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PROGRAMME

Friday, 20/11/2009	
9:00 – 9:15	**Opening address**
9:15 – 10:00	**Keynote**
9:15 -10:00	**John A. Musick**
K1	Chondrichthyan reproduction – viviparity came first.
10:00 – 11:00	**Session 1: Taxonomy**
10:00 – 10:20	**Albert Baranes**
S1-1	The Red Sea sharks: taxonomy, biology and ecology.
10:20 – 10:40	**Farid Hemida**
S1-2	On some morphometric characters in carcharhinid species from off the algerian coast.
10:40 – 11:00	**Nicolas Straube**
S1-3	Population structure of the Luminescent deep-sea shark *Etmopterus granulosus* (Squaliformes: Etmopteridae).
11:00 – 11:30	**Coffee Break**
11:30 – 13:10	**Session 2: Biology**
11:30 – 11:50	**Julien M. Claes**
S2-1	Complex control of photophores luminescence from a lanternshark, *Etmopterus spinax* (Squaloidea: Etmopteridea).
11:50 – 12:10	**Mason N. Dean**
S2-2	Micromorphology and mechanics of the tessellated skeleton of cartilaginous fishes.
12:10 - 12:30	**Ross A. Jeffree**
S2-3	Phylogenetic consistencies in different patterns of bioaccumulation of multiple trace elements from seawater by chondrichthyan and teleost fishes.
12:30 – 12:50	**Claudia Junge**
S2-4	Genetic diversity of basking sharks (*Cetorhinus maximus*) – a North Atlantic perspective and its global relevance.
12:50 – 13:10	**Niriniony. Rabehagasoa**
S2-5	Comparative analysis of the individual age of the blue shark, *Prionace glauca* in the Southwest Indian Ocean.

13:10 – 14:20	**Lunch Break**

14:20 – 14:40	**Session 2: Biology**
14:20 – 14:40	**María Valls**
S2-5	Feeding ecology of elasmobranch species in the western Mediterranean.
14:40 – 18:10	**Session 3: Management and Conservation**
14:40 – 15:00	**Massimiliano. Bottaro**
S3-1	A conservation and management chance for elasmobranchs in the italian waters: first results from monitoring of cetacean by-catch in the Adriatic Sea.
15:00 – 15:20	**Mika S. Diop**
S3-2	West African action plan for sharks: where are we?
15:20 – 15:40	**Sonja Fordham**
S3-3	European shark conservation: progress and opportunities.
15:40 -16:00	**Ali Hood**
S3-4	Skate and ray management and conservation in the UK.

16:00 – 16:30	**Coffee Break**

16:30 – 16:50	**Rich Hurst**
S3-5	The importance of accessible identification materials in fisheries management.
16:50 – 17:10	**Giulio Relini**
S3-6	The ELASMOIT project.
17:10 – 17:30	**Bernard Séret**
S3-7	Sharks and rays of French fisheries.
17:30 – 17:50	**Joana Silva**
S3-8	The status and management of thornback ray *Raja clavata* in the South-western North Sea.
17:50 – 18:10	**Colin D. Speedie**
S3-9	Basking shark hotspot sites in western Scotland: developing appropriate protection measures for the species on a site specific basis.

Saturday, 21/11/2009	
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K2	The elasmobranchs of Borneo: an investigation of the fauna based on field and market surveys.
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9:30 – 9:50	**Harald Baensch**
S4-1	Spatial distribution of benthic Chondrichthyans in the US Gulf of Mexico.
9:50 – 10:10	**Sandra Mallol**
S4-2	Incidental catches and fishing impacts on elasmobranchs in small-scale multigear, multispecies fisheries of the northwestern Mediterranean (Balearic Islands).
10:10 – 10:30	**Bechir Saïdi**
S4-3	Artisanal elasmobranch fishery in the Gulf of Gabès (Southern Tunisia).
10:30 – 10:50	**Colin A. Simpfendorfer**
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S5-2	Estimating population parameters for bull sharks at a feeding site in a marine protected area in Fiji.
12:00 - 12:20	**Ramón Bonfil**
S5-3	White sharks (*Carcharodon carcharias*) from New Zealand like to vacation in the tropics.
12:20 – 12:40	**Juerg M. Brunnschweiler**
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14:20 – 17:30	**Session 5: Ecology**
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S5-8	Preliminary analysis of grey reef shark movements on the Great Barrier Reef.
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15:40 -16:00	**Francesc Ordines**
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S5-11	Population size and structure of whale sharks *Rhincodon typus* at Holbox Island, México.
16:50 – 17:10	**Rodolfo Vögler**
S5-12	Population structure and spatio-temporal distribution of blue shark (*Prionace glauca*) at the eastern tropical Pacific off Mexico.
17:10 – 17:30	**William T White**
S5-13	Biodiversity and biogeography of tropical marine chondrichthyans.
17:30 – 17:50	**Ana Bricia Guzmán Castellanos**
S2-7	Feeding habits of the chilean round ray *Urotrygon chilensis* (Günther, 1871) (Myliobatiformes: Urolophidae) in the gulf of Tehuantepec, Mexico.

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ABSTRACTS

THE ELASMOBRANCHS OF BORNEO: AN INVESTIGATION OF THE FAUNA BASED ON FIELD AND MARKET SURVEYS

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Borneo is the third largest island on the planet and lies at the western margin of the mega-diverse, Coral Triangle of South-East Asia. Its aquatic environments are rich and variable with a broad variety of marine habitats. Divided administratively between the states of Indonesia, Malaysia and Brunei, the intraregional distribution and utilisation of the marine biota varies considerably within the region. Indonesia traditionally has the largest annual global production of elasmobranchs but, despite these fishes being the focus of early 19th C natural historians, only recently has the composition of this fauna been comprehensively described. The first major investigation of the elasmobranchs of Sabah was undertaken by a team supported by the Darwin Foundation in the 1990s. This project was followed by a broader based field project, funded partly by the National Science Foundation, to survey the elasmobranchs of Borneo and their metazoan parasites (2001-09). Several thousand specimens of more than 100 species were examined from trawlers, landing sites, and fish markets from around the island. The surveys led to the discovery of many new species and records, and the observation of endangered, rare or little known species, including the rediscovery of a shark considered to be possibly extinct. Several species exhibit regional patterns in distribution that appear to be closely related to habitat availability. The environs of the large Kapuas River estuary, western Kalimantan, has several micro-endemic stingrays, and additional undocumented, extreme, intraspecific variability in some shark groups. Main characteristics of the fauna, as well as some of the more interesting discoveries are presented. These data have been summarised in a soon to be published guide to the sharks and rays of Borneo.

CHONDRICHTHYAN REPRODUCTION – VIVIPARITY CAME FIRST

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The primitive reproductive mode in neoselachiens, and the Chondrichthyes as a whole dogmatically has been assumed to be oviparity. On the contrary recent research has suggested that lecithotrophic yolk-sac viviparity is the ancestral reproductive state that has led to evolution of oviparity, and all forms of matrotrophic viviparity The hypothesis that yolk-sac viviparity is unequivicably the plesiomorphic reproductive state in neoselachians and plausibly in the Chondrichthyes is supported by multiple sources of evidence:

Female Reproductive System: The simplest, least specialized oviducal glands and uteri are found in species with yolk-sac viviparity

Male Reproductive System: All male Chondrichthyes, both recent and fossil possess claspers. These have no other use than internal fertilization during copulation. Internal fertilization along with the presence of well-developed uteri in females provides the potential, if not the probability, for viviparity.

Urea retention: Chondrichthyes retain urea in marine environments as the principal mechanism to maintain osmotic equilibrium. Urea is produced through the ornothine-urea cycle which is found in all gnathostome classes except the Aves in which it has been lost). The ornothine-urea cycle probably evolved in early grathostomes as a means of detoxifying ammonia produced by catabolism in internally-developing embryos. Thus viviparity must have evolved quite early in the evolution of chondrichthyans or their ancestors. Conversion of ammonia to urea would not be necessary in oviparous marine forms because ammonia is rapidly diluted and carried away in sea water. In early chrondrichthyans, post-embryonic urea retention probably evolved through paedomorphosis, and allowed more efficient osmoregulation and greater euryhalinity than in their isosmotic, stenohaline ancestors.

Parsimony: Studies that have been based on oviparity as the plesiomorphic reproductive state in modern elasmobranchs are less parsimonious than one based on plesiomorphous yolk-sac viviparity. In the oviparity “camp,” various authors have estimated that viviparity evolved from oviparity 9-20 times. These studies were based in part on older elasmobranch classifications and either

assumed that oviparity was plesiomorphous, or used an oviparous outgroup in their cladistic analyses. Thus the possibility that viviparity might be plesiomorphous was never considered or adequately tested. In contrast, hypothesizing yolk-sac viviparity as the plesiomorphic state, and analyzing the most recently accepted elasmobranch phylogeny, there are only six transitions from viviparity to oviparity . Thus, with yolk-sac viviparity as ancestral there are 3 to14 fewer transitions.

Phylogeny. Yolk sac viviparity is unequivocally the plesiomorphous reproductive state in the Batoidea, and in the selachien Squalomorphi. The latter is the sister group to the Galeomophi in which reproductive patterns in the most primitive clades are not so well defined; Heterodontiformes are oviparous, and Orectolobiformes includes both oviparous, and viviparous clades. However in the latter order the oldest families (Bracheluridae, Orectolobidae) are yolk-sac viviparous. Thus the preponderance of evidence supports the hypothesis that yolk-sac viviparity is plesiomorphous in neoselachians.

Plesiomorphic yolk-sac viviparity simplifies the pattern of reproductive evolution in living elasmobranchs and forms the unspecialized basis for all other modes of elasmobranch reproduction. Early chondrichthyans possessed intromittant organs, internal fertilization , viviparity, and precocial young. Thus, their eggs and developing embyos had a large measure of protection from newly evolving gnathastome egg predators. In contrast, the Actinopterygii with vulnerable unprotected eggs and small larvae evolved adaptations to decrease egg and larval predation (egg hiding, nest building, parental protection), or to increase fitness by producing huge numbers of small pelagic eggs. Such adaptations have been superfluous for the chondrichthyans.

THE RED SEA SHARKS: TAXONOMY, BIOLOGY AND ECOLOGY

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Although the Red Sea is a tropical habitat connected to the Indo-Pacific ecosystem, less than expected shark species are found in the area.

The data presented is based on specimens collected in the Gulf of Aqaba, the Gulf of Suez and the Red Sea proper (Egyptian and Eritrean coast).

For the case of Carcharhinus obscurus, data from Mediterranean specimens was compared to the data obtained in the Red Sea.

The present work covers the taxonomy of 26 shark species belonging to 9 families. Data on their meristic and morphometric is given, additional information on their feeding habits and reproduction is presented.

The distribution of the Red Sea Sharks, showing a gradient from the southern Red Sea to the northern tip of the Gulf of Aqaba is discussed.

ON SOME MORPHOMETRIC CHARACTERS IN CARCHARHINID SPECIES FROM OFF THE ALGERIAN COAST

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There are six requiem sharks reported from the Algerian waters, in offshore pelagic fisheries. Primarily *Carcharhinus altimus* (Springer, 1950), *C. brachyurus* (Gunther, 1870), *C. brevipinna* (Miller & Henle, 1839), *C. obscurus* (LeSueur, 1818), *C. plumbeus* (Nardo, 1827) occurred rather frequently (Hemida *& al*, 2002). These sharks may be considered less frequent inhabitants of at least the Algerian basin, in the last few years. Identification is based on a referenced guides (Cadenat et Blache, 1981; Garrick, 1982, Compagno, 1984; Fisher *& al*, 1987) and morphometrics data given by the different authors. Requiem sharks share similar characters and determination remains uncertain for some specimens. About 112 individuals of Carcharhinid were sampled from off the Algerian coast during a six years period (1995- 2001). A complete set of eight biometric characters according to the gender and the site was gathered for 45 specimens belonging to four species: *C. brachyurus*, *C. obscurus*, *C. plumbeus* and *C. altimus*.

The measurements used to calculate the proportional dimensions given here were made as follow: TL (total length); SD1 (snout tip to first dorsal origin); SD2 (snout tip to second dorsal origin); D1H (vertical height of first dorsal); SL (snout length); WM (width of mouth); INM (internarial-mouth length). The dimensions were expressed as percent of the total length: SD1%; SD2%; D1H%; SL%; WM%; INM%. Two ratios were also calculated: SD1/D1H and WN/INM.

Data were mainly analysed using techniques concerning with PCA (principal components analysis) and DA (Discriminant analysis) performed by Stastistica software package (Statsoft, 1997). PCA results showed the affinities occurring between naturally groups and DA determines which variables discriminate better between them. The eight variables separate the 4 species into 2 groups: *C. brachyurus* - *C. obscurus* and *C. plumbeus* - *C. altimus*. The variables contributing the most to discriminate between the two groups are D1H%, WM%

and SD1/D1H for the first axis while on the third axis are SD1% and SD2%. Some morphological characters such as the presence/absence of the interdorsal ridge and shape of the upper teeth allow to distinct the bronze whaler *C. brachyurus* from the dusky shark *C. obscurus*. In contrast, differentiation between individuals of bignose shark (*C. altimus*) and sandbar (*C. brachyurus*) remains rather difficult. Position of first dorsal fin and snout shape (SD1, INM and WM) are biometric measures having the highest discriminant power to differentiate between them (bignose shark *C. altimus* and sandbar *C. brachyurus*). Some individuals assigned to putative species could be misidentified.

POPULATION STRUCTURE OF THE LUMINESCENT DEEP-SEA SHARK *ETMOPTERUS GRANULOSUS* (SQUALIFORMES: ETMOPTERIDAE)

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Recent molecular phylogenetic studies of speciose Lantern Sharks (Etmopteridae) provide evidence for cryptic diversity, both among species considered to be wide-spread and others described as regionally endemic. We decided to analyse the population structure of *Etmopterus granulosus* as an example of a species with still debated distribution range and taxonomic status. This species is considered endemic to Argentinean and Chilean waters with several uncertain records off South Africa and the Indian Ocean. Our analysis includes a morphologically close congener, *Etmopterus baxteri*, which is assumed to be restricted to South Australia and New Zealand and is considered by some a junior synonymy to *E. granulosus*. We analysed haplotype networks attained from the mitochondrial barcoding gene COI of samples from different locations where both species were recorded, i.e. Chile, Kerguelen Island, New Zealand, and South Africa to gain insights into haplotype-correlated distribution ranges possibly referable to distinct populations.

Preliminary results from analyses of mtDNA data support the hypothesis that *Etmopterus baxteri* (New Zealand) represents a junior synonymy of *E. granulosus* and confirm the species to be present off Chile, New Zealand and South Africa. Therefore, its distribution range is probably covering the whole Southern Hemisphere. Samples analysed from several locations reveal no obvious differences between species sampled except for specimens collected at Kerguel Island, which represent a still undescribed species. Additional population genetic analyses using AFLPs (Amplified Fragment Length Polymorphisms) will be compared to results attained from analyses of the barcoding gene and will produce more detailed data concerning differences between potential populations inhabiting different locations. In times of expanding deep sea fisheries, the distribution ranges of deep sea sharks, which are common commercial fishery bycatches, remain unclear and need to be analysed in detail to separate endemic from widespread species which demand alternative sustainable strategies for fisheries managment and conservation.

RAPID MORPHOMETRIC MEASUREMENT OF STINGRAYS USING DIGITAL PHOTOGRAPHY

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A comparison between physical morphometric measurements and photographic measurements was carried out on 60 stringrays (*Hymantura gerrardi*, and *Gymnura poecilura*). Nearly all measurements showed highly significant correlation between photographic and physical methods. Large measurements such as length of pectoral margins or snout to vent distance were nearly identical in both sets of data. Small measurements such as gill width or spiracle width showed traces of discretization in the physical measurements. For measurements located near the edge of the photograph (preorbital length or preoral length) suggestion of a small parallax bias was also observed. Overall, the photographic method used in the present study provides a quick and inexpensive alternative to traditional morphometric physical measurements.

EGG CASES MORPHOMETRY USED FOR SPECIFIC DETERMINATION OF SOME MEDITERRANEAN SKATES

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In the Mediterranean Sea at least 15 rays species have been recorded, but objective difficulties occur in the identification at specific level, especially due to a high morphological interspecific variability. Analyses on some morphometric parameters of several hundreds egg cases from Italy and Spain suggest a set of linked characteristics typical of some species that could be useful in the taxonomic discrimination. The species that can be determined with a significant probability from the egg-cases characteristics are, by now, *Raja miraletus, Raja asterias, Raja polystigma, Raja clavata, Raja undulata, Raja brachyura, Dipturus nidarosiensis, Dipturus oxyrinchus* and *Rostroraja alba*.

Key-words: *Rajidae, egg cases, Mediterranean Sea.*

COMPARATIVE ASPECTS OF HABENULAR NUCLEI IN DIFFERENT SPECIES OF FISHES

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In the last years our research attivity focused on diencephalic asymmetries, especially about habenulae; in fact, diencephalic habenular nuclei of several species of Chondrohycthyes and Ostehycthyes were investigated in order to ascertain their asymmetry. These nuclei are diencephalic structures, part of the olfactory tract that links telencephalon and ventral mesencephalon.

In our previous works we showed, with differents techniques, diencephalic asymmetries of some species of Elasmobranch (*Scyliorhinus canicula, Hydrolagus mirabilis, Myliobatis aquila* and *Raja asterias*); in this work we do a comparison among other Elasmobranch and Teleostean species and we give a summary of our results.

Briefly*, Raja asterias, Squalus acanthias, Mustels mustelus,* and *Scyllium stellare* show the left habenula larger than the right, as occurs in all the Elasmobranchs till now investigated. Among the species of Teleostean we studied, the habenulae of *Liza aurata, Anguilla anguilla* and *Trisopterus minutus* are symmetrical, while in *Lepidorhombus boschi, Platichthys flesus* and *Solea vulgaris* the habenulae are slightly asymmetrical. This finding might suggest a relation, to be better investigated, among bentic life and habenular asymmetry in teleostean.

THE *CHLAMYDOSELACHUS ANGUINEUS* IN THE ZOOLOGICAL MUSEUM OF THE UNIVERSITY OF BOLOGNA

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With this work we would like to indicate the presence in the Museum of Zoology of the University of Bologna of one individual of *Chlamydoselachus anguineus,* an extremely interesting Chondrichthyan, that shows very primitive features, such as to be considered a living fossil. In fact, the only living species of *Chlamydoselachus* genus, exibits very different morphological characters from other Elasmobranch species.
The mouth is terminal, not ventral, and after a careful observation it's possible to see that the placoides scales around the external side are much larger than the other, demonstrating the derivation of the teeth from the same placoides scales; internally, in the mouth, teeth have three peaks each, and are arranged in rows with a characteristic sequence; they have a small spiracle and there are six pairs of gill slits; the caudal fin has the only upper labe.
This *Chlamydoselachus* was caught with bottom trawls along the Irish coast of the Atlantic Ocean, during an oceanographic cruise, and it's preserved in formalin at the collection of the Museum.

MOLECULAR PHYLOGENY AND NODE AGE ESTIMATION OF LANTERN SHARKS (ELASMOBRANCHII: ETMOPTERIDAE)

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Deep-sea Lantern Sharks (Etmopteridae) represent the most speciose family within Dogfish Sharks (Squaliformes). We compiled an extensive DNA dataset to estimate the first molecular phylogeny of the family and to provide node age estimates for the origin and diversification for this enigmatic group. Phylogenetic inferences yielded consistent and well supported hypotheses based on 4685 bp of both nuclear (RAG1) and mitochondrial genes (COI, 12S- partial 16S, $tRNA_{Val}$, and $tRNA_{Phe}$).The monophyletic family Etmopteridae originated in the early Paleocene around the C/T boundary, and split further into four morphologically distinct lineages supporting three of the four extant genera. The exception is *Etmopterus* which is paraphyletic with respect to *Miroscyllium*. Subsequent rapid radiation within *Etmopterus* in the Oligocene / early Miocene was accompanied by divergent evolution of bioluminescent flank markings which morphologically characterize the four lineages. Higher squaliform interrelationships could not be satisfactorily identified, but convergent evolution of bioluminescence in Dalatiidae and Etmopteridae is supported.

FOSSIL ELASMOBRANCHES OF THE BALEARIC ISLANDS ON SCIENTIFIC COLLECTIONS OF MENORCA AND MALLORCA

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In the Balearic Islands, since time ago one has evidence of the presence of fossil teeth of elasmobranches in materials of different chronology. There are simple works of ancient pioneers in this field, but an author who hit a strong push was Federico Gómez-Llueca at the beginning of 20th century, studying the teeth of fish of the upper Miocene of Muro (Mallorca). Some years ago, Joan Bauzà dedicated a lot of effort to the study and collection of the Majorcan fossil fish, becoming a specialist with more that 50 papers published.

A revision of the data bases of the fossil elasmobranches of Menorca and of Mallorca has been preserved in scientific collections of Menorca and Mallorca. In Menorca the data come from two private collections (Josep Quintana and Fernando Escalante collections) and other one of collection of the Museu Diocesà de Menorca (Ciutadella de Menorca). In Mallorca the material comes from collections deposited in two scientific societies: the Society of Natural History of the Balearics (SHNB, Palma de Mallorca), and the Balearic Museum of Natural Sciences (MBCN, Sóller).

We have elaborated this work with the following methodology: consulting the data bases of the SHNB and the MBCN, revision of material in collections and bibliographical research. Some fossils yet it was not to included on the data base, for which data has been used for introducing new registers into the basis, as the case of the fossil elasmobranches of the collection Andreu Muntaner of the SHNB.

It has been tried to unify synonymous spices following recent taxonomical criteria of near 1900 fossils.

In the SHNB there are different bodies of collections with fossil teeth of elasmobranch, the Andreu Muntaner collection, the Damià Vicens collection, the Francesc Gràcia- Damià Vicens collection, the Joan Rosselló collection and the La Salle (Palma) collection (about 250 specimens).

In the MBCN there is the most important collection of remains of elasmobranches of the Balearic Islands, the Joan Bauzà collection, with about 1550 specimens.

It can be called that 99% of the total of specimens are teeth. The rest, (1%) some caudal sting, one articulates. 78% of the specimens from Mallorca comes of *Carcharias* cf *taurus* (that is about 1400 specimens are of this taxa).

The major part of the fossils comes from the deposits of the upper Miocene. The fossils of the Cretaceous, Eocene and Pleistocene are very scarce. Referent to the taxa present on the collections, there are some coming from Cretaceous and eocenic deposits, as *Isurus mantelli* is; Miocene, as they are: *Carcharias cf. taurus, Carcharodon megalodon, Isurus hastalis, Isurus desori*, *Galeorcedo aduncus, Carcharhinus priscus, Carcharhinus egertoni*, *Notorynchus* sp, *Sphyrna prisca*, *Hemipristis serra, Myliobatis* cf. *meridionalis*; Pliocenes: *Carcharhinus egertoni*, *Carcharias acanthodon*, *Galeocerdo* sp, *Myliobatis* cf. *aquila*; and of Pleistocene deposits: *Carcharodon carcharias*.

COMPLEX CONTROL OF PHOTOPHORES LUMINESCENCE FROM A LANTERNSHARK, *ETMOPTERUS SPINAX* (SQUALOIDEA: ETMOPTERIDEA)

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Lanternsharks are small deepwater sharks endowed with the ability to emit light from thousand of tiny light organs called photophores. Various benefits have been suggested for this phenomenon including camouflage by counter-illumination and intraspecific communication. Here we present results of the first physiological study on luminous control mechanism of photophores from Etmopterus spinax. Pharmacological experiments and immunohistochemical labelling reveal that light emission is under hormonal control: melatonin and prolactin trigger a long lasting luminescence from photophores, hormones receptors were identified using antagonists. Immunoreactive cells to both hormones were detected. We further demonstrate that hormonally-induced luminescence is modulated by nitric oxide (NO) and inhibited by α-MSH. The presence of an inhibitory tonus that prevents photophore to emit light is also suggested. A control mechanism is proposed for *Etmopterus spinax* luminescence; features related to the ecology of this deepwater shark species will be highlighted. It is the first time that a hormonal control of luminescence is demonstrated in fishes.

MICROMORPHOLOGY AND MECHANICS OF THE TESSELLATED SKELETON OF CARTILAGINOUS FISHES

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The endoskeletal elements of sharks and rays are comprised of an uncalcified, hyaline cartilage-like core overlain by a thin layer of mineralized hexagonal tiles (tesserae), adjoined by intertesseral fibers. The basic spatial relationships of the tissue phases (unmineralized cartilage, mineralized cartilage, fibrous tissue) are well-known —endoskeletal tessellation is a long-recognized synapomorphy of elasmobranch fishes— but a high-resolution and three-dimensional (3D) understanding of their interactions has been hampered by difficulties in sample preparation and lack of technologies for visualizing microstructure and microassociations. We have used cryo-electron microscopy, microfocus computed tomography and synchrotron radiation tomography to investigate the tessellated skeleton down to submicron thicknesses but without damage to the delicate relationships between phases or among tesserae. Our digital tomographic methods are non-invasive and thus provide non-destructive investigations of never before appreciated hard tissue anatomy on any virtual slice plane and in both extant and fossil species. Our data reveal structural features (e.g. canalicular passages linking cells within tesserae, mineralized cross-bridges connecting adjacent tesserae) that are likely important for the growth and mechanics of elasmobranch skeletons. We discuss these and other microanatomical features in the context of models we have generated of tessellated cartilage function and address where these “typical” morphologies are modified, such as high-stress or curved regions of the skeleton. We also highlight our 3D methodologies, which present several compliments and advantages to traditional dissection or chemical preparation of heterogeneous tissues such as tessellated cartilage.

FEEDING HABITS OF THE CHILEAN ROUND RAY *UROTRYGON CHILENSIS* (GÜNTHER, 1871) (MYLIOBATIFORMES: UROLOPHIDAE) IN THE GULF OF TEHUANTEPEC, MEXICO.

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We analyzed 275 chilean round rays *Urotrygon chilensis* from the Gulf of Tehuantepec, Mexico. Samples were taken between May and August 2007 at different depths, ranging from 13 to 53 m. For each individual, we recorded sex, total length (TL), disc width, weight and maturity stage (newborn, young, adult). The females ranged from 12 to 44 cm TL; males were between 11.6 and 32 cm TL. The chilean round ray females had a larger size than males. We found sexual dimorphism in this species, with males presenting cusped teeth and females with molariform teeth. Our results indicate that crustaceans and polychaetes were the dominant prey for rays of both sexes. The index of relative importance (IIR) showed the main prey categories for chilean round rays, which were amphipods, decapods, polychaetes, stomatopods and fishes. Both sexes seems to be opportunistic predators which take advantage of available prey resources in their distribution area. The Gulf of Tehuantepec appears to be an important feeding area for this species, but also might be a nursery and mating ground.

Key words: *Urotrygon chilensis,* feeding habits, Gulf of Tehuantepec

PHYLOGENETIC CONSISTENCIES IN DIFFERENT PATTERNS OF BIOACCUMULATION OF MULTIPLE TRACE ELEMENTS FROM SEAWATER BY CHONDRICHTHYAN AND TELEOST FISHES

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Multi-tracer experiments of the accumulation from seawater and tissue distributions of trace elements (^{54}Mn, ^{60}Co, ^{65}Zn, ^{134}Cs, ^{241}Am, ^{109}Cd, ^{110m}Ag, ^{75}Se and ^{51}Cr) by three teleost and three chondrichthyan fish species evaluated the hypothesis that these taxonomic groups have different bioaccumulation characteristics, based on previously established contrasts between the chondrichthyan *Scyliorhinus canicula* (dogfish) and the teleost *Psetta maxima* (turbot). Discriminant function analysis on whole body: water concentration factors (CFs) for trace elements separated dogfish and turbot in two independent short-term experiments. and classification functions grouped all individuals of the teleosts, seabream *Sparus aurata* and seabass *Dicentrarchus labrax*, with turbot and the chondrichthyans, undulate ray *Raja undulata* and spotted torpedo *Torpedo marmorata*, with dogfish, thus supporting our initial hypothesis of taxon-based bioacumulation patterns. Hierarchical classificatory, multi-dimensional scaling (MDS) and similarity (ANOSIM & SIMPER) analyses based on the CFs for the nine radiotracers, also separated all three teleosts (that aggregated lower in the hierarchy) from all chondrichthyans that were more diverse amongst themselves compared to teleosts. Dogfish were the most distant from teleosts, followed by the undulate ray and then torpedo. Similarly, the results of these analyses performed on each of six dissected body components repeatedly separated teleosts from chondrichthyans.

Among the several multivariate statistical techniques that compared the CFs between the fish taxa particular trace elements were repeatedly prominent in determining the separations between teleosts and chondrichthyans, viz. Cs-134 was elevated in teleosts and Zn-65 was elevated in chondrichthyans. For both these elements the differences between taxa are interpreted as being predominantly due to variable uptake rates rather than loss rates. Chondrichthyans were also higher in Cr-51, Co-60, Ag-110m and Am-241, whereas teleosts were higher in Mn-54.

Based on CFs for whole bodies our results are also consistent with the chondrichthyans used in this experiment being more susceptible to contamination from exposure in seawater for a greater range of trace elements, compared to the teleosts examined, and other previous studies that have indicated increased sensitivity of chondrichthyans to metal exposure compared to marine teleosts.

GENETIC DIVERSITY OF BASKING SHARKS (*CETORHINUS MAXIMUS*) – A NORTH ATLANTIC PERSPECTIVE AND ITS GLOBAL RELEVANCE

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This study presents the first project of the newly founded Norwegian Shark Alliance “HAI Norge”. The aim was to investigate the genetic diversity of basking sharks occurring in Norwegian waters using samples from former commercial fisheries that were presumed to be lost for more than 10 years.

Basking sharks (*Cetorhinus maximus*) are distributed worldwide. Due to a relatively long gestation period and few offsprings the reproduction rate is relatively low, and the species is therefore very sensitive to overfishing. Accordingly, basking sharks are globally classified as vulnerable in the IUCN red list and listed on Appendix II of the CITES. Earlier studies have addressed the mitochondrial DNA diversity through sequencing of 1149 bp of the control region (CR). They detected only 6 haplotypes, and haplotype and nucleotide diversity were low on a global scale. Only 3 individuals from the Norwegian Sea were included. In the current study we assessed the mitochondrial DNA diversity through genotyping 28 basking sharks captured in the 1990s at the Norwegian coast. The mitochondrial control region was amplified in two overlapping fragments using different primer combinations of previously published primers. We analyzed 1045 bp that could be unambiguously read for all samples, and covered most of the region that was targeted earlier. As expected, mitochondrial diversity was low with only 5 positions variable. 5 haplotypes were found in frequencies between 5 and 40% with a haplotide diversity of h = 0.748 +/- 0.058 and a nucleotide diversity π = 0.00121 +/- 0.00023. Our study confirms earlier results of a low genetic diversity in *C. maximus*. Increased sample size from the Norwegian Sea did not reveal new mitochondrial haplotypes. However, haplotype BS4 that was not very common in earlier studies was the secondmost frequent in our dataset. The current study also supports the previous finding of a low genetic diversity of basking sharks

worldwide, and the data are in line with the hypothesis of a population bottleneck that affected the global diversity. We will also use museum samples (some of them 100 years old) to investigate temporal variations in genetic diversity and present current results.

COMPARATIVE ANALYSIS OF THE INDIVIDUAL AGE OF THE BLUE SHARK, PRIONACE GLAUCA IN THE SOUTHWEST INDIAN OCEAN

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The blue shark, *Prionace glauca*, is a ubiquitous oceanic pelagic predator and one of the main bycatch species in longline fisheries worldwide. Amount of scientific and fisheries-related data is varies widely between regions. Little is known about this species from Southwest Indian Ocean, which makes difficult to evaluate and to quantify the status of this species. In this context, basic knowledge on life history traits such as growth rates and demographic structure of the populations are necessary for prediction of population responses to disturbances, such as fishing pressure.

Age and growth rate estimates for 48 individual blue sharks were obtained based on counting of growth increments on central cones of whole and sectioned vertebrae. Samples were collected in the southwestern Indian Ocean from dead individuals caught accidentally by commercial long-liners and during in research cruises from the East of Madagascar, along the Mozambique Channel and the West of Reunion Island. An anterior portion of the vertebral column (above the branchial chamber) was removed, thawed, cleaned of excess muscles and tissues, separated into individual vertebra and dried. The second or the third vertebra which was photographed whole before sectioning transversally into 0.7-0.9 mm thick slabs, using a Buehler low-speed saw with two diamond blades, was used for analysis. Growth bands in both cases were viewed using a binocular microscope with transmitted light. Each growth band consisted opaque zone on the section or as a ridge on the surface of the centrum for non-sectioned vertebra were considered as annuli.

Size of sampled sharks ranged from 125 to 243 cm fork length. Preliminary results indicated that the age estimates did not depend on the method of

vertebral preparation. No statistical difference was found on age estimations between sectioned and whole vertebrae. Ages determined from whole vertebrae varied between 10 to 25 years, while age counts from the sections ranged from 10 to 23 years. The von Bertalanffy growth model using empirical length at birth provided the biological and statistical fit to the data. This model gave parameter estimates of L_{∞}= 258cm fork length (FL) and k = 0.18 $years^{-1}$ for male and L_{∞} = 252cm FL and k = 0.13 $years^{-1}$ for female. Male and female exhibited statistically significant differences in growth, indicating than female grow slower and are smaller than male. Our length-age estimates for blue shark are consistent with north Atlantic studies but highly differ from age estimated obtained from south Atlantic. Therefore an age validation study is required before hypothesis on annual growth band formation could be accepted.

Keywords: *Prionace glauca*, ageing, growth, vertebra, transverse section, growth bands, von Bertallanffy

FEEDING ECOLOGY OF ELASMOBRANCH SPECIES IN THE WESTERN MEDITERRANEAN

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The feeding ecology of 8 elasmobranchs (*Scyliorhinus canicula*, *Galeus melastomus*, *Etmopterus spinax*, *Raja clavata*, *Raja miraletus*, *Leucoraja naevus*, *Raja polystigma* and *Myliobatis aquila*) was studied by analysing the stomach contents of specimens caught during three surveys, carried out in the Balearic Island in the summer from 2007 to 2009. Stomach contents were analysed to describe food habits and trophic interactions between the species studied. Food items were identified to the lowest identifiable taxon and were further assembled into major taxonomic groups. The following indices were used to determine the importance of each prey in the diet of these species: i) frequency of occurrence (F %); ii) percentage by number (N %); iii) percentage by volume (V %); and iv) index of relative importance (IRI %). Multivariate analyses were used to detect interspecific differences in diet and the effect of biological and environmental parameters in the most abundant species.

The similarity percentage analysis (SIMPER) highlighted the generalized diet exhibited by all elasmobranchs species except for *Myliobatis aquila*. In terms of IRI % the diet of *Etmopterus spinax* consisted primarily of cephalopods. Euphausiids were the most important prey for *Galeus melastomus*. *Scyliorhinus canicula* had the most diverse diet, showing preferences for polychaetes, bony fishes, and reptantian crustaceans. *Raja clavata* also feed on a wide variety of preys, being the main diet categories bony fishes, and both natantian and reptantian crustaceans. Brachyuran crabs and natantian crustaceans were the most important preys for *Raja miraletus*. *Leucoraja naevus* mainly fed on natantian crustaceans. Natantian crustaceans were also important food items for *Raja polystigma*. *Myliobatis aquila* feed primarily on brachyuran crabs. The results are discussed taking into account the resource partitioning and dietary overlap among species related to environmental and biological factors.

REPRODUCTION AND ISOTOPIC CHARACTERISTICS OF *Sphyrna lewini* IN SOUTH OF MEXICO.

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The reproduction and stable isotope were analyzed in scalloped hammerhead shark *Sphyrna lewini,* which is one of most important species in the shark fisheries in Mexico. Samples were collected every week at the artisanal fishing in Salina Cruz, Oaxaca during 2005. A total of 749 hammerhead sharks (233 females and 516 males), including juveniles (45 to 160 cm TL) and adults (170 – 288 cm TL) were sampled. For isotopic analysis, we process 68 muscle samples from the shark dorsal area. The sex ratio in adults was 1F:2M. The hammerhead shark was present all year round, but the highest abundance was from May to July. During this period, pregnant females were presented in the area. We recorded 40 pregnant females with a fecundity interval of 6 to 40 embryos. Births were in July to August and the birth size was from 41 to 51 cm TL. The size of first maturity for females was 220 cm TL. We do not found sperm storage in the oviductal glands of females, but this condition has been confirmed for this specie. The histological analysis showed that males have diametric testes, sperm in epididymis, ductus deferents and spermatozeugmata in seminal vesicle, which suggests a size of first maturity for males at 180 cm TL. When we compare isotopic ratios for nitrogen and carbon between sexes, we found that in females, nitrogen average value was 15.43 ± 0.71‰ and for carbon -16.29 ± 0.30‰. For males, nitrogen average value was 15.44 ± 0.58‰ and for carbon -16.08 ± 0.43‰. There were no significant differences between immature sharks ($\delta^{15}N$ 15.65 ± 0.63‰; $\delta^{13}C$ -15.92 ± 0.52‰) and mature sharks ($\delta^{15}N$ 15.44 ± 0.55‰; $\delta^{13}C$ -16.17 ± 0.39). During 2005, $\delta^{15}N$ and $\delta^{13}C$ values for muscle were similar throughout the months. The reproductive condition and isotopic evidence would indicate that Salina Cruz, Oaxaca is a nursery area of scalloped hammerhead, where mature females are feeding in this area during the birth and courtship season.

TROPHIC LEVEL AND ISOTOPIC COMPOSITION OF $\delta^{13}C$ AND $\delta^{15}N$ OF *SQUATINA CALIFORNICA* IN THE SOUTHERN GULF OF CALIFORNIA, MEXICO

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$\delta^{13}C$ and $\delta^{15}N$ **s**table isotopes were used to determine trophic level and the assimilated food components of Pacific angel shark, *Squatina californica* and its variation between size, sexes and seasonally in the southern Gulf of California, Mexico. Muscle tissues from the anterior-dorsal region of 38 angel sharks were analyzed with a mass spectrometer. The values of stable isotope of carbon ($\delta^{13}C$) ranged from -16.55 to –15.06‰ (av. -15.94‰ ± 0.34); and nitrogen ($\delta^{15}N$) was between 18.30 to 19.52 ‰ (av. 18.90‰ ± 0.27), we found that as male as female feeds on same zones, not differences were found among years and seasonally, therefore the angel shark present a same trophic level to feed on benthic preys in the coast zone. Trophic level determined for *S. californica* was 4.5, therefore is considered a tertiary consumer in the southern Gulf of California.

TROPHIC SPECTRUM OF THE BLUE SHARK *PRIONACE GLAUCA* (LINNAEUS, 1758) IN THE WEST COAST OF BAJA CALIFORNIA SUR, MEXICO

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The blue shark *Prionace glauca* is the main shark species on the catch in the western coast of Baja California Sur. It is the most abundant and widespread oceanic shark in the world. Despite its importance, there are very few studies on its feeding habits, and none for the Mexican Pacific. A number of 368 samples from the artisanal fishery of Las Barrancas, Punta Belcher and Punta Lobos were analyzed. In the field, sharks were measured and identified by sex; the stomach was removed and fixed in 10% formaldehyde for posterior analysis in the laboratory). Prey were separated, weighed and identified depending on the digestion state. The trophic spectrum of *P. glauca* was 13 cephalopods, 7 fish, 3 crustaceans, one macroalgae, one bird and one elasmobranch. We applied the Index of Relative Importance (IRI) to determine the most important prey item in terms of number, weight and frequency of occurrence. The most important prey was *Pleuroncodes planipes*, followed by the squid: *Gonatus californiensis*, *Ancistrocheirus lesueurii* and *Haliphron atlanticus*. Levin's Index indicated that the blue shark is a specialist (*Bi=0.08)* despite its spectrum amplitude. This is because only one part of the food components had a considerable importance. Diet overlap was evaluated using the Morisita-Horn Index. We determined that between sexes trophic overlap was medium (*C*λ= 0.35) and between sizes (juveniles-adults) it was high (*C*λ= 0.95).. We conclude that the blue shark is a predator that feeds mostly on squid, showing considerable vertical migrations given that its prey have epipelagic, mesopelagic and benthonic habits. We infer that this species presents sexual segregation given that we obtained a medium diet overlap, which does not occur between juveniles and adults due to their high trophic similarity.

CONTRASTING PATTERNS OF METAL AND RADIONUCLIDE ACCUMULATION IN THE ELASMOBRANCH AND TELEOST EGG.

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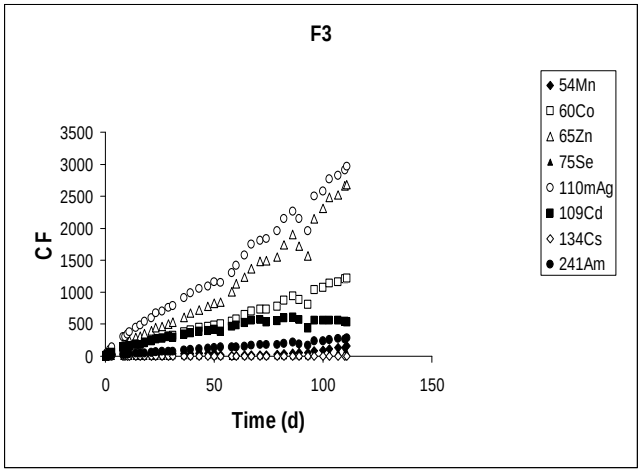
Egg-laying cartilaginous fishes, in general contrast to bony fishes, have low intrinsic rates of increase and small numbers of large eggs with embryos that develop slowly after laying in coastal waters. The quality of these waters is increasingly under threat from a variety of land-based contaminants.

This experimental study has investigated the comparative susceptibility of dogfish and seabream eggs to contamination by various stable and radioactive elements during the period from their oviposition to hatching. This period extends to over 100 days in dogfish eggs and is typically a most sensitive stage in the life cycle of fishes, with regard to toxic effects of metals.

The typical full-term patterns of accumulation of various radiotracers in a dogfish egg are shown below;



where CF is the ratio of radiotracer in the total egg relative to that in water. All radiotracers enter the interior of the case and are accumulated in the embryo, but most are associated with the collagenous egg-case, which can reach CFs of 5-15. 10^3. This very high accumulatory capacity of the egg-case for gamm-

emitting radionuclides captures the embryo within a surrounding radiation field that increases in intensity during the long embryonic developmental period. In contrast, for the seabream egg there is a relatively quick equilibration between the level of radionuclide associated with the egg and that in the water, and at much lower levels CFs, as exemplified by Co-60;

AGE AND GROWTH OF THE BROWN RAY, *RAJA MIRALETUS*, OFF THE GULF OF GABÈS (SOUTH-CENTRAL MEDITERRANEAN SEA)

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The life histories of skates have become an area of rapidly growing interest because of the regularity and volume with which they are taken as bycatch in commercial fisheries. The goal of this study was to assess the age and growth of the brown ray *Raja miraletus* in the Gulf of Gabes (central Mediterranean Sea) using vertebral annuli counts. The age and growth parameters were determined from 95 females (13.5- 56 cm total length (TL)) and 85 males (13.5 to 58 cm TL) collected from January to December 2007.

The relationship between total length and total mass did not significantly different between sexes. The relationship between total mass (TM) and TL for both sexes combined was expressed: $M= 1\times10^{-3}\ TL^{3.35}$.

The relationship between TL and vertebral radius (VR) for combined sexes was linear (TL = 5.057 + 237.9 VR), suggesting isometric growth of vertebrae with total length. Annual deposition of growth increments was verified with marginal increment analysis. The observed maximum ages were 7 years for males and 9 years for females. Von Bertalanffy parameters were L_∞ = 67 cm, k = 0.22 $year^{-1}$, t_0 = -1.017 year for males and L_∞ = 69.19 cm, k = 0.18 $year^{-1}$, t_0 = -0.11 for females. Age at 50% sexual maturity was 2.38 years for males and 3.86 years for females.

The basic age and growth parameters for the brown skate provided in the present study support the hypothesis that *R. miraletus*, like other elasmobranchs, require conservative management because of their slow growth rate and susceptibility to over-exploitation.

DIET COMPOSITION OF ROUGH RAY, *RAJA RADULA* IN THE GULF OF GABÈS (CENTRAL MEDITERRANEAN SEA)

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The diet of the rough ray, *Raja radula*, in the Gulf of Gabès (Southern Tunisia) was investigated with respect to fish size, season and sex. Stomach contents of 950 (400 males, 550 females) specimens, 13.5 to 80 cm in Total length, collected from January to December 2007 were analyzed. Of the total number of stomachs examined, 183 were empty (19.26%). The species fed mainly on crustaceans and teleosts while cephalopods, sipunculids, polychaets and echinoderms were minor components of the diet. No significant differences were found between the diets of males and females but ontogenetic changes in diet were observed, with crustaceans preys decreasing in importance while teleosts importance increasing with increasing skate size. Predation patterns on other invertebrates were not related to fish size. Prey diversity increased also with size, large and mobile prey species were found more commonly in the diet of larger skates. Diet composition changed seasonally in accordance with the dynamics of the predator and the prey species in the area.

MORPHOLOGICAL AND DEVELOPMENTAL STAGES OF EMBRYOS OF MAKO SHARK, *ISURUS OXYRINCHUS*, IN THE SOUTH PACIFIC.

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The reproductive cycles of large elasmobranchs have been scarcely described because of dispersion of individuals and the difficulty to find pregnant females in open ocean.

A total number of eight pregnant shortfin mako sharks females (*Isurus oxyrinchus* Rafinesque, 1810) were collected from the Central South Pacific. Reproductive data of six of them captured between 2006 and 2007 and a total of 70 embryos were analyzed. Data collected on litters included number of embryos, length and mass of embryos, maternal length, capture date and location and sea surface temperature. Several stages of pregnancy were defined. All embryos were between incipient-developing stage, with large yolk sac and no dentition, and advanced-developing stage, with developing dentition and well-defined inner organs. The maximum number of embryos observed in a litter was 16. Several biometrics measures were taken, such as fork and total length, weight and others. Litter size was related to maternal length.

Key words: Lamnidae, *Isurus oxyrinchus*, shortfin mako, sharks, reproduction, embryo, biometry.

TROPHIC INTERACTIONS AMONG THREE RAJIDS, RAJA ASTERIAS, RAJA BRACHYURA, AND RAJA MIRALETUS IN THE CENTRAL-WESTERN MEDITERRANEAN.

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The feeding habits and trophic interactions of three shallow water raijds, *Raja asterias*, *Raja brachyura* and *Raja miraletus*, were studied. The specimens were caught during trawl surveys hauled from 2005 to 2008 at depths between 30 and 138 m in the seas surrounding Sardinia (central-western Mediterranean). All the three species were stenophagous predators, as confirmed by the low values of Shannon and Levin indexes (Bi = 0.15, 0.26 and 0.38 respectively, and H'= 1.12, 1.53 and 1.62). The high values of the Morisita's index showed no differences in the diets of males and females for all the species (C = 0.99, 0.89, and 0.82 respectively). The ontogenetic analysis of the diets of three size groups (small, medium, large) showed a similar predatory behaviour. The young individuals feed mainly on small Crustacea (principally small Decapoda Brachyura in *R.asterias*, Mysidiacea and Amphipoda Gammaridea in *R. brachyura*, and small Decapoda Natantia, Mysidiacea and Amphipoda Gammaridea in *R. miraletus*). Medium and large individuals replace these preys with bigger and more mobile ones (mainly bigger Decapoda Brachyura in *R. asterias*, Osteichthyes in *R. brachyura* and bigger Decapoda Natantia in *R.miraletus*). The Morisita's index and the multidimensional scaling analysis showed high levels of intraspecific competition and low levels of interspecific competition.

LIFE HISTORY OF THE WHITE SPOTTED EAGLE RAY *AETOBATUS NARINARI*

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Aetobatus narinari, a circumglobally occurring batoid, has been listed as 'near threatened' globally and 'vulnerable' in Southeast Asia by the World Conservation Union Red List of Threatened Species since 2006. However, the species is hard to protect and manage adequately as fisheries relevant life history information is lacking. In this study, *A. narinari* was found to grow slowly (k=0.033), mature late, and produce few young, potentially rendering the species susceptible to overfishing. Females grew slower, matured later and attained larger sizes than males. Neonate disc width averaged 54 cm, while size at maturity was estimated around 130.0 cm for males and >150.0 cm for females. Like other myliobatids, *Aetobatus narinari* is a matrotrophic viviparous species that exhibits lipid histotrophy. Only the left ovary and left uterus were found to be functional. The presence of mature sperm in the testes, collecting ducts, epididymis and ductus deferens coincided with the estimated time of parturition and mating. Catches in Taiwan and Australia indicated an unbiased sex ratio. *Aetobatus narinari* is a hard prey specialist that feeds mainly on gastropods, molluscs and hermit crabs. Molluscs comprised the most important prey group and were observed in 83.3 % and 100% of stomachs of rays from Australia and Taiwan respectively. Only minor regional and no gender specific differences were observed related to feeding and only minor dietary shifts, from a gastropod-crustacean based diet to a more gastropod-bivalve based diet, occurred as body size increased.

ONTOGENETIC AND SEXUAL VARIABILITY OF DENTAL AND PLACOID SCALES IN TWO SPECIES OF LATERN SHARKS, (CHODNRICHTHYES, ETMOPTERIDAE)

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Comparative morphology is a useful tool to address general and special evolutionary aspects of an organism. The present study considers two species of lantern sharks (*Etmopterus lucifer*, *E. spinax*) focusing on the intra- and interspecific variations of placoid scale and dental morphologies. Scale morphology and arrangement is very diverse among *Etmopterus* spp. Generally, three types of dermal denticle shapes are distinguished: (a) low flat, concave sessile crowns, (b) erect thornlike, cuspidate crowns, arranged in regular longitudinal rows (c) erect thornlike, cuspidate crowns, not arranged in regular longitudinal rows. The dentition is dignathic heterodont with multicuspid teeth in the upper and unicusp bladelike teeth in the lower jaw. For the present study, 23 specimens of each species including both sexes and different ontogenetic stages were used. Skin-tissue samples were extracted from four different parts of the body; an anterior and a lateral tooth were extracted from the upper jaw of each specimen. Results are: (1) the number of tooth cusplets in small juveniles is similar in either species; (2) there is ontogenetic dimorphism in cusplet numbers in both species; (3) scale size significantly dimorphic between species; (4) density of scales significantly dimorphic between species; (5) scale size ontogentically dimorphic within species; (6) scale arrangement similar in embryonic and mature specimens within species. Juveniles up to 300 mm SL of both species display similar tooth shapes. This is not the case in adult specimens displaying significant interspecific dental dimorphisms. The relative number and arrangement of placoid scales differs in both species and probably is a species-specific character but also indicate different functions such as hydrodynamic affects and protection against ectoparasites.

A CONSERVATION AND MANAGEMENT CHANCE FOR ELASMOBRANCHS IN THE ITALIAN WATERS: FIRST RESULTS FROM MONITORING OF CETACEAN BY-CATCH IN THE ADRIATIC SEA

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In compliance with the Regulation (EC) No. 812/2004, Italy is monitoring cetacean accidental catches through a specific research programme (BYCATCH), funded by the Italian General Directorate of Fishery and Aquaculture and coordinated by CoNISMa and ISPRA. In particular, the programme monitors the pelagic and mid-water trawling operations in Italian waters, mostly in Adriatic Sea. Taking advantage of this activity data on elasmobranchs were also recorded. The monitoring revealed 20 different species of cartilaginous fishes. Some of these, such as *Squalus acanthias*, *Myliobatis aquila*, *Pteromylaeus bovinus*, and *Pteroplatytrygon violacea*, caught in relevant numbers. Others catches are also worth noting, such as those of *Alopias vulpinus*, *Alopias superciliosus, Carcharinus plumbeus* and *Prionace glauca*. Additional opportunistic observations allowed to record landings of others important chondrichthyans, like *Lamna nasus* and *Mobula mobular*. This high incidence of captures of elasmobranch species seems to confirm that the Adriatic Sea is a strategic site for these marine vertebrates. Its hydrological and oceanographic features makes in fact this area one the most productive of the Mediterranean basin that can support a complex food web and represents a great attraction for large predators. On the other hand, the high level of elasmobranch accidental catches stresses once again the importance of the protection for these fishes, which are commonly caught also by non-target fisheries and always put on the market. Most of the species caught by mid-water trawlers are currently considered vulnerable, therefore, actions improving the scientific knowledge and reducing the impact are urgently needed. The BYCATCH programme contributes to the better understanding of this context, providing relevant information on elasmobranchs distribution, biology and bycatch rates, which are fundamental in the planning adequate conservation and management strategies.

WEST AFRICAN ACTION PLAN FOR SHARKS: WHERE ARE WE?

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Sharks have traditionally been fished in West Africa, but in the 1990s, shark fisheries were strongly developed in response to an increase of the international demand for shark products, particularly shark fins. In the whole region, shark catches increased from about 5000 t in 1990 to 26000 t in 2005. The overexploitation of the shark populations caused the sub-regional fisheries commission (SRFC) to elaborate, in 2004, an action plan for the conservation and sustainable management of shark populations (SRAP-Sharks) within the seven countries of the SRFC: Cap Verde, Gambia, Guinea, Guinea Bissau, Mauritania, Senegal and Sierra Leone. We present the results of the five-year period of implementation of this action plan. The main objectives of the SRAP-Sharks were: (1) the elaboration of harmonized regulations for the durable exploitation of rays and sharks within the sub-region, and (2) the definition of pilot plans for the reconversion of specialized fishermen and processors. During the pass five years, the following results were obtained: (1) adoption of national action plans by six out of the seven countries of the SRFC, (2) edition of a field guide for the identification of West African sharks and rays; (3) realization of a documentary film on the development of sharks fisheries in Senegal; (4) participation to the assessments of West African shark and ray species for IUCN Red List, and (5) a review of the shark fisheries within the SRFC sub-region.

EUROPEAN SHARK CONSERVATION: PROGRESS AND OPPORTUNITIES

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The fourth year of the Shark Alliance brings both satisfaction and disappointment with respect to key European shark policy goals. Since the last EEA meeting, the number of elasmobranchs protected in EU waters has tripled (from two to six), EU fishing limits for targeted shark species have been significantly tightened, and areas where skate and ray quotas apply have been expanded. A solid, long-awaited Community Plan of Action for Sharks was finalized by the European Commission and endorsed by all European Member States in the spring of 2009. At the same time, the Plan includes pledges to improve the EU shark finning regulation and adhere to scientific advice that have yet to be realized. In recent months, while Spain has acted to protect some shark species through national regulations, the European Commission has advanced proposals for EU and international elasmobranch fishing limits that have been less than laudable. The November meeting of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and December fishing quota setting by the EU Council of Ministers will be important tests of the Commission's commitment to living up to the principles in the Action Plan. Germany and the UK have strengthened their shark finning policies and yet the timing and content of the Commission's promised proposal for amending the EU shark finning regulation are of great concern. Meanwhile, thanks to strong leadership by Germany, the EU has again offered landmark proposals to list the spurdog and porbeagle shark under the Convention on International Trade in Endangered Species (CITES); efforts to ensure the success of the proposals in March 2010 are well underway. The specifics related to progress and the latest challenges in improving European elasmobranch policies will be detailed with a view toward enhancing the involvement of elasmobranch scientists in the shark and ray fisheries management process.

SKATE AND RAY MANAGEMENT AND CONSERVATION IN THE UK

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The Shark Trust works to advance the worldwide conservation of sharks, skates and rays through science, education, influence and action. Working directly with stakeholders, research institutions and the public the Trust advocates for sustainable fisheries and sound conservation management. This presentation will outline the wide range of Shark Trust activities that have converged to form the basis of a positive change in the management of skate and ray in UK waters.

Background: Although formerly supporting large UK and EU fisheries, skate have been a low priority for both fisheries management and scientific survey. There is currently no EU minimum landing size (MLS) for any species of skate or ray, and only in recent years has species specific management been enforced through the Common Fisheries Policy.

The peak in skate landings after the Second World War was followed by a steep decline; landings are now at the lowest level observed in 100 years. Assessing skate stock status has been attempted by examining fishery catch trends but most records, except fishery independent survey data, are aggregated for all species. The replacement in catches of the largest species, whose stocks have collapsed, by less valuable smaller skates, whose stocks are stable or increasing, is therefore masked and can indicate comparative stability in the aggregated catch trends.

The need to understand more about the population dynamics of individual species has been accepted as a priority requirement in order to manage or protect specific species as required. Landing and recording skate and ray by species and avoiding marketing the larger, more vulnerable species are two initiatives adopted by the UK commercial industry and later supported through the Common Fisheries Policy. In order to facilitate species identification, detailed identification materials have been produced by the Shark Trust in collaboration with a wide range of stakeholders, demonstrating a positive and productive relationship across different sectoral groups.

In conjunction with fisheries associated activities the Shark Trust have engaged the public in complimentary projects such as the Great Eggcase Hunt. The Shark Trust is currently collaborating with the Centre for Environment, Fisheries and Aquaculture Science in order to compare 6 years of eggcase records with the distribution of juvenile elasmobranchs in UK waters. The subsequent identification of critical areas will enable the Shark Trust to propose appropriate and geographically targeted management measures.

THE IMPORTANCE OF ACCESSIBLE IDENTIFICATION MATERIALS IN FISHERIES MANAGEMENT

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Elasmobranchs have long been misidentified and inadequately reported in fisheries. In most cases, species-specific data on shark, skate and ray catches is poor or lacking altogether, making trends hard to quantify with any confidence. There is a growing requirement for fish (including elasmobranchs) to be landed by species and for discards to be accounted for to make management more appropriate and effective. If this is to be a reality, accessible identification materials must be introduced at every level of the fish production industry.

For identification materials to be successful, they must be used extensively by fishers, enforcement officers, management organisations and end users. They must be clear, concise and accessible without being condescending. To this end the Shark Trust has produced an identification guide for the skates and rays of the British Isles and is producing a guide to the sharks, including some interesting and important Northeast Atlantic species.

The guide has been produced in collaboration with Marc Dando, a world-class wildlife illustrator and graphic designer, and has drawn on the expertise of scientists from institutions such as the International Union for the Conservation of Nature; the Centre for Environment, Fisheries and Aquaculture Science; the Natural History Museum in London and the Marine and Fisheries Agency. It has also involved close collaboration with the fishing industry in the southwest of England.

This presentation will discuss; the process of creating the ID guide; which areas we decided to concentrate on and why; the problems of morphological plasticity in skates; common misidentifications in the UK fishing industry; and the use of the ID guide in fisheries enforcement, with particular attention to recently prohibited species such as *Dipturus batis* and *Raja undulata*.

THE ELASMOIT PROJECT

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Elements for the Assessment and Protection of Elasmobranchs in the Italian Seas (ELASMOIT) is a project, started in February 2009, with the goal to collect information on the *status* of exploitation and conservation of elasmobranchs in the Italian seas. This project is promoted and funded by the Italian Ministry for the Environment (MiATTM) and coordinated by the Italian Society of Marine Biology (SIBM), with the primary role of the Group of the Italian Researchers on Sharks, rays and chimeras (GRIS). The ELASMOIT project especially focus on the pelagic species, as respect to demersal species less data of captures of these vulnerable species are available. The project is based on the collection of data available, from bibliography and research surveys, and on field activities. Periodic monitoring both of landings and on board of vessels operating with longlines, in five selected Italian regions (Liguria, Sardinia, Sicily and Apulia) is in fact also performed to obtain additional on the elasmobranch by-catch in those sites and improve the biological knowledge on these species. All the activities are aimed to achieve a database of references and biological data, followed by maps of distribution, and where possible abundance, for the most important species, in order to provide technical support to MiATTM for a critic revision and implementation of the guidelines for the future Italian Action Plan.

SHARKS AND RAYS OF FRENCH FISHERIES

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In the perspective of the implementation of the European Plan of Action for Sharks, the French Ministry of Fisheries took the initiative to support a series of studies on the sharks and rays of the French fisheries. These studies include the edition of a field guide for the fishermen to identify their catches by species, the determination of the conversion factors of the commercial species, and their reproductive parameters, and an analysis of the procedures to collect the fishery statisticla data.

THE STATUS AND MANAGEMENT OF THORNBACK RAY *RAJA CLAVATA* IN THE SOUTH-WESTERN NORTH SEA

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The thornback ray *Raja clavata* is the dominant skate species in the southern North Sea, and the stock also extends into the eastern English Channel. This particular stock is an important bycatch and target species for inshore fisheries in the Greater Thames Estuary. Preliminary assessments used survey data collected during the International Bottom Trawl Survey (IBTS), and indicated that the distribution and abundance of thornback ray had declined markedly in the North Sea as a whole. In recent years, it has become apparent that some of the IBTS data were compromised by confusion between thornback ray and thorny skate *Amblyraja radiata*, although recent studies still indicate a decline in the distribution of thornback ray. Despite this longer-term decline in geographical extent, survey catches in the south-western North Sea have increased in recent years. Given concern over the status of the stock, and subsequent management measures brought in during 2007, a one-year Fishery Science Partnership (FSP) project was initiated to collect further data on this stock, using commercial, inshore vessels. The main aims of the survey were to examine discard survival of skates caught in gillnet, longline and trawl fisheries, the size and species compositions of skates in the area, and other biological information. These data, including all tag return data collected to date, are presented and contrasted with data collected during annual stock monitoring surveys (using beam trawl and GOV trawl), and young fish surveys (also undertaken on inshore vessels in the same area). The benefits of dedicated inshore surveys in this area are discussed.

BASKING SHARK HOTSPOT SITES IN WESTERN SCOTLAND: DEVELOPING APPROPRIATE PROTECTION MEASURES FOR THE SPECIES ON A SITE SPECIFIC BASIS.

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The west coast of Scotland has long been recognised as a key region for the basking shark (*Cetorhinus maximus*) with active hunting of the species being prosecuted within the region from the 1700's until 1995. Since the species achieved full protection from targeted fisheries in 1999, the main threat within Scotland's waters has been removed, but a number of smaller scale threats still remain in place such as disturbance or collision with commercial and leisure craft and bycatch in a range of fishing gear.

Between 2002 and 2006 the Wildlife Trusts Basking Shark Project conducted line transect surveys in the Clyde Sea and the Sea of the Hebrides. These surveys identified two key "hotspot" sites, Canna and Hyskeir, and the island of Coll.

Through identifying key user groups that may visit these hotspot sites on a regular basis, such as ecotourism operators and owners of leisure craft, a range of equitable, appropriate and accurately targeted conservation measures have been developed that will compliment or add to existing legal and educational frameworks. Partnerships between a range of interested parties have been forged in an effort to minimise the potential impacts of human activities within these hotspot sites and encourage public support for simple, practical conservation measures. It is hoped that these measures may form a template for action should additional hotspot sites be confirmed in the future as the result of further surveys.

Additionally, the survey data will also be used to inform management and planning considerations that may potentially affect these sites in the future, as part of the long-term management process.

WHERE THERE IS WATER THERE ARE SHARKS: A CASE STUDY USING LOCAL ECOLOGICAL KNOWLEDGE (LEK) TO IDENTIFY SHARK RIVER HABITATS IN FIJI, SOUTH PACIFIC

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Local people's ecological knowledge (LEK) has the potential to improve community-based coastal resource management (CBCRM) by providing baseline data such as information about the presence, behaviour and ecology of species inhabiting their environment. Our major aim was to explore the potential of LEK and traditional ecological knowledge (TEK) to identify shark river habitats in Fiji, to learn how locals regard and use sharks, and to capture ancestral legends and myths that shed light on the relationship between local people and these animals. Interviews with representatives from 29 villages, communities and fishing settlements associated with eight riverine areas on Viti Levu and Vanua Levu confirmed the presence of sharks in estuaries and rivers on Fiji. Many locals consume shark meat as a source of protein, while for others, sharks are considered sacred and are not consumed, as these animals have a rich background in ancestral stories and play an important part in Fijian myths and legends. When combined, these two factors result in the support of conservation measures by local villagers. Our results lay the foundation for future investigations into coastal and riverine waters in Fiji that may eventually lead to the protection of these important habitats and their fauna.

CONSERVING UK MARINE BIODIVERSITY: ELASMOBRANCHS AND THE UK BIODIVERSITY ACTION PLAN

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As a signatory to the 1992 Convention on Biological Diversity, the UK committed to creating and enforcing a strategy to conserve and enhance biological diversity. Launched in 1997, the UK Biodiversity Action Plan (UK BAP) is the UK's response to this commitment, identifying those species and habitats urgently requiring conservation management, and laying out detailed plans for their protection. As we approach 2010 fifteen elasmobranch species are now identified in the UK BAP as requiring priority conservation management. This reflects a growing disquiet surrounding the over-exploitation of sharks, skates and rays, not only in UK waters, but throughout world oceans. It also represents progress for the Shark Trust and other conservation organisations. Through the provision of impartial scientific, regulatory and policy advice, the Shark Trust has developed productive relationships with a wide variety of stakeholders, ranging from commercial fishers, anglers and divers, to regulatory authorities and UK and EU ministers. With **Natural England** funding the Trust continues this approach, promoting key UK BAP objectives: advocating greater protection of elasmobranch species and research on their role in marine ecosystems, as well as more effective management of existing shark, skate and ray fisheries.

CONSERVATION AND ART: THE POWER OF AN IMAGE

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The age old adage, “A picture is worth a thousand words" helps to illustrate the power that an image can hold on the mind. In a blink of an eye an image can stir an emotive response and convey a series of complex concepts that words could not simply generate. This is the reason why images are so powerful; stirring an emotional responsive from an audience can motivate action and promote change in aid of conservation. In this study I will be looking at positive and negative imagery surrounding sharks and how the Shark Trust utilises images to advance shark conservation.

FASHION ENDANGERING STINGRAYS? – TRADE IN RAY LEATHER

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Leather made from ray (batoid) skins has recently been rediscovered by ‚high fashion' and is promoted as a luxury material. Information on the subject is scarce; published articles, grey literature, and internet resources were reviewed to identify basic trade patterns and the taxonomic groups affected. To assess conservation implications, data on relative value of skins of different species were correlated with maximum size and other measures of vulnerability. Ray leather is mostly produced in South East Asia, namely Thailand, Indonesia, the Philippines, and newly India. Leather and products made thereof are widely available in Europe and the United States of America; trade seems to be increasing. Taxonomically, stingrays (Dasyatidae) are most commonly used, with 22 species identified to be used for leather. Myliobatidae (7 spp.), Rajidae and Potamotrygonidae (rarely) are also used. It is unknown to what extent rays are targeted specifically for their skin, as they are also caught for consumption and as bycatch. However, the high price of skins is an incentive for targeted fisheries. Most species used for leather have a high intrinsic vulnerability to fishing due to their life history characteristics. In addition, species of large maximum size, which is associated with high vulnerability, are preferentially used for their skins and fetch higher prices. Lack of trade statistics, evidence of trade into the European Union and their vulnerability are compelling reasons for listing the species in the Annexes of the EU Wildlife Trade Regulations, at least for monitoring purposes.

SPATIAL DISTRIBUTION OF BENTHIC CHONDRICHTHYANS IN THE US GULF OF MEXICO

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The global decline in chondrichthyan fishes is undisputed as well as their vulnerability to overfishing due to their limited ability to recover from depletion (K-selected species). Due to a lack of baseline data, the exact decline in chondrichthyan diversity and population density cannot be quantified since industrial fishing methods predate most contemporary fishery assessments. In 2002 the NMFS Mississippi Laboratories of Pascagoula (US Dept. of Commerce/NOAA/SEFSC), conducted a deep-sea survey to examine the relative abundance and distributions of macro organisms in the US Gulf of Mexico (90 m – 250 m). A high-opening fish trawl (27.4 m length footrope) was fished on bottom at randomly selected locations for 30 min duration tows; a total of 16 chondrichthyan species were captured (88 specimens) from a total of 142 sampling stations. The three most abundant species were *Mustelus canis*, *Raja texana* and *Squatina dumeril* which accounted for 70% of all caught chondrichthyans; those species were taken at some stations in relatively large numbers therefore indicating aggregational behavior. Spatial habitat overlap between individual shark and ray species, as well as between sharks and rays was identified. The study demonstrates the highly variable distributions of most chondrichthyans which makes them particularly vulnerable to industrial fishing techniques where large numbers are taken within short periods.

INCIDENTAL CATCHES AND FISHING IMPACTS ON ELASMOBRANCHS IN SMALL-SCALE MULTIGEAR, MULTISPECIES FISHERIES OF THE NORTHWESTERN MEDITERRANEAN (BALEARIC ISLANDS)

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This study presents the first data on the impacts of Western Mediterranean small scale artisanal fisheries on elasmobranch species caught as by-catch. The objective was to document and quantify the incidental catches of elasmobranchs and the degree of impact of the most typical small scale artisanal fisheries in the region. This was accomplished by recording the presence of sharks and batoids on the catch of the different fishing tactics (or métiers) carried out by small scale fisheries that seasonally rotate target species and gears. We also evaluate their fate - retained or discarded, and their vitality in the later case - and the relative impact of the métiers according to the vulnerability of each species.

Data on species composition of the catch and their fate were obtained from a scientific observer program on board the artisanal fleets conducted between 1998 and 2008 over all seasons and métiers, with a total of 2819 fishing sets sampled. Fishing was done at depths from 4 to 160 m depth in four different islands of the Balearic archipelago (Mallorca, Menorca, Cabrera and Formentera). A total of 8252 individuals of elasmobranchs belonging to 21 species were recorded (plus 31 individuals of unidentified *Raja* spp).

The elasmobranch species most frequently caught by the artisanal fisheries were *Scyliorhinus canicula*, *Dasyatis pastinaca*, *Raja radula*, *Torpedo marmorata*, *Raja brachyura* and *Myliobatis aquila,* which accounted for 87% in number and 76% in weight of the total catch. The fraction of elasmobranchs species retained was 50% of the catch in number and the factors determining discarding practices were in order of declining importance: 1) species of no or low commercial value (61%), 2) individuals damaged or spoiled (25%), 3) individuals of small size to warrant commercial value (13%), and 4) species of commercial value caught in insufficient quantities for marketing (1%).

A fishing impact index was developed based on the vulnerability, survival probability and frequency of occurrence for each species in the various fisheries. This index was used to assess the relative impact of each métier on the elasmobranchs species interacting with the artisanal fisheries in the region.

This impact index provides a tool for the management and conservation of shark and batoid species.

ARTISANAL ELASMOBRANCH FISHERY IN THE GULF OF GABÈS (SOUTHERN TUNISIA)

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In the Mediterranean Sea, elasmobranchs are an important by-catch of commercial fisheries targeting bony fishes, while few species are subject to directed fisheries. The Gulf of Gabès (central Mediterranean Sea) supports a small artisanal elasmobranch fishery. This study was undertaken as a first step to determine the biological characteristics of this fishery, the catch per unit effort of the principal species and their length frequency distributions.

This fishery, including bottom gill-nets and longlines, is based on the seasonal abundance of the species in the area, operates mainly during spring and summer. Five common species (*Carcharhinus plumbeus*, *Mustelus mustelus*, *M. punctulatus*, *Rhinobatos rhinobatos* and *Glaucostegus cemiculus*) are targeted while most other species, mainly *Dasyatis* sp. *Pteromylaeus bovinus*, *Carcharhinus* sp. are captured incidentally. In longline fishery targeting *C. plumbeus,* the CPUE reached 15.2 sharks/1000 hooks set while in gill-net fisheries the CPUE was in general less than 3 specimens/1000 m net set.

Length-frequency distributions showed that longline catches consisted mainly of juveniles, whereas subadult and adult specimens were more frequent in the gill-net landings. The capture of neonates and mature adults suggests that the main nursery areas are under fishing pressure.

SHARK CATCHES IN THE INSHORE WATERS OF THE GREAT BARRIER REEF WORLD HERITAGE AREA

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The take of sharks in fisheries in the Great Barrier Reef World Heritage Area have become increasingly controversial in recent times. To provide scientific information to inform the consideration of this issue, fishery-dependent surveys have been conducted throughout the area to document species and size composition of various sectors that take sharks. These data show that commercial net fishers catch over 25 species of sharks and ray, with the main species being Australian blacktip, spottail, scalloped hammerhead, milk, whitecheek and spinner sharks. Species composition, importance and size varies between different sectors of the commercial fishery. Discarding practices were also examined and varied by operator and sector, with some species (e.g. milk sharks) more likely to be discarded than others. Post-release survival of discards is unknown, but may be an important consideration in relation to the impact of the fishery. The majority of sharks taken were less than 150 cm in length. Data from recreational fishers was not able to provide detailed species composition data, but did demonstrate release rates >90%. The use of these data in an ecological risk assessment will be discussed.

ARTISANAL FISHERY OF SHARKS LANDED IN SALINA CRUZ, OAXACA, MEXICO.

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The specific composition and seasonal abundance of sharks caught in artisanal fishery in Salina Cruz, Oaxaca, México between September 2004 and august 2006 was analyzed. A total of 2187 sharks were recorded, belonging to 4 families, 7 genera and 12 species. The Scalloped hammerhead shark (*Sphyrna lewini*) was the most abundant shark with 58% (1270 organisms) it is the specie that support the fishery in this area of Gulf of Tehuantepec. The sexual ratio was 1F:2M, the adults were presented during April to July, the pregnant females were important, the neonates were recorded from July to October, and so this zone is a nursery area for this specie. The Pacific sharpnose shark (*Rhizoprionodon longurio*) is the second specie with 16% (359 organisms) it was caught during all the year, with a important number of adults and pregnant females. The Silky shark *(Carcharhinus falciformis*) had 12% (259 sharks) the males had a total length from 90 cm to 219 cm, whereas the females were between 170 cm to 235 cm. the Whitenose shark (Nasolamia velox) with 9% (189 organisms) recorded a sexual ratio of 1F:1M with sizes from 30 cm to 164 cm. The blacktip shark (Carcharhinus limbatus) with 4% (83 sharks), the juveniles dominated the caught, a sexual ratio of 1F:1M was found. The directed fishery was between March to August and the fishermen utilized hook line. During the months of September to March the fishery is realized with nets near to coast, because the winds called “Tehuanos” are present in this season.

A DESCRIPTION OF THE GUINEAN SHARK FISHERIES

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In Guinea Conakry, shark exploitation has mainly been performed by Ghanaian fishermen who seasonally migrate, since the 1980's, to target sharks in Guinean waters. Senegalese fishermen followed them in the 1990's when the demand of the Asian markets for shark fins was growing up. We present a description of these shark fisheries including the socio-economic aspects, as today the Guinean fishermen claim for a reduction or a closure of these fisheries.

PRELIMINARY RESULTS OF FISHING EFFORT BASED ON REAL CATCH OF TWO SPANISH FISHING-VESSELS OF MAKO SHARK AND BLUE SHARK.

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Populations of pelagic sharks in the world are likely suffering an important decrease, but there are few studies on stocks dynamic. Nowadays there is not any regulation of captures and stock assessment is based in reported catches (that in many cases are not real). In the present work, shark captures from two Spanish fishing-vessels were recorded between 1996 and 2009. The most abundant pelagic shark species were studied: the short-fin mako shark *(Isurus oxyrinchus)*, and the blue shark *(Prionace glauca)*, both of them are commercially important. All the samples were caught in the South Pacific and the North Atlantic Ocean. This study reports and compares captures of theses species in both oceans, as well as it analyzes temporal variation of CPUE´s and length of captured specimens.

Key words: CPUE, fisheries management, pelagic sharks, *Isurus oxyrinchus*, *Prionace glauca*.

ELASMOBRANCH BYCATCH IN ARTISANAL BOTTOM FISHERIES AROUND CABRERA ARCHIPELAGO (BALEARIC ISLANDS, WESTERN MEDITERRANEAN)

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The occurrence of elasmobranch bycatch in fisheries where they are not considered as target species can suppose a threat for many species. Indeed, this fact may be partially overlooked because part of these catches are often discarded at sea and so do not appear in fishery statistics. The present study characterizes the elasmobranch assemblages vulnerable to fishing pressure from two artisanal fisheries carried out in waters of Migjorn Marine Reserve and Cabrera Archipelago National Park (Balearic Islands, Western Mediterranean).

The fishing activities studied included: (1) a gill-net bottom fishery targeted to spiny lobster (*Palinurus elephas*) and (2) a bottom longline fishery directed to several teleost species of high commercial value. Observations were made onboard between July and September 2009. Fishing activities were carried out between 28 and 121 meters depth. During fishing operations catches of elasmobranch specimens were recorded (identified, measured and sexed when possible) and other data on commercial catches were also obtained.

Presence and abundance of different elasmobranch species are described and analyzed in relation to several variables. Marked differences were found in bycatch composition between each fishery. Most abundant elasmobranch species caught on gillnets were *Raja miraletus, R. polystigma* and *Leucoraja naevus* together with *Scyliorhinus canicula.* Instead, main species caught on bottom longlines were *Dasyatis pastinaca* and *Myliobatis aquila.*

Whereas most of the elasmobranchs caught on gillnets were discarded dead, many specimens from longlines were released alive, what can involve for the latter a high degree of survival and thus a lesser impact on the populations.

Importance of elasmobranch bycatch in the area and mid-term effects for its populations are discussed.

SHARKS, RAYS AND CHIMAERAS OBSERVED WHILE USING AN ROV IN THE WESTERN MEDITERRANEAN AND SOUTHERN BAY OF BISCAY

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Remotely operated vehicles (ROVs) are increasingly being used in the scientific community to study ocean depths below the reach of underwater divers. In 2006, 2007 and 2008, Oceana employed an ROV to carry out bionomic surveys to study the seabed of areas in the Mediterranean Sea and Bay of Biscay, between 50 and 350 meters depth. Investigators were able to gain information on the populations and distribution of the shark, ray and chimaera (chondrichthyans) species inhabiting these deeper waters.

A total of 14 species were found: five sharks, eight batoids and one chimaera. The total amount of specimens observed accounted for 304 individuals: 158 in the Mediterranean Sea and 146 in the Bay of Biscay. 69% of the observations belonged to the species *Scyliorhinus canicula*. This was the most widespread chondrichthyan in these waters. The densest presence of this species was observed around the Balearic Islands and off the coast of the Basque Country, Spain. The other species found were *Hexanchus griseus, Squalus blainvillei, Galeus melastomus, G. atlanticus, Dasyatis pastinaca, Torpedo marmorata, Raja clavata, R. montagui, R. miraletus, R. naevus, R.radula, R. brachyura* and *Chimaera monstrosa*.

Information on the positions, depths and times when the species were observed was collected and recorded, providing new data on the geographic range and bathymetric distribution of these species. For example, this was the first time *Galeus atlanticus* was recorded in the Bay of Biscay, out of its reported range of the Alboran Sea, Strait of Gibraltar and the surrounding European and African Atlantic waters.

The use of an ROV in underwater investigations such as this can help us gain a better understanding of the chondrichthyan populations which live at deeper depths.

ESTIMATING POPULATION PARAMETERS FOR BULL SHARKS AT A FEEDING SITE IN A MARINE PROTECTED AREA IN FIJI

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Marine megafauna attracts increasing attention in ocean conservation planning and threatened predators, such as sharks, are used to promote marine protected areas. Such sites attract divers which has led to the growth in the popularity of marine wildlife watching as a marine tourism activity, but also provide a good opportunity to estimate fish abundance and life-history parameters. We assessed biological and population parameters of the bull shark, *Carcharhinus leucas*, at a stationary feeding site in the Shark Reef Marine Reserve, Fiji, through direct underwater observation between 2003 and 2008. The number of bull sharks decreases over the course of a calendar year with fewest sightings between September and November. Based on body conditions of females, such as pregnancy and mating scars, we hypothesize that bull shark absence from the site towards the end of a calendar year is related to reproductive activity. Peak abundances at the Shark Reef Marine Reserve occur in the first half of the year with most sightings in February. The female:male sex ratio is 3.64:1. Based on natural distinctive marks for individual recognition, direct observation led to the identification of 54 individuals (7 males, 47 females). Of these, 29 (5 males, 24 females) were reliably identified in multiple years with 89.7 % sharks observed over at least 2 years indicating site-fidelity. Bull shark super-population sizes were estimated using the zero-truncated Poisson-log normal mark-resight model available in Program MARK. The overall mean local bull shark population size was estimated to be 55, but the super population sizes fluctuated between months and years indicating movements into and out of the study site.

WHITE SHARKS (*Carcharodon carcharias*) FROM NEW ZEALAND LIKE TO VACATION IN THE TROPICS

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A total of 24 great white sharks *Carcharodon carcharias* have been electronically tagged with pop-up (23) and real-time satellite tags (1) in New Zealand during 2005-2009 as part of an international research project aimed at defining the space utilization and conservation needs of this species in the Southwest Pacific Ocean. Two locations were chosen for tagging due to their known seasonal abundance of white sharks. We tagged 10 sharks (7 females, 3 males) at the Chatham Islands and 14 sharks (6 females, 8 males) at Stewart Island, in southern NZ. So far, we have received useful data from 17 tags, four failed to send any relevant information or remain in the shark for significant periods of time, and three more tags are due to report at the end of 2009. Preliminary results show that white sharks from New Zealand make long-distance (ca. 3000 km) migrations to tropical areas in the region. While crossing open oceans, the sharks all dived periodically to depths greater than 500 m, up to a maximum of 1,000 m. New data from recent tag recoveries will be presented, and used to provide a picture of the large-scale spatial ecology of this species in the south-west Pacific Ocean.

OCEANS APART? SHORT-TERM MOVEMENTS AND BEHAVIOUR OF ADULT BULL SHARKS IN ATLANTIC AND PACIFIC OCEANS DETERMINED FROM POP-OFF SATELLITE ARCHIVAL TAGGING

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Satellite telemetry can provide insight into movement patterns and behaviour of coral-reef or coastal shark species such as the bull shark, *Carcharhinus leucas*. In this study, we monitored adult bull sharks with electronic tags to gain insight into horizontal movements, including the species' potential for long-distance migration, at two aggregation sites in the Atlantic and Pacific Oceans and evaluated vertical behaviour in terms of time spent at depth and temperature. In both locations, bull sharks showed some fidelity to specific coastal areas with only limited horizontal movements away from the tagging sites after tag attachment. In the Bahamas, bull sharks were detected mostly in the upper 20 m of the water column in water 25–26° C, whereas sh arks tagged in Fiji spent most of their time below 20 m in water usually above 26° C. The results show that bull sharks are important parts of coastal ecosystems and underpin the need for international and national cooperation when devising conservation strategies for this species.

PRIONACE GLAUCA (LINNAEUS, 1758) IN THE LIGURIAN SEA: CATCHES, POPULATION STRUCTURE AND ECOLOGY.

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Monitoring the professional long-line fishery targeting the swordfish, during the period 1990-2009 observations were made directly onboard the fishing vessels and at landings in the Western Ligurian Sea (Western Mediterranean). The overall ratio swordfish/blue shark catches resulted 22,2:1; the average CPUEs in number were respectively 6,9 and 0,36 per 1000 hooks.
An account of blue shark catches, with some historical traits, is given, with emphasis on the abundance, size distribution and seasonal variation The size structure of the fished stock (size range 52-304 cm LT) showed a majority of pre-adult individuals (less than 200 cm TL) and the presence of 0 + age group (50-70 cm TL) and juveniles, especially during July and August. In general, the population of blue shark of the Ligurian Sea does not seem to be abundant; CPUE time series show a great decline during the ’90 and at the beginning of this century, with a good recovery during the last two years.
237 stomach contents were sampled in order to investigate feeding habits. 48 of these resulted to be completely empty (20%). Diet analysis showed the great importance of cephalopods (mainly Histioteuthidae) in the diet, but fish, crustaceans, birds and cetaceans were also present. Despite the wide niche breadth, probably the effect of the natural competition with a great number of top predators relegates the blue shark to the role of scavenger. This is reflected in the trophic level of blue shark, that is lower than expected, also if compared to other top predators inhabiting the same area (mainly swordfish and cetaceans). The possible niche overlap with odontocetes cetacean is discussed.

SPATIAL AND TEMPORAL SEGREGATION BETWEEN FOUR ELASMOBRACH SPECIES RELATED TO BIOLOGICAL AND ENVIRONMENTAL FACTORS

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This study analyses 605 hauls performed during eight (from 2001 to 2009) bottom trawl fishing surveys developed between 36 and 755 m depth around the continental shelf and the upper slope of the Balearic Islands. The information obtained yielded a total of 28 chondrichthyans species belonging to 8 families. Cluster analysis and multi-dimensional scaling (MDS) ordination were applied to detect zonation pattern. The bathymetric, geographic and temporal variations of the species composition was analysed by means of Redundancy Analysis. The spatial and temporal distribution of the community descriptors abundance, biomass, mean fish weight and diversity index were analysed by mean of General Additive Models (GAMs). The spatiotemporal information of density (abundance and biomass) and size of the most abundant species (*Galeus melastomus*, *Scyliorhinus canicula*, *Raja clavata* and *Raja miraletus*) were regressed against co-located covariates (geographic and bathymetric) using GAMs. We applied a modified and non-additive GAM formulation to test the hypothesis of potential changes of geographic and bathymetric covariates under years of low or high species abundance. This modelling approach was firstly applied in the whole dataset, and secondly on separated datasets divided based on size information (size of first maturity or small, medium and large individuals). Additionally, we investigated potential overlapping areas between the most abundant species by means of spatial correlation of species-specific ordinary kriging interpolations. Our results show, for all the species, areas with high abundance once the bathymetric effect was taken into account which evidences species-specific aggregation patterns. Moreover, the geographic and bathymetric effects were highly size dependent. The results are discussed taking into account spatial heterogeneity of fishing

activity, preferred benthic habitats for each species (i.e., trophic requirements) and oceanographic conditions. This study will shed new light on how elasmobrach species are spatially distributed and organized off the Balearic Islands, improving the understanding of underlying processes (biotic and abiotic) shaping their distribution, which is currently required for protecting marine organisms strategies along with their habitats.

AN APPROACH TO THE DIAGNOSIS OF ELASMOBRANCH POPULATIONS IN THE CIRCA-LITTORAL SOFT BOTTOMS OFF THE BALEARIC ISLANDS (NORTH-WESTERN MEDITERRANEAN)

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The Balearic archipelago, together with other insular areas, shows the most diverse and abundant elasmobranch communities in the western Mediterranean. The present contribution attempts to assess the elasmobranch populations in the circa-littoral soft bottoms off the Balearic Islands, exploited by the trawl fishery. For this purpose, the temporal variations of their communities and species have been analysed, from different sources of information: (i) time series of landings since 1965 from Mallorca; (ii) daily sale bills from the trawl fleet of Mallorca between 2000 and 2008; (iii) sampling of trawling catches carried out by on board observers in Mallorca from 2001 and 2008; and (iv) data obtained annually since 2001 in the MEDITS experimental bottom trawl surveys, carried out on the continental shelf and upper slope off Mallorca and Menorca. The diagnosis of elasmobranch populations has been done separately for the shelf and the slope using different ecological indicators estimated annually: e.g. standardised abundance and biomass, species richness and diversity, percentage of elasmobranchs with respect to demersal assemblages, size and biomass spectra, catch per unit of effort and percentage of elasmobranchs discarded by the trawl fishery. The temporal trends of these indicators have been explored by applying general additive models, with the aim to identify and discuss the status of elasmobranch populations in the Balearic Islands. The use of these ecological indicators based on elasmobranches could be very useful to assess the fishing impact on marine ecosystems, due to the special vulnerability shown by these species in front of fishing activity.

PRELIMINARY ANALYSIS OF GREY REEF SHARK MOVEMENTS ON THE GREAT BARRIER REEF

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Data on the presence and distribution of reef sharks on the Great Barrier Reef (GBR) are currently limited. In addition, recent research examining the abundance of reef sharks has produced contradictory results about the status of these populations. This results in a need for a better understanding of the movement and space utilisation of these species to help interpret the limited data available for these populations. This pilot study examined the movements of grey reef sharks (*Carcharhinus amblyrhynchos*) on 6 reefs in the northern GBR to define whether individuals remained attached to a single reef platform and define the efficacy of Marine Park Zoning in sheltering these individuals from fishing pressure. Five different management zone areas were represented in the study site. A series of 31 VR2 acoustic receivers were deployed to passively track the movement of reef sharks from January to July 2008. Eight sharks ranging in size from 84 – 152 cm total length (TL) were monitored for periods of 13-167 days and detected on 1-130 days during that period. Three patterns of movement were observed from the eight sharks fitted with transmitters: 1) long-term presence at a single reef, 2) movement away from the monitored area, and 3) movement between and among reef platforms. Implications of these movement patterns for research and management of these populations will be discussed.

DISTRIBUTION OF COASTAL ELASMOBRANCHS IN THE BALEARIC ISLANDS (NW MEDITERRANEAN) BASED ON ARTISANAL FISHERIES SURVEYS

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Most of the data regarding distribution and fishing pressure on elasmobranchs in the Mediterranean Sea are based on trawl surveys, which are usually carried out at depths greater than 50 m. For this reason, the elasmobranch assemblage occurring in shallow waters has been traditionally undereported for management purposes, due to the scarcity of data coming from the monitoring of artisanal fisheries. This work provides an insight into the distribution of demersal species of elasmobranchs inhabiting over the continental shelf of the Balearic Islands.

Data were obtained from both fishery-dependent and fishery-independent surveys using trammel nets (1758 samples) and bottom long lines (749 samples), at a depth range of 4-160 m between 1998 and 2008. Four shark species and 16 batoids species were recorded. For the most important species (*Scyliorhinus canicula*, *Torpedo marmorata*, *Raja brachyura*, *Raja clavata*, *Raja miraletus*, *Raja polystigma*, *Raja radula*, *Dasyatis pastinaca* and *Myliobatis aquila*), bathymetric and seasonal differences in abundance, biomass and length distribution were analysed, as well as species richness, diversity, abundance and biomass of the elasmobranch assemblage. The observed patterns of distribution for the whole assemblage and selected species were also analyzed in relation to the sampling method (gear and/or mesh size).

BALEARIC ISLANDS VS. ALGERIA: TWO NEARBY WESTERN MEDITERRANEAN ELASMOBRANCHES POPULATIONS WITH DIFFERENT OCEANOGRAPHIC SCENARIOS AND FISHING HISTORIES

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The Balearic Islands (north-western Mediterranean) and Algeria (south western Mediterranean) coasts show different oceanographic scenarios and bottom trawl fishing histories. The Archipelago is mainly influenced by Mediterranean originated waters, whereas Algeria coast is mainly influenced by the Atlantic inflow. It is also remarkable the high oligotrophy and the absence of river runoff in the former area. In the Archipelago, the slope red shrimp fishery has a long term history with an increasing fishing effort down to 750 m depth in the last decades. In Algeria the most important fishing activity is targeted at small pelagic species. The geo-morphological characteristics of Algeria have not facilitated the development of a demersal trawl fishery, which is mainly performed with small boats fishing down to 400 m depth.

The present work updates the analysis of the elasmobranches ecology in the Balearic Islands and is a first approach to the ecology of these species in Algerian waters. For both areas we applied: i) Generalized Linear Models (GLM) in order to analyse the species-specific bathymetric distribution models; ii) General Additive Models (GAM) to identify the trends of the community descriptors abundance (A), biomass (B), mean fish weight (MFW), species richness (S) and diversity (H'); and cluster analysis in order to determine bathymetric assemblages. Moreover, the community descriptors were compared between areas for each assemblage.

The bathymetric distribution models for species common in both areas were similar, with the exception of *Etmopterus spinax,* more abundant at shallower waters in Algeria. MFW had a similar trend in both areas, however, the rest of indexes showed a very different trend, a general depth-decreasing trend predominate in Mallorca, whereas a depth-increasing trend predominates in Algeria. Cluster analyses identified the same bathymetric assemblages, with similar depth ranges in both areas: shelf, shelf break, upper slope and middle slope. However, the species composition of these assemblages differed

between areas. It is remarkable the higher importance of Rajidae species on the shelf and shelf break bottoms off the Archipelago when compared to those in Algeria. Most community descriptors also displayed differences when compared between areas and assemblages, with the exception of the upper slope.

The differences in species composition and community descriptors trends between Balearic Islands and Algeria coast are discussed in the context of distinct oceanographic conditions and fishing history between both areas.

POPULATION SIZE AND STRUCTURE OF WHALE SHARKS *Rhincodon typus* AT HOLBOX ISLAND, MÉXICO

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We used photo-identification and tagging to estimates of population size and structure of whale sharks Rhincodon typus at Holbox Island, Mexico. We analyzed photographs of whale sharks taken from 2005 to 2008. A combination of spot and stripe patterns behind the five gills slit and forward of the dorsal fin (lateral view) on the left side, these patterns appeared to be unique to individuals and distinctive markings could be recognized on some sharks for more than a decade. Also the distinctive scars and marks on the body and fins were useful for identifying individual sharks. From 1115 photographs, 350 sharks were identified. Of these, 65% were male, 27% were female and 8% were of indeterminate gender. Photographed sharks ranged in estimated size from 2.5 to 9.5 m total length (TL). The size distribution of sharks was bimodal with a large peak at 6 m and a smaller Peak at 7 m TL. Forty six sharks were resighted in different years. The interval between inter-annual resightings was typically 1 yr. We estimated the super population of whale sharks that visit Holbox Island to consist of approximately 516 to 802 individuals (95% confidence interval) based on Jolly-Seber open-population models. We estimate the size of the whale shark aggregation from each year using a Jolly-Seber open-population model. In 2005 we estimate an aggregation of 94 to 122 sharks, in 2006 we estimate and aggregation of 211 to 260 sharks, in 2007 70 to 105 and in 2008 152 to 202 (95% confidence interval).

POPULATION STRUCTURE AND SPATIO-TEMPORAL DISTRIBUTION OF BLUE SHARK (*Prionace glauca*) AT THE EASTERN TROPICAL PACIFIC OFF MEXICO

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This study evaluated the population structure of *Prionace glauca* at the Eastern Tropical Pacific off México (ETPOM) by the analysis of the spatial (latitude, longitude) and temporal (annual, intra-annual) changes on the distribution of sex groups (males, females), size groups (juveniles, adults), and sex-size groups (male-juvenile, male-adult, female-juvenile, female-adult). Samples were collected from the oceanic longline commercial fleet (8 vessels, 548 females, 3443 males, 2000-2002, 16°16'-27°00' N, 105°22'- 11 7°00' W) and from the coastal longline commercial fleet (25 vessels; 824 females; 1031 males; 2003-2006; 16°02'-20°00' N, 103°40'-107°00' W). During e ach fishing set the specimens were indentified to species level, sexed, counted and measured. A complex population structure of *P. glauca* at the ETPOM was detected, reflecting a spatial segregation by groups of sex-size that were distributed along a coastal-oceanic axis. Within the oceanic waters the annual male-female ratios were dominated by males and this proportion was significantly different of 1:1 ($\chi^2_{0.05,2}$= 54.05). At the coastal waters the annual proportion showed changes in dominance between sexes and was significantly different of 1:1 ($\chi^2_{0.05,3}$= 46.59). In adults, annual catches collected in ocean-and-coastal waters showed a high(low) proportion of males(females). In juveniles, annual catches reflected a high proportion of males(females) in oceanic(coastal) waters.

BIODIVERSITY AND BIOGEOGRAPHY OF TROPICAL MARINE CHONDRICHTHYANS

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This study details the biodiversity and the biogeographic patterns of the chondrichthyans inhabiting the continental shelves of the tropical marine environment. The tropical marine regions of the world are typically defined by the 20℃ isocryme for the coldest month of the year and, due to direction of the major currents, are broader on the west coasts of ocean basins than on the east coasts. A total of 449 nominal and 15 undescribed chondrichthyans occur in the tropical marine shelf regions, which represents 39% of the global chondrichthyan fauna. All 9 orders of sharks and rays were present, but the Chimaeriformes (chimaeras and ghost sharks) are absent. The high level of biodiversity of chondrichthyans is likely a result of the much longer palaeohistory of the tropical region and the great level of solar radiation this region receives. The most speciose shark families are the Scyliorhinidae, Triakidae and Carcharhinidae which together contribute 58% of tropical shark species. The Dasyatidae, Narcinidae, Rhinobatidae and Rajidae are the most speciose ray families contributing 61% of the tropical ray species. Four major biogeographic regions exist, the highly diverse Indo-West Pacific (301 spp), Eastern Pacific (81 spp), Western Atlantic (95 spp) and Eastern Atlantic (70 spp). Within most of the biogeographic regions, minor barriers to gene flow exist which have created different provinces with high levels of endemism. The East Indies triangle has the greatest diversity of marine species in the world, with the chondrichthyan fauna being no exception.

DISTRIBUTION OF *SCYLIORHINUS CANICULA* IN THE CIRCALITTORAL SEABEDS OF CABRERA NATIONAL PARK

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The circalittoral seabeds of the Cabrera Archipelago National Park (Spain) and the surrounding areas are characterized by a combination of soft detritic bottoms scattered with corals or rocks, harbouring a wide variety of Mediterranean flora and fauna, including several species of elasmobranches.

In 2007, Oceana carried out bionomic investigations to survey the seabeds in and around Cabrera National Park, covering an area of 7,750 hectares. The small spotted catshark (*Scyliorhinus canicula*) was recorded during 53 observations for a total of 55 specimens among the three areas sampled, representing 91.7% of all elasmobranch sightings during the investigations. The other species seen were *Raja miraletus* (three specimens) and *Raja montagui* (two specimens), bringing the total to 60 elasmobranches. The frequency with which *S. canicula* was seen, in the deepest waters of the protected area and in the surrounding circalittoral areas, allows us to estimate the density of this species, which could mean that the population in these areas could be higher than 30,000 sharks, and confirms that the biomass contribution of elasmobranches in this National Park is higher than in surrounding areas (Moranta et al., 2007).

This species, while mainly present on soft detrictic bottoms, can also be found on mearl beds, near kelp forests and, less commonly, on rocky seabeds.

PRELIMINARY RESULTS: STUDY ON RESIDENCY AND MIGRATORY HABITS OF SHARKS OF COCO'S ISLAND NATIONAL PARK

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Coco's Island National Park is the last place on earth where large populations of some shark species exist. The great diversity of elasmobranchs occurring in this area is due to the wealth of ocean currents, the abundance of marine life from lower trophic levels and the distance to the mainland, also the lack of human activities and pollution. Coco's Island National Park is part of Seascape Tropical Eastern Pacific.

This study aims to determine habitat use, local and regional movements of scalloped hammerhead sharks (*Sphyrna lewini*) and silky (*Carcharhinus falciformis*), which cross the waters of Coco's Island National Park. Also, thanks to parallel investigations being conducted in the Galapagos Islands (Ecuador) and the Malpelo Island (Colombia), it aims to determine the connectivity between populations of sharks in the Eastern Pacific Seascape. Besides, it is try to evaluate the management and protection of those, to ensure their conservation.

These species are characterized for being coastal-pelagic and perform migrations in tropical and subtropical waters, whose routes are still unknown. To monitor the movements of populations of hammerheads, ultrasonic transmitters V16 code VEMCO multipurpose were used for medium and large species in individual sharks, which work in conjunction with an automated VR2 receiver, which is fixed to the substrate by a anchor and suspending in the water column by a buoy.

Satellite tags MK10 PAT type (for *S. lewini*) and SPLASH (for *C. falciformis*) were also used, which allowed to observe the depth profiles and ranges.

Preliminary results allow us to observe, among other things, that both species spend much time near to the surface. Illegal fishing remains the major threat to their survival, because both species are very susceptible to coastal artisanal fisheries and pelagic long line.

INFORMATION ABOUT FOUR SPECIES OF CHONDRICHTHYES (*SCYLIORHINUS CANICULA,* LINNAEUS 1758, *EMOPTERUS SPINAX,* LINNAEUS 1758 AND *GALEUS MELASTOMUS* RAFINESQUE, 1810 AND *GALEUS ATLANTICUS* (VAILLANT, 1888)) IN WATERS OFF THE GULF OF CADIZ (ICES IXA SOUTH)

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In waters off the Gulf of Cádiz inhabit several species of bottom chondrichthyes. These groups of species usually do not have any commercial interest for the fishing fleet, with exceptions. However, they are captured as by-catchspecies. The particular biological characteristics of this group (low reproductive potential, slow growth and long life span) make them highly vulnerable to the overfishing. Along the last years, the worrying situation of these species has increased; therefore the international community has undertaken measures for the conservation of chondricthyes populations, one important measure of these actions is the monitoring of the species through the collection of fishery and biological data.

Four demersal chondrichthyes species are the most abundant in waters off Gulf of Cádiz: *Etmopterus spinax*, *Scyliorhinus canicula*, *Galeus atlanticus* and *Galeus melastomus*. Aspects related to bathymetric and seasonal distribution, abundance (yields in weight and number) and sex ratio pattern are presented in this work.

During 1993 to 2009, in spring and autumn, a total of 29 demersal trawl surveys carried out by the Instituto Español de Oceanografía in the gulf of Cádiz. A total of 29 demersal trawl surveys have been carried out by the Instituto Español de Oceanografía since 1993 to 2009 in order to assess the most important demersal resources of the Gulf of Cadiz (17 in March and 12 in November). Using a random stratified sampling, was observed that *Scyliorhinus canicula* appears in a whole depth analyzed strata, nevertheless *Galeus atlanticus, Galeus melastomus* and *Etmopterus spinax* were captured on fishing grounds deeper than 200 metres.

THE GULF OF GABÈS: A NURSERY AREA FOR SHARKS AND RAYS

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Elasmobranchs nurseries are habitats where females give birth to their young and juveniles spend their early life history. Nursery areas offer the young a better source of food and protection against predation; overall, nurseries are located in coastal, shallow, protected and highly productive waters.

The Gulf of Gabès (southern Tunisia, central Mediterranean Sea), contributing by 62 % of national production of cartilaginous fish, seems to have these conditions for several Elasmobranchs: *Carcharhinus plumbeus, Mustellus mustellus*, *Rhinobatos rhinobatos, Glaucostegus cemiculus*, *Gymnura altavela*...

In fact, monthly samples from landings in the main harbours of this zone and some observations onboard, from 2002 to 2006, show the presence of pregnancy females around the year. Neonate (individuals showing an unhealed umbilical scar) and juvenile are captured during summer and the begging of autumn. These elasmobranchs are caught by gillnets, bottom trawls, and long lines.

DISTRIBUTION AND RELATIVE ABUNDANCE OF *CHIMAERA MONSTROSA* (CHIMAERIDAE, CHIMAERIFORMES) IN THE SPANISH GULF OF CADIZ WATERS.

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The principal aim of this study is to describe the distribution pattern of abundance and biomass, both on a seasonal and bathymetric basis of the *Chimaera monstrosa* in the Spanish Gulf of Cadiz waters. For these purposes, the results from the whole survey series (29 bottom-trawl surveys), carried out in the study area in spring and autumn from 1993 to 2009 were analysed. The surveyed area corresponds to the continental shelf and upper-middle slope from the latitude 6º 20' W to 7º 20' W and from 15 m to 800 m depth covering an area of 5456 Km^2. Haul duration was 60 minutes and they were carried out during daylight at a mean towing speed of 3.0 Knots.

Rabbit fish constitutes the unique ratfish species catches along the whole surveys data series. Its yields expressed in number of individuals/hour did not show significant differences between spring and autumn catches. There is also no difference in terms of biomass (grams/hour).

The species showed a narrow bathymetric range because only appears in the deeper survey strata. This fact revealed species-specific preferences for mainly two depth strata (from 200 m onwards). Despite the absence of seasonal differences, yield significant differences in terms of biomass appear between the depth strata (201-500 m vs. 501-800 m). These biomass differences are related with the species mean size, which shows a clear rise as the depth increases.

INFORMATION ABOUT MAIN BATOIDS SPECIES CATCHED FROM ARSA BOTTOM TRAWL SURVEYS IN THE SPANISH GULF OF CADIZ WATERS.

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The principal aim of this study is to describe the distribution patterns of abundance and biomass, both on a seasonal and bathymetric basis, and the historical evolution of the mean total length of the main batoids species from the Spanish Gulf of Cadiz waters. For these purposes, the results from the whole survey series (29 bottom-trawl surveys), carried out in the study area in spring and autumn from 1993 to 2009 were analysed. The surveyed area corresponds to the continental shelf and upper-middle slope from the latitude 6º 20' W to 7º 20' W and from 15 m to 800 m depth covering an area of 5456 Km^2. Haul duration was 60 minutes and they were carried out during daylight at a mean towing speed of 3.0 Knots.

22 different batoids species were catched along the surveys. The most abundant species captured in the survey data series were *Leucoraja naevus, Raja clavata*, *Torpedo marmorata* and *Neoraja iberica*. In terms of biomass, *Raja clavata* was the most important batoid species in the Gulf of Cadiz waters. This paper included a more detailed study of these 4 main species.

Only *Torpedo marmorata* presented higher yields in autumn than spring, suggesting a seasonal pattern in abundance and biomass. This species showed the widest bathymetric range and appears in almost the whole study area. However there is no significant yield differences between the 5 depth strata considered.

Despite its absence of seasonal yield differences, only *Raja clavata* showed significant abundance yield differences between certain depth strata. Total mean length by depth strata did not revealed a clear increasing trend, although length distribution by season presents larger individuals in shallow bottoms along autumn surveys.

OCCURRENCE OF *SQUALUS MEGALOPS* (CHONDRICHTHYES: SQUALIDAE) IN THE MEDITERRANEAN SEA

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Two species of spurdog of the genus *Squalus* occur in the Gulf of Gabès (southern Tunisia, central Mediterranean): the longnose spurdog *Squalus blainvillei* (Risso, 1826) and a shortsnout spurdog of the *Squalus megalops-cubensis* group. Morphometrical and meristic data along with genetic analysis (DNA Inter Simple Sequence Repeats markers and molecular Barcoding methods) support the assignation of this shortsnout spurdog to *Squalus megalops* (Macleay, 1881). *Squalus megalops* mainly occurs in temperate and tropical Australian waters, and is thought to occur in the eastern Atlantic, southern Indian Ocean and western North Pacific although these records need to be confirmed. Our study supports its occurrence in the Mediterranean Sea.

NEW RECORDS OF THE BASKING SHARK, *CETORHINUS MAXIMUS*, IN THE AEGEAN SEA

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The basking shark (*Cetorhinus maximus*) is a large, coastal-pelagic shark found throughout the world's arctic and temperate waters. Because of its life-history characteristics this species has proved to be extremely vulnerable to depletion and it is already listed on several international and regional natural resource agreements. In the Mediterranean Sea most of the basking shark records are reported in the western and central areas, where the species is often caught incidentally. Here, we provide new data on the occurrence of basking shark in the eastern Mediterranean Sea reporting the incidental catches of two specimens in the Aegean Sea during the year 2009.

IS IT GOOD-LOOKING OR DOES IT SMELL GOOD? PRELIMINARY OBSERVATIONS ABOUT GREAT WHITE SHARK'S DISCRIMINATORY PATTERNS

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The White Shark *Carcharodon carcharias* L. is a top predator worldwide distributed. Its high survival and adaptation capacity is related with high developed senses, used to efficiently interact with a target. During daily activities of cage diving in the Marine Reserve of Dyer Island (South Africa) the behavioural patterns of the white sharks in front of different targets were observed. Previous studies showed that in an unnatural situation, as the cage diving is, the white shark displays a curiosity approach and it long investigate the situation before an attack.

The aim of the present study was to understand if a white shark, in front of a still floating decoy similar to the natural prey (Cape fur seal, *Arctocephalus pusillus pusillus*) and a bloody piece of tuna fish, makes a choice based upon the sigh or the smell. The preliminary data analysis showed that the choice of the target could be related to size (and consequently) age of sharks. We also analyzed the type of approach (vertical, horizontal or diagonal) and observed that in this case the choice could be related to light and weather conditions. A correlation between type of approach and type of target (decoy or bait) was also observed: usually vertical tactics were more often used in presence of sealshaped decoy, while horizontal tactics were showed in presence of tuna bait. Our observations suggest that these patterns appear to be adapted for exploiting a challenging suite of surface-dwelling prey species and may be the basis of a speculative hunting strategy wherein individual sacrifice much of the possibility of identifying a potential prey item in exchange for an increased chance of capture.

SIZE COMPOSITION AND DISTRIBUTION OF SPINY DOGFISH *SQUALUS ACANTHIAS* IN THE NORTH PACIFIC

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Results of long-term research on spatial and vertical distribution of spiny dogfish *Squalus acanthias* in the North Pacific and its size composition are provided. This report is based on the analysis of datasets of TINRO-Center 1970 to 2007 and Alaska Fisheries Science Center 1983 to 2007. In total, 6728 captures of spiny dogfish were analyzed (2407 with indication of capture depth). Description of size composition is based on measurements of 413 specimens caught by driftnets, 328 by pelagic trawls and 387 by bottom trawls.

Occurrence of spiny dogfish in the water column and near the bottom considerably differed. Seasonal and long-term changes of its spatial distribution were observed. This species is widest distributed in the North Pacific in summer and autumn months during feeding migrations. Wide distribution of spiny dogfish in the Bering Sea occurred after 2000 that likely associated with recent climate change.

In the water column, maximum number of spiny dogfish captures were observed within the upper 25 m layer (about 90%). Near the bottom, this species occurred at depths less than 50 m (over 45%) and within depth range of 101-200 m (over 50%). During the daytime spiny dogfish catches are considerably larger as compared to nighttime that may testify to existence of vertical diurnal migrations. In catches this species was found at water temperatures ranged 0 to 12.7ºC, maximum catches were observed at temperatures over 8ºC.

Size compositions of bottom and pelagic trawl catches were rather similar (average length 69.1 and 68.6 cm respectively). In driftnet catches spiny dogfish was represented by considerably larger specimens (average length 75.3 cm).

SPATIOTEMPORAL PATTERNS OF DISTRIBUTION OF PELAGIC SHARKS IN CALABRIA (CENTRAL MEDITERRANEAN, SOUTH ITALY)

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Usually at the apex of trophic chains, large pelagic sharks play an important role in the structure and functioning of marine ecosystems. These fishes are particularly vulnerable to increased mortality rates because of their slow growth, late age of maturity, and low reproductive rate. Thus, the decline of large sharks may have marked ecological consequences. Little is known about the presence and distribution of pelagic sharks in the Mediterranean. Main objective of this paper was to describe briefly the spatio-temporal distribution of these sharks in Calabrian waters (Central Mediterranean, Southern Italy), employing different sources of information, including commercial and recreational fisheries landings, scientific surveys, and sightings records. 12 shark species were recorded for the region: *Hexanchus griseus* (17 records), *Prionace glauca* (16), *Sphyrna zigaena* (7), *Carcharodon carcharias* (7), *Cetorhinus maximus* (6), *Alopias vulpinus* (5), *Isurus oxyrhincus* (4), *Lamna nasus* (2), *Carharhinus brevipinna* (1), *Carcharhinus plumbeus* (1), *Odontaspis ferox* (1) e *Sphyrna lewinii* (1). The 66,2 % of the records refers to sharks caught by fishermen, the 23,5 % to sharks observed in the wild, 7,3% to beached sharks and the 2,9% refers to dead dolphins bitten by sharks. 59% of records were found along the Tyrrenian side of the region,while the remaing 41% along the Ionian side. There was not found any significant relationship between months of the year and the side of the region or the number of records. From a biogeographical point of view, the presence of *Sphyrna lewinii* is a very interesting report: the species is, in fact, known only for the western Mediterranean, from Gibraltar to Balearic Islands. Other interesting information come from the records of a bottlenose dolphin bitten by a white shark and a striped dolphin bitten by a shortfin mako.

THE PRESENCE OF THE COOKIECUTTER SHARK, *ISISTIUS BRASILIENSIS* (QUOY & GAIMARD, 1824) IN ANGOLAN WATERS

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The present study is the result of a series of bottom trawl surveys conducted off Angola on board the R/V 'Dr. F. Nansen', between 2002 and 2009.

The cookiecutter shark is a typical member of the dogfish order; it has a cigar shaped body, no anal fin, and a short conical snout. It presents two very small spineless dorsal fins posterior on the body, and a nearly symmetrical caudal fin. It's coloration being grey to grey-brown, with a distinct dark collar mark in the gill region. The ventral surface, with the exception of the dark collar, is covered with photophores.

I. brasiliensis is scattered distributed worldwide. In the Eastern Atlantic Ocean, it is found from Cape Verde and Guinea to Sierra Leone, Angola and South Africa including Ascencion Island. In Angola it was found only between 6° and 12° South. It's reported to live in deep waters (up to 3500 m). We caught it down to 811m depth, mainly during the night and always as a single specimen. It seems to migrate vertically to the surface at night to feeed, and one individual was caught at 5m depth feeding on a school of lanternfish.

In our sample (*n*=10) sizes ranged between 36-40 cm TL for males (*n*=5) and 30-48 cm TL for females (*n*=5) which is within the reported limits, being females larger than males. The smallest mature male found was 37 cm TL, while for females the size was 39 cm TL.

From all the stomachs examined, 72% (*n=7*) had some content consisting of cephalopods and teleosts. The length-weight relationship is $y=0.003x^{3.082}$ $R^2=0.939$ (*n=10*). It seems to be a weak relation between size and depth, with smaller fish in deeper waters, but the number of individuals caught was not big enough for a final conclusion. The liver accounts for 20.8% of the body weight.

The cookiecutter shark seems to prefer water temperatures between 5° and 9° C, salinity levels around 34 and can tolerate waters with an oxygen content as low as 1.01 ml/l (with a saturation level between 4 and 35%).

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