisia). In Israel all Cartilaginous Fishes are protected. Some information's are gathered as follows:

Croatia: Strict protection for *Cetorhinus maximus*,*Carchadon carcharias* and *Mobula mobular* (OG n°7/2006, issued by Nature Protection Directorate,Ministry of Culture).

European community: Catch, retention on board, transhipment and landing prohibited since 2007 for *Cetorhinus maximus* and *Carchadon carcharias*.

Greece: Protected species are the ones that are mentioned in CITES Convention Bern convention and SPA –Biodiversity protocol of Barcelona Convention

Israel: All Cartilaginous Fishes (2005 declaration within the legislative framework of National Parks, Nature Reserves and National Monuments 1998 (Ministry of Environmental Protection)).

Italy: Applies to species listed for strict protection under Barcelona Protocol, Bern Convention and in CITES Appendices.

Malta: Strict protection for *Carcharodon carcharias, Cetorhinus maximus* and *Mobula mobular*.

14 species of national interest whose taking in the wild and exploitation may be subject to management measures (Sch.VIII): *Alopias vulpinus, Carcharhinus, brevipinna, Carcharhinus limbatus, Carcharhinus plumbeus, Carcharias taurus, Galeorhinus galeus, Hexanchus griseus, Isurus oxyrinchus, Lamna nasus, Leucoraja melitensis, Prionace glauca, Pristis pristis, Rostroraja alba, Squatina squatina*. (Flora, Fauna and Natural Habitats Regulations (311/2006) issued under the Environment Protection Act (Malta Environment and Planning Authority).

Monaco: species listed in CITES Appendices (Ordonnance Souveraine n° 67 du 23 mai 2005, Journal de Monaco du 26 mai 2006 n° 7757).

Montenegro: protection for *Carcharodon carcharias* and *Lamna nasus* (Decision on Endangered or Threatened Species of Flora and Fauna (2006) and CITES implementation legislation (Decision on Strict control list of import, export and transit: Official Gazette RME, no. 28/06).

Slovenia : Strict protection for *Carcharodon carcharias* and *Cetorhinus maximus* (Decree on Protected Wild Fauna, Official Bulletin 46/2004 (Ministry of Environment and Physical Planning)

Tunisia: It is prohibited to fish rays and skates less than 40 cm and torpedos below 20 cm in length, measured from tip of snout to start of tail (Decree 28.9.1995, Minister of Agriculture)

Turkey: Strict protection for *Carcharhinus plumbeus* and *Cetorhinus maximus* (Circulars on Fisheries related to Fisheries Law: 1380) (Ministry of Agriculture and Rural Affairs).

III-5 Habitat protection/MPAs to support Elasmobranches conservation

According information available, there are no MPAs established specifically for Elasmobranches in the Mediterranean Sea except in Turkey where Mating and breeding habitats of *Carcharhinus plumbeus* in the Bay of Boncuk are protected by the Environmental Protection Agency for Special Areas. The lack of legislation in this issue would come mainly from lack of knowledge on critical habitats of this group. Some mapping of nursery areas and spawning ground for some species being carried out by some countries. Critical habitats should be identified for conservation porpoises. Otherwise, Sharks are protected in MPAs along with other marine species but no MPAs established with reference to these species such as PELAGOS Sanctuary (for cetaceans) and the two MPAs: Larvotto (Ordonnance Souveraine du 25 avril 1978) and Spélugues (Ordonnance Souveraine du 29 août 1986) in Monaco.

Marine protected area can be efficient to manage sharks fisheries: (to protect nursery area, parturition zone….).

Temporary closure of fishing area can be efficient to reduce capture of critical stage of the life history of the species (new born, pregnant females….). In Tunisia the gulf of Gabès is closed to trawling fishery from July to Septembre,

III-6 Regulation of shark finning

Shark fins are among the most highly priced fisheries products in eastern Asia and this is stimulating the targeting of sharks and retention of only their fins, the practice known as 'finning'.This practise is wasteful of protein and other potential products derived from sharks. In fact only fins are used, the remainder being thrown away. Finning causes the death of tens of millions of sharks in the world, directly threatening rare and vulnerable shark species and indirectly impacting other commercial species due to the effects of removal of top predators from these food webs.

As fining activities don't take place generally in Mediterranean countries, there are no national regulations of shark fining except in Spain. However, Regulation EC n°1185/2003 bans removal of fins followed by discard of the carcass at sea. Finning with retention of carcasses on board is permitted in accordance with the provisions of Regulation. The theoretical correspondence between the weight of fins retained and the parts of the bodies retained on board should be established by the Member States but cannot exceed 5% of the live weight of the shark catch. In Mediterranean, this activity is likely to interest more and more fishermen.

The ICCAT 2004 regulation and the GFCM 2005 regulation recommend the full utilisation of sharks (only head, skin and guts may be discarded). Landed fins are not to exceed 5% of landed shark weight. The live release of incidentally caught sharks is encouraged but not required.

In Spain, the order of the Ministry of Agriculture, Fisheries and Food, dealing with specific conditions for the catching of sharks (June 2005), prohibits shark finning (removal of fins and discarding the carcass at sea). It is prohibited to hold on board, unload, tranship or transport sharks' fins without the corresponding weight of the rest of the body. In cases where fins or the rest of the shark's body are held on board, transhipped, unloaded or transported separately, they should be accompanied by a document certifying the placing on the market of each part, as applicable. Such activity is therefore permitted only under special permit in accordance with EC Regulation n° 1185/2003.

Conclusion

576 references, dealing with elasmobranches, were analyzed in this document. The temporal apparition of papers shows that interest on elasmobranches research is relatively recent. It was starting in the last of the 1990s. Works were concentrated mainly in the western Mediterranean following by the Eastern basin. Few works concerned endangered species and those of the GFCM priority list.

After critical analysis of the literature and taking into acount new published data on the systematic of elasmobranches, we consider 86 species of elasmobranchs thought to occur in the Mediterranean Sea (49 species of sharks and 37 batoids). Among the 86 species 13 species (7 sharks and 6 batoids) were recorded in the Black Sea. At least other 8 species of elasmobranchs have been reported in the Marmara Sea which is with the Black Sea and Sea of Azov in the same FAO sub-area. However, much confusion persists for some species and some others are doubtful. These species need more systematic revision.

Endemism of chondrichthyans in the Mediterranean is low, only four batoids species were considered as endemic. Alien species are increasingly recorded, 8 species are known to occur in the Mediterranean

Within the Mediterranean, the distribution of elasmobranch fishes is not homogenous. A recent work showed that concentration of rays and sharks occurred in coastal waters of the western basin and the central Mediterranean especially in the waters of Tunisia and Libya. In the Adriatic Sea, the presence of cartilaginous fish species is scarce especially in the northern part. The Black Sea fauna is composed of Mediterranean species. Thirteen elasmobranchs species are assumed to live in the Black Sea whose three species are relatively common; the thornback ray *Raja clavata* and the common stingray *Dasyatis pastinaca* having no commercial importance and the spiny dogfish *Squalus acanthias*. Some areas are considered critical habitat for elasmobranches. For example, Tunisian waters provide a nursery area for great white shark *Carcharodon carcharias*. The gulf of Gabès seems to be also a nursery for many other elasmobranches.

The IUCN red list (2010 regional assessment) shows clearly the vulnerability of elasmobranchs and the lack of data on this fish group; 42. 5 % are vulnerable and endangered to critically endangered, 22.5 % are Near Threatened (NT) and 21. 25 % are Data Deficient (DD).

Elasmobranchs fish species are exploited for their fins, skin, jaws or meat. Sometimes they are directly targeted by commercial and recreational fisheries while in other cases they are incidentally caught as bycatch. In Mediterranean Sea, catches represent only 1.1% of the total landings. A decline in cartilaginous fish species landings has been observed while fishing effort has generally increased. The catches show an increasing trend; 24,000 tonnes attained in 1983 and since then a regular decrease are observed. The present elasmobranchs productions are about 7000 tonnes annually. Sharks represent 1.3 times the production of batoïdes. The major elasmobranchs fishing countries within the Mediterranean are Italy, Turkey and Tunisia; they contributed on average with 76 % in the production of elasmobranchs during the last 30 years. Countries report generally shark statistics without distinction between species or, worse still, the species are not recorded at all. Moreover, FAO data only report official landings and therefore bycatch returned to the sea is not included. A protocol should be developed to collect and promote the collection of basic data on elasmobranchs species.

In the Mediterranean, almost no elasmobranchs are subject to directed fisheries, but elasmobranchs constitute part of the bycatch in most local artisanal fisheries. Catches of elasmobranchs primarily derive from two different fisheries: the pelagic artisanal fishery with longlines and gillnets and the demersal trawl fishery.

The Bycatch has become one of the issues to be considered in any development of fisheries. Elasmobranchs who's considered mainly as bycatch are very sensitive given their particular biological characteristics. The Bycatch can induce imbalances between top predators and prey and consequently affect biodiversity.
96 papers covering many aspects and approaches to fisheries were identified and analyzed. The interest in the incidental catch is relatively recent; More than 75 % of papers on this topic appeared last decade.

Trawling generates several problems: juvenile catches, important discards and negative impact on the environment. In the Mediterranean, discards constitute over 40% of the catch. At least 74 species are mainly caught by trawlers. The sustained increase in trawl fishing effort appears to have contributed to a decline in biodiversity in the Mediterranean elasmobranch (stock and habitat). For this fishing gear, very often the information concerns a listing of species without an estimate of catch rates by fishing effort. A regional research programme on this issue should be launched.

Surface longlines targeting swordfish, albacore and tuna generate significant bycatch of sharks. At least 15 species of sharks are affected by this gear. In all areas studied, the blue shark, *P. glauca*, is the species the most represented in the catch of surface longline. It is over 70% of the elasmobranchs catch. It is followed by mako *Isurus oxyrinchus*.
The bottom longlines incidentally bring several demersal species such as *Mustelus sp, Squalus sp.*, *Torpedo* sp. and some Rajidaes. It catches especially batoids.
It is finally noted that studies of elasmobranch fishery bycatch by hooks are missing on the southern shore of the Mediterranean.

Although banned now, few fleets Mediterranean (France, Italy, Morocco, Tukey) continue to use the drift nets. They generate incidental catch of elasmobranchs. Incidental catches of large sharks species have been cited in various driftnet fisheries.

In the Mediterranean, there is a little use of gillnet targeting sharks. However, these nets bring several other non-target species of elasmobranchs.

Although there is little information available in the literature on the bycatch of encircling nets, these nets catch occasionally pelagic sharks and stingrays in fisheries of the bluefin tuna and small pelagic. In central Mediterranean over 70% of the white shark catches are reported to the purse seine.
Many management tools and technical procedures were suggested to reduce bycatch but a big effort is needed to enhance researches on this issue and to adapt procedures tested worldwide.

Sharks and rays occupy a high level in the trophic webs and are characterised by a K-strategy. This determines a high sensibility to even relatively low fishing pressure, but in the Mediterranean very few stocks assessment and standardised data are available. However, some assessments, based on abundance indices such as elaborated in the frame of Medits bottom trawl surveys, are available. Series of data based on this programme are too short to identify specific trends in species abundances. This programme should be extended to the entire region. Stock assessment of elasmobranchs, based on biologic parameters (mainly age and growth) should be developed.

138 references dealing with the biology of the reproduction were inventoried but only 97 papers report detailed data on reproductive parameters, the others give some general information. A standardisation of methods and expression of results should be generalised in the whole Mediterranean. Data is available for only 43 species, 33 viviparous and10 oviparous.

Only 11 species (about 12 % of the Mediterranean elasmobranches fauna) were the subject of age and growth studies (20 references in total). Data were scarce.
The organization of a training course on age reading and growth parameters of the main elasmobranches species seems to be very urgent to enhance research on this field. Growth parameters are necessary for stock assessment studies.

Sharks are considered top predators and may have an important role in the regulation of marine ecosystems at lower trophic levels. In addition, quantitatively describing the diet and foraging habitat and predator-prey interactions of top predators in a community is a key step in ecosystem approaches to fisheries management.

Analysis of bibliography dealing with Food and feeding habits shows that most species appear to be opportunistic feeding predators, foraging on broad range of prey species. However, crustaceans and teleost fishes are the main preys of elasmobranchs. Cephalopods are major prey for some species. Polycheates, sipunculids and echinoderms were of minor importance food; in contrast, *O. centrina* is the only shark species ingesting polycheates. Chondrchtyans are reported to be preys also for various species.

Papers on biologic parameters cover all Mediterranean and Black Sea but primarily in the occidental and central areas. Their majority appeared in latest decade.

Few elasmobranchs species occurred in the Black Sea and some data on biology and ecology are available mainly for three common species; *Raja clavata*, *Dasyatis pastinaca* and *Squalus acanthias*. Many papers in Russian, on the issue, were not analyzed in this document.

Protection currently granted to chondrichthyan fish species under various regional and international conventions where generally few species were considered. An amendment of some convention lists and action plans should be undertaken in parallel with developing knowledge on this fish group.

Few countries developed their own legislation on species protection which is generally elaborated implementing CITES Convention and/or Bern convention and SPA –Biodiversity protocol of Barcelona Convention. In Israel all Cartilaginous Fishes are protected. National action plans should be elaborated and generalised in the Mediterranean and Black Sea countries

According information available, there are no MPAs established specifically for Elasmobranches in the Mediterranean and Black Sea. The lack of legislation in this issue would come mainly from lack of knowledge on critical habitats of this group. Marine protected area can be efficient to manage sharks fisheries (protection of nursery areas, parturition zone….).

As fining activities don't take place generally in Mediterranean countries, there are few national regulations of shark fining but this activity is likely to interest more and more fishermen. National legislations should be also developed in many countries.

Following the present bibliographic analysis and the diagnostic of the situation of elasmobranchs in the Mediterranean and Black Sea, research programmes and conservation Priorities for Sharks of the region are as follow:

- Developing research programs on systematic, general biology, ecology and population dynamics for species of concern.
- Identifying and mapping critical habitat.
- Taking action to collect reliable statistics on landings and Bycatch of elasmobranchs
- Initiating fisheries management strategies for commercially exploited species.
- Developing research programs to reduce elasmobranchs bycatch
- Developing National Action Plans as recommended by the FAO IPOA-Sharks.

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APPENDIX 1

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LIST OF ELASMOBRANCHS OF THE MEDITERRANEAN AND THE BLACK SEA

[redacted]

? Doubtful presence in Black Sea

SHARKS

Order **HEXANCHIFORMES**. Cow & frilled sharks

Family **HEXANCHIDAE**. Sixgill & sevengill sharks

Heptranchias perlo (Bonnaterre, 1788). Sharpnose sevengill shark

Hexanchus griseus (Bonnaterre, 1788). Bluntnose sixgill shark

Hexanchus nakamurai Teng, 1962. Bigeye sixgill shark

Order **SQUALIFORMES**. Dogfish sharks

Family **ECHINORHINIDAE**. Bramble sharks

[redacted]

Family **SQUALIDAE**. Dogfish sharks

[redacted]

Squalus megalops (Macleay, 1881). Shortnose spurdog

Family **CENTROPHORIDAE**. Gulper sharks

Centrophorus granulosus (Bloch & Schneider, 1801). Gulper shark

Centrophorus uyato (Rafinesque, 1810)

Family **ETMOPTERIDAE**. Lantern sharks

Etmopterus spinax (Linnaeus, 1758). Velvet belly

Family **SOMNIOSIDAE**. Sleeper sharks

Centroscymnus coelolepis Bocage & Capello, 1864. Portugese dogfish

Somniosus rostratus (Risso, 1810). Little sleeper shark

Family **OXYNOTIDAE**. Roughsharks

Oxynotus centrina (Linnaeus, 1758). Angular roughshark

Family **DALATIIDAE**. Kitefon sharks

Dalatias licha (Bonnaterre, 1788). Kitefin shark

Order **SQUATINIFORMES**. Angel sharks

Family **SQUATINIDAE.** Angel sharks

Squatina aculeata Dumeril, *in* Cuvier, 1817. Sawback angelshark

Squatina oculata Bonaparte, 1840. Smoothback angelshark

[redacted]

Order **LAMNIFORMES**. Mackerel sharks

Family **ODONTASPIDIDAE**. Sand tiger sharks

Carcharias taurus Rafinesque, 1810. Sand tiger shark

Odontaspis ferox (Risso, 1810). Smalltooth sand tiger

Family **ALOPIIDAE**. Thresher sharks

Alopias superciliosus (Lowe, 1839). Bigeye thresher

Alopias vulpinus (Bonnaterre, 1788). Thresher shark

Family **CETORHINIDAE**. Basking sharks

Cetorhinus maximus (Gunnerus, 1765). Basking shark.

Family **LAMNIDAE**. Mackerel sharks

Carcharodon carcharias (Linnaeus, 1758). Great white shark

Isurus oxyrinchus Rafinesque, 1810. Shortfin mako

Isurus paucus Guitart Manday, 1966. Longfin mako

Lamna nasus (Bonnaterre, 1788). Porbeagle shark.

Order **CARCHARHINIFORMES**. Ground sharks

Family **SCYLIORHINIDAE**. Cat sharks

[redacted]

Scyliorhinus stellaris (Linnaeus, 1758). Nursehound

Galeus atlanticus (Vaillant, 1888). Atlantic catshark

Galeus melastomus Rafinesque, 1810. Blackmouth catshark

Family **TRIAKIDAE**. Hound sharks

Galeorhinus galeus (Linnaeus, 1758). Tope shark

Mustelus asterias Cloquet, 1821. Starry smoothhound

Mustelus mustelus (Linnaeus, 1758). Smoothhound

Mustelus punctulatus Risso, 1826. Blackspot smoothhound

Family **CARCHARHINIDAE**. Requiem sharks

Carcharhinus altimus (Springer, 1950). Bignose shark

Carcharhinus brachyurus (Günther, 1870). Bronze whaler shark

Carcharhinus brevipinna (Müller & Henle, 1839). Spinner shark

Carcharhinus falciformis (Bibron, *in* Müller & Henle, 1839). Silky shark

Carcharhinus limbatus (Valenciennes, *in* Müller & Henle, 1839). Blacktip shark

Carcharhinus melanopterus (Quoy & Gaimard, 1824). Blacktip reef shark

Carcharhinus obscurus (Lesueur, 1818). Dusky shark

Carcharhinus plumbeus (Nardo, 1827). Sandbar shark

Galeocerdo cuvier (Peron & Lesueur, *in* Lesueur, 1822). Tiger shark

Prionace glauca (Linnaeus, 1758). Blue shark

Rhizoprionodon acutus (Rüppell, 1837). Milk shark

Family **SPHYRNIDAE**. Hammerhead sharks

Sphyrna (Sphyrna) lewini (Griffith & Smith, *in* Cuvier *et al.* 1834). Scalloped hammerhead

Sphyrna (*Sphyrna*) *mokarran* (Rüppell, 1837). Great hammerhead

Sphyrna **(*Mesozygaena*)** *tudes* (Valenciennes, 1822). Smalleye hammerhead

[redacted].

BATOIDS (SKATES & RAYS)

Order **PRISTIFORMES**. Sawfishes

Family **PRISTIDAE.** Sawfishes

Pristis pectinata Latham, 1794. Smalltooth sawfish

Pristis pristis (Linnaeus, 1758). Common sawfish

Order **RHINOBATIFORMES**. Guitarfishes

Family **RHINOBATIDAE**. Guitarfishes

Rhinobatos (Glaucostegus) cemiculus St. Hilaire, 1817. Blackchin guitarfish

Rhinobatos (Rhinobatos) rhinobatos (Linnaeus, 1758). Common Guitarfish

Order **TORPEDINIFORMES**. Electric rays

Family **TORPEDINIDAE**. Torpedo rays

Torpedo (Tetronarce) nobiliana Bonaparte, 1835. Great torpedo

Torpedo(Torpedo) sinuspersici

Torpedo (Torpedo) marmorata Risso, 1810. Spotted torpedo

Torpedo (Torpedo) torpedo (Linnaeus, 1758). Ocellate torpedo

Order **RAJIFORMES**. Skates

Family **RAJIDAE.** Skates

[redacted] **?**

Dipturus oxyrhynchus Linnaeus, 1758. Sharpnose skate

Dipturus nidarosiensis (Storm, 1881). Norwegian skate

Leucoraja circularis Couch, 1838. Sandy skate

Leucoraja fullonica Linnaeus, 1758. Shagreen skate

Leucoraja melitensis Clark, 1926. Maltese skate

Leucoraja naevus Müller & Henle, 1841. Cuckoo skate

Raja undulata Lacepede, 1802. Undulate skate

Raja africana Capape, 1977. African skate

Raja asterias Delaroche, 1809. Atlantic starry skate

[redacted] **?**

[redacted]

Raja miraletus Linnaeus, 1758. Twineye skate

[redacted] **?**

Raja polystigma Regan, 1923. Speckled skate

Raja radula Delaroche, 1809. Rough skate

Rostroraja alba Lacepede, 1803. White skate

Order **MYLIOBATIFORMES**. Stingrays

Family **DASYATIDAE**. Whiptail stingrays

Dasyatis centroura (Mitchill, 1815). Roughtail stingray

***Dasyatis marmorata* (Steindachner, 1892)**

[redacted]

Dasyatis tortonesei Capape, 1975. Tortonese's stingray

Himantura uarnak (Forsskael, 1775). Honeycomb whipray

Pteroplatytrygon violacea (Bonaparte, 1832). Pelagic stingray

Taeniura grabata (Geoffroy St. Hilaire, 1817). Round fantail stingray

Family **GYMNURIDAE**. Butterfly rays

[redacted]

Family **MYLIOBATIDAE**. Eagle rays

Myliobatis aquila (Linnaeus, 1758). Common eagle ray

Pteromylaeus bovinus (Geoffroy St. Hilaire, 1817). Bullray

Family **RHINOPTERIDAE**. Cownose rays

Rhinoptera marginata (Geoffroy St. Hilaire, 1817). Lusitanian cownose Ray

Family **MOBULIDAE**. Devil rays

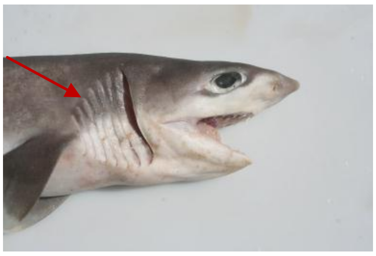
Mobula mobular (Bonnaterre, 1788). Giant devilray

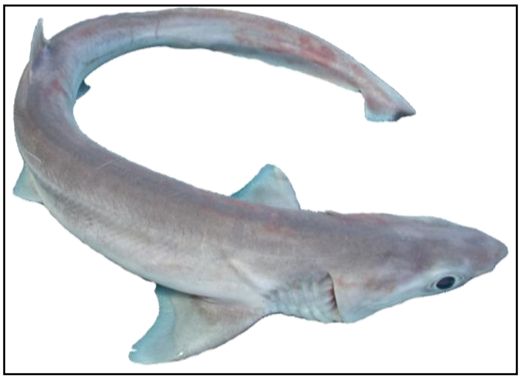
The regional IUCN Red List status of all assessed Mediterranean elasmobranch species (Gibson et al., 2007).

Scientific name	Common name	Threatened Status Mediterranean assessment
Oxynotus centrina	Angular roughshark	CR A2bd
Squatina aculeata	Sawback angelshark	CR A2bcd+3cd+4bcd
Squatina oculata	Smoothback angelshark	CR A2bcd+3cd+4bcd
Squatina squatina	Angelshark	CR A2bcd+3cd+4bcd
Pristis pectinata	Smalltooth sawfish	CR A2bcd+3cd+4bcd
Pristis pristis	Common sawfish	CR A2bcd+3cd+4bcd
Dipturus batis	Common skate	CR A2bcd+4bcd
Leucoraja melitensis	Maltese skate	CR A2bcd+3bcd+4bcd
Rostroraja alba	White skate	CR A2cd+4cd
Gymnura altavela	Spiny butterfly ray	CR A2bcd
Carcharias taurus	Sand tiger shark	CR A2abcd+3cd+4abcd
Isurus oxyrinchus	Shortfin mako	CR A2acd+3cd+4acd
Lamna nasus	Porbeagle shark	CR A2bd
Squalus acanthias	Spiny dogfish	EN A2bd+4bd (VU Black Sea)
Rhinobatos cemiculus	Blackchin guitarfish	EN A4cd
Rhinobatos rhinobatos	Common guitarfish	EN A4cd
Leucoraja circularis	Sandy skate	EN A2bcd+3bcd+4bcd
Giant devilray	Giant devilray	EN A4d
Odontaspis ferox	Smalltooth sand tiger	EN A2abd+4abd
Carcharodon carcharias	Great white shark	EN A2bc+3bc+4bc
Carcharhinus plumbeus	Sandbar shark	EN A2bd+4bd
Heptranchias perlo	Sharpnose sevengill	VU A2d+3d+4d
Centrophorus granulosus	Gulper shark	VU A3d+4d
Alopias vulpinus	Thresher shark	VU A2bd+3bd
Cetorhinus maximus	Basking shark	VU A2bd
Galeorhinus galeus	Tope shark	VU A2bd
Mustelus asterias	Starry smoothhound	VU A2ab+3bd+4ab
Mustelus mustelus	Smoothhound	VU A2ab+3bd+4ab
Prionace glauca	Blue shark	VU A3bd+4bd
Sphyrna zygaena	Smooth hammerhead	VU A4bd
Chimaera monstrosa	Rabbitfish	NT
Hexanchus griseus	Bluntnose sixgill shark	NT
Dipturus oxyrhynchus	Sharpnose skate	NT
Leucoraja naevus	Cuckoo skate	NT
Raja clavata	Thornback skate	NT
Raja polystigma	Speckled skate	NT
Dasyatis centroura	Roughtail stingray	NT
Dasyatis pastinaca	Common stingray	NT
Pteroplatytrygon violacea	Pelagic stingray	NT
Myliobatis aquila	Common eagle ray	NT

Rhinoptera marginata	Lusitanian cownose ray	NT
Galeus atlanticus	Atlantic catshark	NT
Scyliorhinus stellaris	Nursehound	NT
Etmopterus spinax	Velvet belly	LC
Centroscymnus coelolepis	Portuguese dogfish	LC
Somniosus rostratus	Little sleeper shark	LC
Torpedo marmorata	Spotted torpedo ray	LC
Torpedo torpedo	Ocellate torpedo ray	LC
Raja asterias	Atlantic starry skate	LC
Raja miraletus	Twineye skate	LC
Raja montagui	Spotted skate	LC
Galeus melastomus	Blackmouth catshark	LC
Scyliorhinus canicula	Smallspotted catshark	LC
Hexanchus nakamurai	Bigeye sixgill shark	DD
Echinorhinus brucus	Bramble shark	DD
Dalatias licha	Kitefin shark	DD
Torpedo nobiliana	Great torpedo ray	DD
Leucoraja fullonica	Shagreen skate	DD
Raja brachyura	Blonde skate	DD
Raja radula	Rough skate	DD
Raja undulata	Undulate skate	DD
Dasyatis chrysonota	Blue stingray	DD
Himantura uarnak	Honeycomb whipray	DD
Taeniura grabata	Round fantail stingray	DD
Alopias superciliosus	Bigeye thresher	DD
Mustelus punctulatus	Blackspot smoothhound	DD
Carcharhinus altimus	Bignose shark	DD
Carcharhinus brachyurus	Bronze whaler shark	DD
Carcharhinus brevipinna	Spinner shark	DD
Carcharhinus limbatus	Blacktip shark	DD
Carcharhinus obscurus	Dusky shark	DD

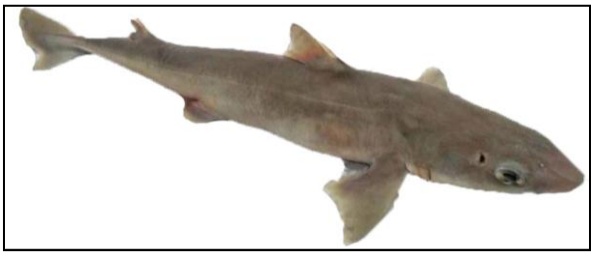
COLOUR PLATES



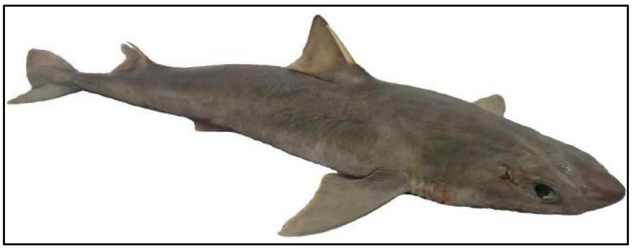


HEXANCHIDAE *Heptranchias perlo*

HEXANCHIDAE *Hexanchus griseus*



SQUALIDAE *Squalus megalops*



SQUALIDAE *Squalus blainvillei*

CENTROPHORIDA *Centrophorus granulosus*

OXYNOTIDAE *Oxynotus centrina*

SQUATINIDAE *Squatina squatina*

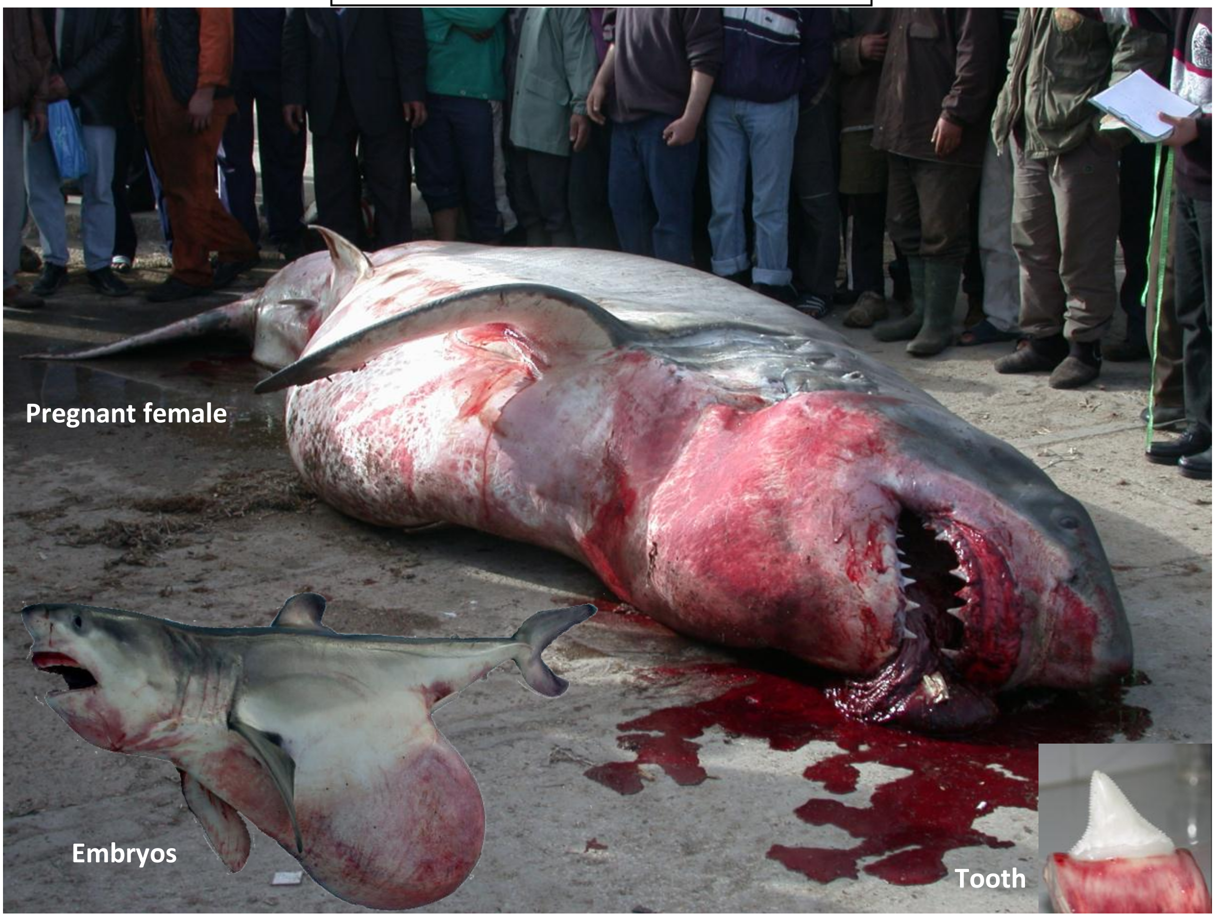
SQUATINIDAE *Squatina aculeata*

SQUATINIDAE *Squatina oculata*

ALOPIIDAE *Alopias vulpinus*

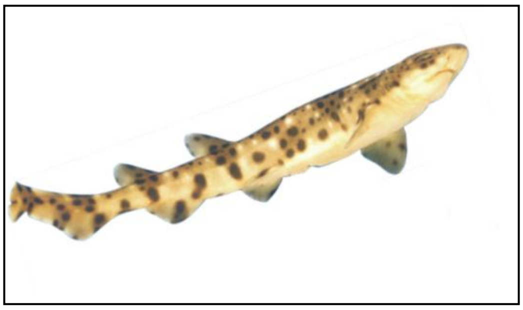
CETORHINIDAE *Cetorhinus maximus* **(juvenile)**

LAMNIDAE *Carcharodon carcharias*



LAMNIDAE *Isurus oxyrinchus*

SCYLIORHINIDAE *Scyliorhinus canicula*



SCYLIORHINIDAE *Scyliorhinus stellaris*

TRIAKIDAE *Mustelus punctulatus*

TRIAKIDAE *Mustelus mustelus*

TRIAKIDAE *Mustelus asterias*

CARCHARHINIDAE *Prionace glauca*

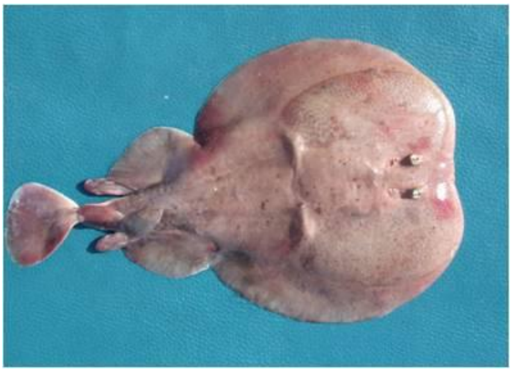
CARCHARHINIDAE *Carcharhinus plumbeus*

CARCHARHINIDAE *Carcharhinus brevipinna*

SPHYRNIDAE *Sphyrna (Sphyrna)* zygaena

RHINOBATIDAE *Rhinobatos (Rhinobatos) rhinobatos*

RHINOBATIDAE *Rhinobatos (Glaucostegus) cemiculus*



TORPEDINIDAE *Torpedo marmorata*

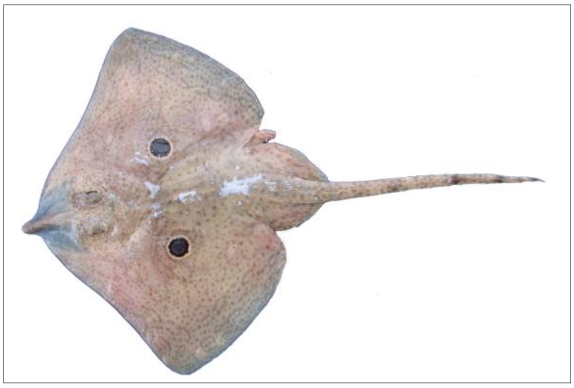
TORPEDINIDAE *Torpedo torpedo*

RAJIDAE *Rostroraja alba*

RAJIDAE *Raja asterias*

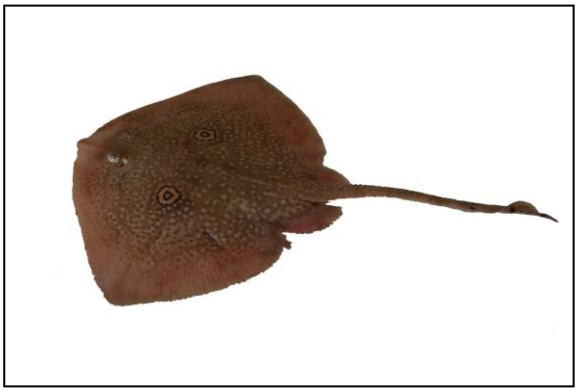
RAJIDAE *Raja clavata*

RAJIDAE *Leucoraja melitensis*



RAJIDAE *Raja miraletus*

RAJIDAE *Dipturus oxyrinchus*

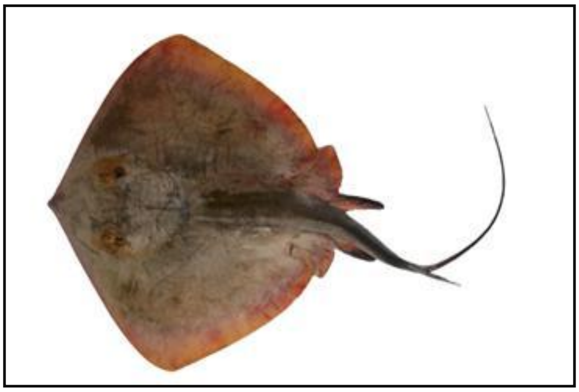


RAJIDAE *Raja radula*

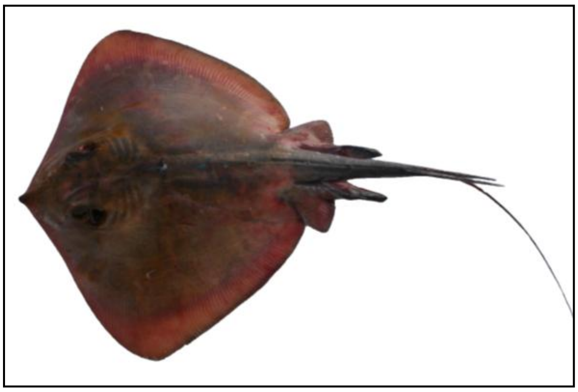
Dasyatidae *Dasyatis marmorata*

Dasyatidae *taeniura grabata*

Dasyatidae *Dasyatis centroura*



Dasyatidae *Dasyatis pastinaca*

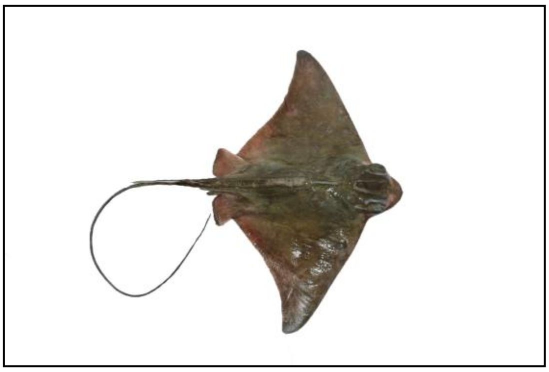


Dasyatidae *Dasyatis tortonesei*

Dasyatidae *pteroplatytrygon violacea*

GYMNURIDAE *Gymnura altavela*

MYLIOBATIDAE *Pteromylaeus bovinus*



MYLIOBATIDAE *Myliobatis aquila*

MOBULIDAE *Mobula mobular*