



Programme Booklet



The 15th Annual Scientific Conference of the
European Elasmobranch Association
is hosted by the German Elasmobranch Society



Deutsche Elasmobranchier-Gesellschaft e.V.

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Welcome



Dear Attendees!

Welcome to the 15th Annual Scientific Conference of the European Elasmobranch Association!

The German Elasmobranch Society (Deutsche Elasmobranchier-Gesellschaft, D.E.G.) is delighted to be hosting the EEA scientific conference for the third time and welcomes you warmly in Berlin, one of today's most popular metropolitan cities in Europe.

The EEA conference is the only annual European conference on cartilaginous fishes that brings together science and conservation of these fascinating creatures. The EEA's mission to promote and advance the study, management and conservation of these fishes has started in 1996, and since then has gained 12 national member organisations dedicated to these objectives under its umbrella. Most of the organisations, just like the EEA itself, are run completely voluntary, but all the more with great passion and engagement.

Every year one of these passionate scientific and/or conservation groups takes over this work-intensive endeavour to provide a venue for our exchanges and discussions. This year the D.E.G. was rewarded by the astonishing number of nearly 100 attendees from 27 countries from all continents, which brings in a truly global aspect to the meeting. We thank you for your great interest and hope that you will have an exciting stay in Germany's capital city and that the two days of presentations are inspiring for the work of us all.

The D.E.G. is the oldest of the European elasmobranch organisations, and was founded in 1995 in Hamburg by a group of interested citizens. It is not exclusively a scientific society consisting only of scientific members, but we also have sailors, divers, fossil collectors, and other elasmobranch enthusiasts among our members, yet we are strictly science-based in our scientific and conservation work.

We are happy to take all of your questions that may arise during your stay and try to help you as good as we can to answer these. We hope you can find some time to also visit some of the historical places in Berlin, that have set the scene for many political and historic developments – good and bad – in the 20th century.

Finally, we would like to give our special thanks to the Natural History Museum of Berlin for the generous support to provide a unique venue for the conference and the very fruitful cooperation during the last months. We are very grateful to our sponsors, Okeanos – Foundation for the Sea and the Shark Alliance, who have actually only made the conference possible and especially in regards to keep the costs down for all delegates and allowed the low cost registrations.

Thank you all for helping to make this meeting a success!

Heike Zidowitz

On behalf of the D.E.G. Conference Organising Committee





Programme

Scientific Programme

Saturday, 29th of October 2011

9:30-9.45	<p>Welcome and Opening of conference</p> <p>Opening address of the Chair of the German Elasmobranch Society, Heike Zidowitz Opening address of the Museum of Natural History, Peter Bartsch Opening address of the EEA President, Massimiliano Bottaro</p>
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Keynote Presentations

9.45-10.20	<p>Shelley Clarke Keeping the Science in Shark Conservation</p>
10.20-10.55	<p>Sonja Fordham EU shark conservation: progress and next steps</p>

10.55-11.30 Tea & Coffee Break

Session 1: Elasmobranch Conservation & Fisheries Management

11.30-11.50	<p>Mika Diop Elasmobranch management and conservation in West Africa</p>
11.50-12.10	<p>Julia Spät The status of elasmobranchs in the Red Sea</p>
12.10-12.30	<p>Paddy Walker A Blueprint for Shark Survival</p>
12.30-12.50	<p>Matthew Gollock Sharks on the EDGE</p>

12.50-14.00 Lunch Break

Session 2: Fisheries

14.00-14.20	Rima Jabado The shark fishery and fin trade in the United Arab Emirates
14.20-14.40	John Richardson UK Shark Fisheries: 1985 – 2010
14.40-15.00	Joana Silva Spurdog <i>Squalus acanthias</i> in the north-east Atlantic: Do they really qualify as Critically Endangered?
15.00-15.20	Nuno Queiroz Interactions and space-use overlap between satellite-tracked blue sharks and longline fishing vessels
15.20-15.40	Andres Lopez Garro Conservation of scalloped hammerhead shark (<i>Sphyrna lewini</i>) and its critic habitats in Golfo Dulce, Costa Rica

15.40-16.10 Tea & Coffee Break

Poster Session

16.10-18.00	The poster session will take place in a different room of the museum. Please follow announced instructions on how to get there.
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19.30 Dinner at Restaurant Dehlers in Reinhardtstraße 14
(Please see instructions on separate sheet in your conference folder)

Sunday, 30th of October 2011

Session 3: Taxonomy

10.00-10.20	Alec Moore Rediscovery and conservation status of <i>Carcharhinus leiodon</i> (Carcharhinidae) from Kuwait, a geographically restricted whaler shark
10.20-10.40	Simon Weigmann Contribution to the taxonomy and distribution of seven shark species (Chondrichthyes, Elasmobranchii) from coastal waters of Thailand
10.40-11.00	Silvia Hinojosa-Alvarez Comparison between ND5 and COI genes in Giant Manta ray (<i>Manta birostris</i>) and Mexican Caribbean Giant Manta Ray (<i>Manta</i> sp.)

11.00-11.30 Tea & Coffee Break

Session 4: Anatomy & Morphology

11.30-11.50	Jonathan Cox Hidden Treasure in the Nasal Passageways of a Ghost Shark
11.50-12.10	Farid Hemida Morphology and Biometry analysis of the genus <i>Centrophorus</i> (Elasmobranchs, Squalidae) in the Algerian Basin
12.10-12.30	Barbara Wueringer The sawfish's saw – antenna and weapon

12.30-13.30 Lunch Break

Session 5: Behaviour

13.30-13.50	Frank Velte Dominance hierarchy in the Brownbanded Bambooshark (<i>Chiloscyllium punctatum</i>)
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13.50-14.10	Vera Schlüssel Cognitive functions and their neural substrates in elasmobranchs
14.10-14.30	Juerg Brunnschweiler Individual, sex- and species-specific boldness in three species of reef sharks from an ecotourism provisioning site in Fiji
Session 6: Biology, Ecology & Population Dynamics	
14.30-14.50	Sophy McCully An overview of the biology and status of undulate ray <i>Raja undulata</i>
14.50-15.10	Celia Pinto Up with the youngsters: Demographic characteristics of deepwater sharks in the North West of Scotland (Rockall Through)

15.10-15.40	Tea & Coffee Break
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Session 6: Biology, Ecology & Population Dynamics continued	
15.40-16.00	David Jacoby Developing a deeper understanding of shark movements and spatial dynamics through novel application of network analyses
16.00-16.20	Wolf Isbert Potential use of parasites as tags to identify populations: comparative study of the parasite fauna of <i>Etmopterus spinax</i> (Linnaeus, 1758) in two deep-sea NE Atlantic areas (Galicia Bank and Avilés Canyon)
16.20-16.40	Eleanor Stone Using genetic analysis to validate photo identification of individual basking sharks
16.40-17.00	Ilena Zanella Dynamic population and habitat use of whitetip shark (<i>Triaenodon obesus</i>) at Coco's Island National Park, Costa Rica
17.00	Closing of the meeting and farewell to attendees



Keynote Speakers



Dr. Shelley Clarke

Shelley Clarke received her doctorate in quantitative fisheries science from Imperial College London in 2003 for her ground-breaking study of the shark fin trade. She first acquired her interest in the marine environment while growing up in the lobster fishing town of Winter Harbor, Maine, but an observer assignment aboard a Japanese mothership and Luce Foundation fellowship took her to Japan and China where she has been based for the last 20 years. Shelley believes that East Asia, as the home of the world's most powerful fishing fleets and the largest and fastest-growing seafood markets, exerts a tremendous, but often overlooked and widely misunderstood, influence on the world's oceans. By applying her scientific skills while immersing herself in the rich traditions and languages of these two cultures she hopes to contribute to better understanding and dialogue on sustainable utilization of global fisheries resources.

(taken from Ocean Voices by SeaWeb: <http://www.seaweb.org/getinvolved/oceanvoices/ShellyClarke.php>)

Keeping the Science in Shark Conservation

Shelley Clarke

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The last decade has brought about a remarkable change in public awareness of the threat to sharks and the need for their protection. Two media trends have contributed significantly to this change: a) the advent of social media, including blogs and social networking, which re-post and propagate information; and b) the rise of shark conservation as entertainment through movies and television programmes such as 'Sharkwater' and Gordon Ramsey's 'Shark Bait'.

While these trends have undoubtedly mobilized public opinion, they have largely focused on banning the wasteful and distasteful practice of shark finning in many major fishing grounds, and in more recent years on the creation of shark "sanctuaries" mainly in the waters of small poor developing countries. The extent to which science has played a part in these conservation successes is limited. Campaigns have been aimed at politicians and public opinion, and have often either not had a strong scientific component or have made selective use of scientific information to support their cause. As one example, my estimate of the number of sharks killed for the shark fin trade has been widely mis-cited or exaggerated in favour of higher estimates for which I can find no clear scientific basis. In this case, while science is inevitably reduced to media sound bites, its underlying accuracy and



defensibility is critical when designing effective conservation policies. For this reason, shark scientists must insist that standards such as independent peer review of results are maintained, and authors should speak up when conservation campaigns misrepresent findings.

Left behind in this era of media-friendly shark campaigns is the need for sustainable shark fisheries. Finning regulations do not prevent sharks from being threatened by overfishing and the creation of shark sanctuaries will not protect sharks if prohibitions on shark fishing are not enforced. Under the current lack of catch controls in many nations' coastal zones and on the high seas millions of sharks remain vulnerable to over-exploitation. In spite of this, shark scientists pursuing untelegenic topics such as ageing shark vertebrae, compiling and quality-checking fishing records, and constructing and running stock assessment models, cannot be blamed for feeling irrelevant to the work of shark conservation groups focused on finning and sanctuaries. It is not realistic to believe that all, or even most, sharks can be protected without fisheries management. Therefore, a scientific understanding of species' productivities, exploitation rates and recovery times will be critical to maintaining shark populations and marine ecosystems. We should all do more to acknowledge and support important shark research which will never feature on the Discovery Channel.

Although in some cases available science is not fully or effectively utilized by shark conservation campaigns, in many cases there are simply no scientific results to inform policy decision-making. This was, up until earlier this year, the situation for sharks in the Western and Central Pacific Ocean, but the first analyses of the longest-term and most comprehensive shark datasets held by any Regional Fisheries Management Organization (RFMO) was released by the Western and Central Pacific Fisheries Commission (WCPFC) in August 2011. These analyses show consistent, dramatic declines in abundance and size of oceanic whitetip sharks in three independent data sets. Despite this undisputed evidence, and bans on retaining oceanic whitetip sharks in two of the five other tuna RFMOs, no member country has proposed any WCPFC management action for this species. This case points to a worrying de-coupling of shark science and shark conservation which prevents the kind of synergy needed to create political support for controls on shark fishing. When scientists and conservationists fail to coordinate their agendas, both sides, and most of all sharks, stand to lose critical opportunities for progress.



Sonja Fordham

Sonja Fordham has two decades of experience in the field of shark conservation. She directed shark conservation projects at the Washington, DC-based Ocean Conservancy from 1991-2009. In mid-2006, she began a three and a half year assignment in Brussels as policy director for the Shark Alliance, a coalition formed to improve European shark policies. She founded Shark Advocates International as a project of The Ocean Foundation in May 2010. Her work has focused on publicizing the plight of sharks and advocating science-based shark policies before fishery management and wildlife conservation bodies.

Ms. Fordham has been a leading proponent of numerous landmark shark conservation actions, including the first U.S. fishing limits for Atlantic sharks and rays, the United Nations International Plan of Action for Sharks, U.S. and international finning bans, the first listings of sharks and rays under the Convention on International Trade in Endangered Species, the addition of sawfish to the U.S. Endangered Species list, various protections for threatened European sharks and rays, a series of international shark fishing limits at Regional Fishery Management Organizations (RFMOs), and several United Nations General Assembly Resolutions encouraging shark conservation.

Ms. Fordham has co-authored numerous publications on shark fisheries management and is a member of various shark, skate, and RFMO advisory panels. She serves regularly on U.S. delegations to meetings of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Northwest Atlantic Fisheries Organization (NAFO). Ms. Fordham is Deputy Chair of the IUCN (International Union for Conservation of Nature) Shark Specialist Group and Conservation Committee Chair for the American Elasmobranch Society.

Ms. Fordham received a U.S. Department of Commerce *Environmental Hero Award* in 2000, a Mid-Atlantic Fishery Management Council *Fishery Achievement Award* in 2004, and the inaugural *Peter Benchley Shark Conservation Award* in 2007. In 2008, *Washingtonian* magazine named her one of 30 local Eco-Heroes.



EU shark conservation: progress and next steps

Sonja Fordham

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The European Union (EU) has been slow to regulate elasmobranch fishing and champion shark protection, but has taken significant steps toward conserving these species since 2006. The EU's notorious not-so-distant past – characterized by severe population depletion, unregulated fishing and exceptionally weak regulations – is now finally being balanced by increasing regulation of EU elasmobranch fisheries and growing interest in securing international shark protections.

EU fishery managers have shut down several unsustainable shark fisheries, established many new elasmobranch quotas, and fully protected several threatened species. These actions, however, came only after serious overfishing had already occurred. Moreover, there are still no limits for the current main targets of EU shark fisheries while many threatened species remain woefully under-protected. The lengthy process to close loopholes in the EU shark finning ban is finally in its final months, but the widely recommended prohibition on at-sea fin removal is by no means the certain outcome.

On the international front, the EU has had reasonable success promoting protection for particularly vulnerable shark species through Regional Fishery Management Organizations, even without protecting the same species at home. The EU, thanks to Germany and Belgium, has championed measures for porbeagle and spurdog through global wildlife treaties (the Convention on International Trade in Endangered Species and the Convention on Migratory Species) with mixed results.

The 2009 EU Shark Action Plan, while long overdue, has set the stage for continuing policy improvements on all these fronts. The long-term sustainability of European shark populations depends on prompt and full implementation of this Plan by, among other things, closing finning ban loopholes, enforcing science-based fishing limits, and protecting endangered species. Given the EU's influence on international fisheries policies and developing countries, such progress is also key to a brighter future for elasmobranchs around the world.

This presentation will detail progress toward these achievements and outline, with recommendations, steps for securing the next significant milestones in EU elasmobranch conservation policy.



Oral Presentations



Elasmobranch management and conservation in West Africa

Mika Samba Diop and Justine Dossa

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The intensive exploitation of shark populations in West Africa has resulted in the collapse of fisheries and loss of biodiversity. Hence the Sub-Regional Action Plan for conservation and sustainable management of shark populations (PSRA-Requins) launched a project in 2004 promoting a sustainable shark resource management strategy within the region of the Sub-Regional Fisheries Commission. The project aims to improve the understanding of elasmobranch distribution, biology, bycatch rates and landings, as well as social and cultural uses. This information is fundamental in the planning adequate conservation and management strategies.

The results presented here relate to shark exploitation, the distribution of species encountered in each country and their conservation status. The information was gathered through a thorough review of the literature, existing databases and scientific monitoring of shark landings.

This project enabled the development of a conservation and sustainable shark management strategy in the sub-region. The first phase of the project lasted four years and the knowledge gained lead to establishing the shark conservation status and the shark landings development in the countries across West Africa and to updating the Red List of the IUCN, with regards to elasmobranchs in West Africa.

Keywords: Sharks conservation, management, West Africa

Session: [Elasmobranch Conservation & Fisheries Management](#)

The status of elasmobranchs in the Red Sea

Julia L.Y. Spät and Michael L. Berumen

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Given the rising global concerns about the status of elasmobranch fishes, the paucity of available information on elasmobranchs in the Red Sea is worrisome. Research on stock assessment, population ecology and life history aspects are almost completely missing and it is suggested that even species estimates are far from being complete. This lack of data is critically hampering the development of any meaningful conservation efforts, such as the implementation of management initiatives to regulate the exploitation of Red Sea elasmobranch stocks. A new research project based in Saudi Arabia has been initiated to create a baseline of Red Sea shark populations as well as to provide scientific information to support new management plans. As part of an integrated approach, a range of fisheries dependent (market surveys) and independent (long-line and baited remote underwater video surveys (BRUVS)) shark population assessment methods are being implemented throughout the Red Sea. Preliminary data indicate an alarming scarcity of elasmobranch species in Saudi Arabian waters in concert with increasingly high catch levels, pointing to currently unsustainable levels of fishing in this area. The project will further involve the assimilation of data from elasmobranch tagging studies, genetic analyses and the assessment of potential nursery areas. Collectively the study aims to establish a baseline foundation for future studies on Red Sea elasmobranchs.

Keywords: Red Sea, Saudi Arabia, fisheries

Session: Elasmobranch Conservation & Fisheries Management

Blueprint for Shark Survival

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In April 2009 the EU council of fisheries ministers adopted the Community Plan of Action for Sharks (CPoA). This plan of action calls on governments to implement management measures under national law. Although the Plan of Action was supported by the EU and member states, there is little evidence that national governments have included the recommendations from the CPoA in policy or management. Two years on some governments have made a certain amount of progress, but a lot still needs to be done. Dutch nature conservation organisations have developed a 'Blueprint for Shark Survival' in order to give government a helping hand. The presentation will give an outline of the steps necessary for a complete management and conservation strategy, as well as an overview of the relevant research. Progress will be illustrated by best practice examples from the Netherlands and the UK.

Keywords: conservation, management, shark

Session: Elasmobranch Conservation & Fisheries Management

Sharks on the EDGE

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As pressures on the marine environment increase, novel approaches to conservation are required. It's estimated that at least 33 million sharks are killed annually both in targeted fisheries, and as bycatch. Many chondrichthyan species are apex predators and their rapid removal is impacting entire ecosystems. The combination of lack of knowledge, poor management and high fisheries mortality increases the potential loss of phylogenetic diversity.

The EDGE of Existence Programme aims to conserve Evolutionarily Distinct (ED) and Globally Endangered (GE) (EDGE) species, thus helping to maintain the focal taxon's diversity, and maximise their ability to adapt and survive anthropogenic and environmental challenges. Applying the EDGE criteria yields different focal species when compared to 'classical' conservation drivers, such as habitat degradation. EDGE Mammals, and Amphibians, projects are already established and EDGE Aquatics is now progressing; in the first instance it will address Sharks, as well as Corals Reefs.

EDGE species are identified using available phylogenetic data to assess 'ED' - the absence of a complete phylogeny, sequence data are being analysed to determine focal chondrichthyes - and the IUCN Red List for 'GE'; with the combined 'EDGE' scores providing a priority list.

The EDGE programme not only approaches conservation from a new perspective, it is focussed on long-term community lead initiatives in developing nations. These species rarely have existing conservation attention and in-country 'EDGE Fellows' are trained to develop projects to benefit each one, as well as build local capacity in regions where the effects of marine pressures is greatest.

Keywords: Evolutionarily distinct; chondrichthyes; conservation; capacity building.

Session: Elasmobranch Conservation & Fisheries Management

The shark fishery and fin trade in the United Arab Emirates

Rima W. Jabado ¹, Saif M. Al Ghais ¹, Waleed Hamza ¹, Aaron C. Henderson ²

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Data collected at landing sites across the United Arab Emirates (UAE) indicate that shark catches are increasingly high which suggests unsustainable levels of fishing. Research on the shark fishery is sparse and shark species occurring in the Arabian/Persian Gulf have not been comprehensively described. Furthermore, it is believed that the UAE is serving as a regional hub for the export and trade in shark fins and shark products to Asia.

Interviews conducted with fishermen across the country have suggested a recent large decline in shark abundance in UAE waters in parallel with the growth of targeted shark fishery. Market surveys are on-going with over 12,000 specimens already examined and genetic samples collected from a confirmed 28 species of sharks originating from UAE Gulf waters. Commercially important species include the milk shark *Rhizoprionodon acutus*, and the spottail shark, *Carcharhinus sorrah*, while other elasmobranchs such as the giant guitarfish, *Rhynchobatus djiddensis*, are most valued for their fins.

The Sultanate of Oman and Islamic Republic of Iran are the largest contributors to the trade in shark fins and shark products being processed in the UAE for export to various countries around the world. Further data collected includes information on the fishery characteristics, species composition, seasonal abundance, distribution, genetics and fin trade of sharks. This data lays the foundations for future studies on sharks in the region as well as provides scientific information to support the development and implementation of new national and regional regulations on the exploitation of these stocks and their conservation.

Keywords: Arabian/Persian Gulf, fishery, fin trade, management

Session: Fisheries

Shark Fisheries: 1985 – 2010

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Assessment of fisheries data compiled by the Food and Agricultural Organisation for the period 2000 to 2008 identified EU Member States as accounting for over 13% of global shark landings, with the UK responsible for 1.6% of landings during this period – ranking 19th in the world's top 20 shark fishing nations (Lack and Sant 2009).

The UK fleet is active worldwide, and as an EU Member State, is managed in accordance with the Common Fisheries Policy which until recently has provided little in the way of effective management for elasmobranch populations. Based on analysis of fisheries data for the UK >10m commercial fishing fleet for the period 1985 – 2010, the Shark Trust is examining how significant declines in former commercially important elasmobranch stocks, combined with more effective management, has driven significant changes in the activity of the UK fleet: namely a marked reduction in shark landings.

This presentation will outline some of the changes emerging within the industry over this 25 year period, as well as charting the shifting impact of the fleet throughout global sea areas, the diversification of elasmobranch fisheries, and the influence of greater regulation including the introduction of species-specific landings. Analysis to date highlights the challenges of working with datasets compiled from multiple sources, as well as problems associated with aggregated catch reporting, which effectively masks true catch composition. Improving the identification of many elasmobranch species (in particular Batoids) can be problematic, often undermining potential improvements in catch recording and subsequent species-specific management.

Keywords: Fisheries, Management, Landings, UK

Session: Fisheries

Spurdog *Squalus acanthias* in the north-east Atlantic: Do they really qualify as Critically Endangered?

Joana Silva, Jose de Oliveira, Sophy McCully and Jim Ellis

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Spurdog *Squalus acanthias* is one of the more common dogfish in the north-east Atlantic, and was subject to intense fisheries exploitation from the 1950s. European management measures were first introduced in 1999, although the initial Total Allowable Catch (TAC) only covered part of the stock area and was higher than reported landings. Restrictive management measures have only been in place since about 2007/08. Earlier, exploratory assessments of spurdog included a Bayesian, Schaefer-model assessment, and suggested that the stock was depleted to about 5% of virgin biomass. This information was used to support the classification of the stock, using IUCN Red List Criteria, as 'Critically Endangered'.

This original model, however, assumed that demographic characteristics were unchanged over time. Analyses of fecundity data suggest that fecundity may have increased over time and the inclusion of such density-dependent changes have been incorporated into a revised assessment model. This model suggests the level of depletion to be about 15% of virgin biomass (and 18% in comparison to 1955, approximately three generations), which is less than first thought and given current management, would support listing the stock as 'Endangered'. Additionally, data from scientific trawl surveys are beginning to show some increases in catch rates and/or frequency of occurrence.

Continued management actions that prevent targeted spurdog fisheries re-opening in the short-term are justifiable. Updated assessment models also indicate that a limited quota (e.g. bycatch allowance) should not prevent some population growth, and conservative management would allow spurdog to remain a viable commercial species.

Keywords: Fisheries management, Squalidae, Stock assessment

Session: Fisheries

Interactions and space-use overlap between satellite-tracked blue sharks and longline fishing vessels

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Surface longlines are widely known to interact with several marine predators and are linked with declines in targeted and bycatch species in the open ocean, including seabirds, turtles, tunas and sharks. Many large pelagic sharks are of current conservation concern because of their vulnerability to overfishing and rapid declines in populations.

Using vessel monitoring system (VMS) data from surface longliners operating in the North-east Atlantic and recorded movements of blue sharks *Prionace glauca* from satellite-linked transmitters, we investigate the vulnerability of sharks to bycatch mortality. Longlines were deployed over an extensive area for a cumulative number of 17,853 days, with fishing effort concentrated in four main areas: southwest of Ireland, south of the Azores, west of the Iberian Peninsula and southwest of the Canary Islands.

Tracked blue sharks occupied a broad range of sea surface temperatures (SSTs), ranging from 15.2 to 24.6°C and displayed high space-use of coastal/shelf edge areas, with seven individuals (35%) spending at least one day-at-risk from longlines. Confirmed fishing induced mortality of satellite-tracked blue sharks was around ~11%, with four sharks being caught by longliners over the 8 – 120 d of tracking time.

Our results indicate that different segments of the blue shark population may be facing differential risk from spatially heterogeneous longlining effort, depending on which geographical regions are occupied at specific times. Preliminary results on the space-use overlap between oceanic-tagged sharks and the longlining fleet operating in North Atlantic waters will also be presented.

Keywords: pelagic sharks, surface longliners, shark-vessel interactions, space-use overlap

Session: Fisheries

Conservation of scalloped hammerhead shark (*Sphyrna lewini*) and its critical habitats in Golfo Dulce, Costa Rica

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From May 2010 until May 2011, researchers analysed scalloped hammerhead sharks (*Sphyrna lewini*) catches of artisanal fishermen in Golfo Dulce, from the Pacific coast of Costa Rica. They observed 67 fishing operations (bottom line), 37 dock landing observations (55.2%) and 30 (44.8%) on board observations. During the fishing observations, *S. lewini* was the most common species of the year, with more of 50% of all sharks analysed, followed by other elasmobranchs like the common smooth hound (*Mustelus lunulatus*), the Pacific sharpnose shark (*Rhizoprionodon longurio*) and the longtail stingray (*Dasyatis longa*).

The catch condition of the elasmobranchs (alive or dead) was different, for some species such as *S. lewini* and *R. longurio* the survival was less of 15%, but another species like nurse shark (*Ginglymostoma cirratum*) and the longtail stingray the survival was 100%.

The catch condition and the low commercial price of shark meat in Costa Rica, allowed the tag and release of 126 elasmobranchs, 59 sharks (30, *S. lewini*), and 67 rays (54, *D. longa*). The highest relative abundance (CUE) of *S. lewini* was reported in July-August. In these months the juveniles had the smallest sizes. So probably, *S. lewini* pups are born in these months that represent the beginning of winter (high abundance of nutrients in the waters). Due these high abundances of juveniles in some areas of the Golfo Dulce, we recommend a closure of bottom line fisheries, from June to August, in order to protect the pups in their first stages of life.

Keywords: *Sphyrna lewini*, scalloped hammerhead shark, Golfo Dulce, juveniles

Session: Taxonomy

Rediscovery and conservation status of *Carcharhinus leiodon* (Carcharhinidae) from Kuwait, a geographically restricted whaler shark

A.B.M. Moore, W.T. White, G.J.P. Naylor, R.D. Ward and R. Peirce

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The smoothtooth blacktip shark *Carcharhinus leiodon* was described in 1985, based on a holotype - the only known specimen for over 100 years - collected from the Arabian Sea coast of Yemen. We report on the re-discovery of this species from the Persian/Arabian Gulf (Kuwait) approximately 3,000 km away, and based on several specimens, provide the first data on fresh colouration, size range and maturity.

Using DNA barcode (CO1) and ND2 data we discuss genetic relationships to similar species, and provide field characters to readily identify *C. leiodon* from these. *Carcharhinus leiodon* is a relatively rare example of a geographically restricted marine carcharhinid, and subject to intensive fisheries in its known range.

Keywords: *Carcharhinus*, Kuwait, Persian Gulf

Session: Taxonomy

Contribution to the taxonomy and distribution of seven shark species (Chondrichthyes, Elasmobranchii) from coastal waters of Thailand

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A collection of 10 shark specimens from seven different species, obtained in 1993 from the marine shelf around Thailand, was examined in this study. The sharks were determined, morphometrically and meristically analyzed, photographically documented and compared with relevant literature and available material from the fish collections of the Zoological Museum Hamburg, the Senckenberg Naturkundemuseum Frankfurt and the Muséum national d'Histoire naturelle, Paris. Contrary to many other references, prominent dorsal ridges were detected in several specimens of *Chiloscyllium griseum* as well as a very unusual big ocellar blotch on the head of one of the specimens which had not been reported for this species before. The teeth of juvenile *Hemipristis elongata* were found to differ significantly from those of adult specimens. The serration of the teeth of juvenile *Hemipristis elongata* consists of much less and distinctly bigger cusplets than that of adult specimens and the serration is only present on the distal sides of the teeth and not on both sides. A morphologically intermediate dentition could be found in a semi-adult female specimen. For *Paragaleus randalli* it could be proven that the teeth morphologically deviate strongly from those shown in literature due to having much larger cusps. Furthermore the known distribution area of *Paragaleus randalli* could be extended considerably eastwards by about 2000 km.

Keywords: Sharks, Thailand's shelf, taxonomy, distribution

Session: Taxonomy

Comparison between ND5 and COI genes in Giant Manta ray (*Manta birostris*) and Mexican Caribbean Giant Manta Ray (*Manta* sp.)

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Based on coloration and morphological differences, the existence of a possible third species for the genus *Manta* has been suggested in previous studies. At least two morphotypes with variations in mouth, ventral and dorsal colorations as well as in some key morphological features have been observed in the giant manta of the Mexican Caribbean.

In order to test the hypothesis about whether those differences are produced by the environment or have a genetic basis we used several mitochondrial DNA markers both nuclear (RAG1) and mitochondrial (ND5, COI, 12S and 16S), to determine if there are enough differentiation levels to further contribute to the definition of the possible third manta ray species previously reported. This work reveals our primary findings using ND5 and COI genes. The DNA from 30 samples collected off Holbox and Revillagigedo Islands, Mexico were amplified, sequenced, aligned and compared to determine if it exists enough genetic variation between the Mexican populations and the previously reported species (*Manta birostris*). The sequences for each mtDNA region, are being compared with those of Pacific in order to estimate the mean genetic divergence and their correlation with isolation processes.

Keywords: *Manta birostris*, ND5, COI, genes

Session: Taxonomy

Hidden Treasure in the Nasal Passageways of a Ghost Shark

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Thirty years ago, Arthur Holl published two seminal papers on the olfactory organ of *Chimaera monstrosa*, commonly known as a ghost shark, or, less excitingly, a rabbit fish. As part of a project to determine ciliary function in the olfactory epithelium of cartilaginous fish, we re-investigated the olfactory organ of *Chimaera monstrosa*. First we used X-ray micro-computed tomography to reconstruct the three-dimensional structure of the olfactory organ. Then we used histochemistry to inspect the olfactory epithelium. The reconstructed olfactory organ revealed a hitherto unremarked upon nasal passageway linking the incurrent nostril and the excurrent aperture of the olfactory organ. We believe that this bridging channel serves both to divert excess water from the nasal chamber, and, paradoxically, to encourage flow of water through the nasal chamber. We found other anatomical features likely to guide and facilitate flow through the olfactory organ, suggesting a highly efficient ventilation system. We were able to measure the lengths of individual cilia, and found them to be typically 5 or 6 μm , consistent with a mucus-propelling rather than a water-propelling function. In several regions of the olfactory epithelium the ciliary tips were in direct contact with what are likely to be the remnants of a thin mucus layer washed off during the preparation of the material. If the cilia are mucus-propelling, this would imply that the nasal chamber is ventilated primarily by the respiratory activity of the fish, a finding with implications not just for other chimaerid species, but for all cartilaginous fish, including elasmobranchs.

Keywords: *Chimaera monstrosa*, olfaction, ventilation

Session: Anatomy & Morphology

Morphology and Biometry analysis of the genus *Centrophorus* (Elasmobranchs, Squalidae) in the Algerian Basin

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Two species of *Centrophorus* occur in the Mediterranean Sea: the gulper shark *C. granulosus* (Bloch & Schneider, 1801) and the little gulper shark *C. uyato* (Rafinesque, 1809). A taxonomic uncertainty exists regarding this genus; the objective of this study is to determine characters that distinguish its species in the Algerian basin.

Data were collected during investigations conducted from 2006 to 2008 in the area. One hundred and twenty three specimens were examined, after identification based on characters given by the referenced guides: coloration, body and teeth shape, pectoral fin shape, position of dorsal fins and ratios have all been used as diagnostic features of the genus.

A complete set of biometric characters (total length, dorsal fins height, pectoral fin posterior margin length, etc.) according to the gender and the site was gathered for all individuals and standardized by the programme Sizestd. Variables were analysed using principal components analysis and discriminant analysis and performed by Statistica software (Statsoft, 1997).

A morphology analysis determined that most specimens belong to two putative species *C. granulosus* and *C. uyato*, although sharing some similarities with *C. lusitanicus* and *C. squamosus*. Multivariate analysis discriminates individuals into two groups (males and females): the variables separating these two groups are related to the snout width, inner margin length, dorsal fins height and length of body. The results suggest that only one species of *Centrophorus* with great variability occurs in the studied area and could be considered as a complex '*granulosus-uyato*'.

Keywords: Morphology, Morphometrics, *Centrophorus*, Algeria

Session: Anatomy & Morphology

The sawfish's saw – antenna and weapon

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Pristid sawfish are in decline globally, and they are listed on the IUCN red list and CITES. Sawfish may not be targeted commercially, but as they occur in coastal and freshwater habitats and their elongated rostrum easily entangles in fishing gear, they are often taken as bycatch. Although the sawfish's rostrum is a unique adaptation amongst rays, its use has never been studied. In the present study, observations of feeding events by juvenile freshwater sawfish *Pristis microdon* are combined with experiments on their reactions towards prey simulating weak electric fields. The sequential and temporal variations of feeding behaviours of nineteen wild-caught *P. microdon* were quantified. Eighteen behaviours were identified within the ethogram, three of which involved the use of the rostrum. Feeding sequences were separated based on whether the prey item was attacked in the water column or on the bottom, as this may represent two different prey capture strategies of wild animals, for benthic and benthopelagic prey. When attacking a fish in the water column, lateral swipes of the rostrum are followed by behaviours that bring the fish onto the substrate. When feeding on the substrate, *P. microdon* often 'pins' the fish, 'turns' it, or uses lateral swipes. The reactions of freshwater sawfish to weak electric dipole fields presented on the bottom or in the water column are comparable to their feeding reactions. The animals display an innate feeding response towards these dipoles. Interestingly, dipoles suspended in the water column are attacked with lateral swipes of the rostrum, while dipoles on the bottom are only bitten.

Keywords: sawfish, electroreception, rostrum, feeding behaviour

Session: Anatomy & Morphology

Dominance hierarchy in the Brownbanded Bambooshark (*Chiloscyllium punctatum*)

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Only little is known about social structures in populations of sharks and long-term behavioural studies in their natural habitat are difficult to carry out. In studies under aquarium conditions the number of individuals, which should be studied, and space are often limited. In the few studies, published so far, it has been shown that, if two sharks are on a head-on collision course, one individual avoids the other. This behavioural pattern was called “give-way”. In the case of such an interaction the shark, which abruptly changes the course and avoids the other individual is defined as subordinate, while the other shark is defined as dominant. By analysing this behavioural pattern the social structure of a shark population as a dominance hierarchy, could be demonstrated.

At the Aquarium Department of Opel-Zoo Kronberg, Germany, the social organization of a captive group of five juvenile Brownbanded Bamboosharks (*Chiloscyllium punctatum*) was studied during a period of three months. The Bamboosharks were 6 to 12 month old and total body lengths of 0.32 to 0.48 m. The animals could be recognized individually by different caudal fin markings. Total observation time was 36.5 hrs. The observations were carried out from 8:30 to 11:00 and from 16:00 to 17:00. The results show a size-dependent dominance hierarchy in Brownbanded Bamboosharks, too. The largest shark occupied the Alpha-position, while the smallest holds the Omega-position.

Keywords: social structure, give-way

Session: Behaviour

Cognitive functions and their neural substrates in elasmobranchs

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While elasmobranchs were formerly known as ‘primitive fish with primitive brains’, research over the last few decades has provided increasing evidence that sharks and rays show sophisticated behaviour, have a complex biology and are equipped with sensory systems perfectly adapted to life underwater. However, the extent of cognition within this group is still largely unknown and many questions regarding learning and memory capabilities as well as their neural substrates remain unanswered.

To test the hypothesis that elasmobranchs have cognitive abilities that match those of teleosts and other vertebrates, spatial memory, avoidance learning, memory retention and visual discrimination abilities were assessed in two species of bamboo sharks (*Chiloscyllium griseum* and *C. punctatum*), the coral cat shark *Atelomycterus marmoratus* as well as the freshwater stingray *Potamotrygon motoro*. Additionally, the importance of the telencephalon as a neural substrate for cognitive functions was investigated.

Elasmobranchs were found to orient according to different spatial strategies, mastered turn-response as well as place learning tasks and retained this knowledge in the absence of reinforcement for a period of up to six weeks. Orientation was predominantly vision based and sharks were capable of constructing cognitive mental maps of their environment. Telencephalon lesions severely impaired this ability but did not affect turn response learning. In an avoidance learning paradigm sharks were successfully (classically) conditioned to avoid an aversive stimulus. Partial telencephalon ablation impaired this ability only in some individuals. Visual discrimination studies showed that elasmobranchs can distinguish between a variety of two dimensional geometric shapes, such as circles, squares and stripes.

Results indicate that tested cognitive functions in elasmobranchs seem to be just as well developed as in other vertebrates, aiding them in activities such as food retrieval, predator avoidance, mate choice and habitat selection.

Keywords: cognition, learning, memory, telencephalon

Session: Behaviour

Individual, sex- and species-specific boldness in three species of reef sharks from an ecotourism provisioning site in Fiji

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The continuum from shyness to boldness is a fundamental axis of behavioural variation. Variations along the shy-bold continuum can be found in a variety of animal taxa including many teleost fishes, but have never been examined in sharks. Different species of sharks are known to form single species aggregations and to naturally occur in sympatry. Additionally, the development of shark viewing tourism has created sites around the globe where sharks form single- or multi-species groups offering opportunities to identify and quantify behavioural traits that are otherwise difficult to observe in free-ranging sharks. In this project, we studied feeding dynamics and intra- and interspecific variations along the shy-bold continuum in grey reef (*Carcharhinus amblyrhynchos*), blacktip reef (*Carcharhinus melanopterus*) and whitetip reef (*Triaenodon obesus*) sharks at two feeding sites (at 10 and 3 m) within the Shark Reef Marine Reserve in Fiji where sharks are hand fed. We defined boldness as the tendency of a species or an individual to approach and take food from the hand of the feeder and addressed the following questions: 1) which of the three species and which known individuals (based on external markings and colouration) are present, approach and take food from the feeder at 10 and 3 m, respectively? 2) What is the sex of the individuals that approach and take food from the feeder at 10 and 3 m, respectively? 3) How much food do individual sharks take from the feeder?

Keywords: Shark Reef Marine Reserve, behaviour, ecology

Session: Behaviour

An overview of the biology and status of undulate ray *Raja undulata*

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Undulate ray *Raja undulata* is one of the lesser-known skates occurring on the continental shelf of the north-east Atlantic. It is patchily distributed throughout its range, with sites of local abundance in the central English Channel and off the coasts of Ireland, France, Spain and Portugal. *R. undulata* is most abundant in coastal waters (<50 m deep) and is often found in proximity to large estuaries, rías and bays. It is a relatively large-bodied species, attaining a maximum length of more than 114 cm, with females maturing at a length of approximately 84 cm.

Although infrequently taken in existing trawl surveys, it can be locally abundant in certain areas, where it can be the dominant skate species. Given its large size, patchy distribution, and concern over the possibilities of localised depletions, the IUCN listed *R. undulata* as an 'Endangered' species and, since 2009, the European Commission has established regulations to prohibit commercial fisheries landing the species. Given the increased interest in the species, a synopsis of our current knowledge is provided, and available data from internationally-coordinated trawl surveys presented.

Keywords: English Channel, fisheries management, Rajidae

Session: Biology, Ecology & Population Dynamics

Up with the youngsters: Demographic characteristics of deepwater sharks in the North West of Scotland (Rockall Through)

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Managing the ecosystem as a whole requires description of its different levels, consideration of species conservation as well as on economic returns, all based on best use of biological knowledge. It is vital to focus on by catch species with vulnerable life history traits, such as deepwater sharks, in order to not consider only target species when managing the impact of human activities. As data collected for bycatch species are often incomplete or absent, it is vital to develop techniques that consider uncertainty in the assessment process.

This study concentrates on two deepwater species of sharks (*E. spinax* and *G. melastomus*) exploring population viability through a Leslie matrix model, which accounts for uncertainty around the input parameters. The aim of the study is to better understand the biology of the species in order to suggest management advices for these fisheries' by-catch species.

Results obtained show the importance of considering uncertainty when input parameters are not verified and, specifically, underline the importance of survival in long lived, slow growing species. Moreover the importance of juveniles' survival is suggested from stable stage distribution and elasticities analyses.

To protect and manage these species it is fundamental to conserve their juveniles and, when assessing shark populations' state, uncertainty around survival must be considered, if reliable data are not available. Previous studies showed the selectivity of longline fisheries on adults, therefore where these species distribute, human activities could be managed through colocation areas, selecting activities that have a sustainable impact on these species.

Keywords: Leslie matrix model, deepwater sharks, uncertainty

Session: Biology, Ecology & Population Dynamics

Developing a deeper understanding of shark movements and spatial dynamics through novel application of network analyses

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Understanding how and why sharks move within their environment is fundamental for the effective management and conservation of many threatened elasmobranch species. With site fidelity and home ranging behaviour common in sharks, there is a need to determine how fine-scale space use changes with ontogeny, sex, phenotype and a variety of abiotic variables.

For some time, passive acoustic telemetry techniques employing static arrays have been used to gather discrete packets of data pertaining to the presence or absence of individually tagged sharks at known receiver locations. A major limitation of current approaches for analysing these data is that they rarely account for the interconnectivity of these locations as the sharks move freely between them. As a result, traditional analyses do not integrate graphically or statistically a temporal component to spatial changes. Hence, the spatio-temporal structure of movements and habitat use is often hard to extract and compare for large numbers of individuals using the same habitats.

Here we present the novel application of network theory to passive acoustic telemetry data which describe the movements of two very distinct species, the Caribbean reef shark (*Carcharhinus perezi*) and the small spotted catshark (*Scyliorhinus canicula*). This approach treats specific locations as network nodes and the movement of sharks between receivers as network edges. Some descriptive and quantitative analyses that are possible with this new technique are highlighted and assessed in relation to their application to enhanced management and conservation strategies.

Keywords: connectivity, movement analyses, network, space use

Session: Biology, Ecology & Population Dynamics

Potential use of parasites as tags to identify populations: comparative study of the parasite fauna of *Etmopterus spinax* (Linnaeus, 1758) in two deep-sea NE Atlantic areas (Galicia Bank and Avilés Canyon)

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Parasites have been demonstrated to be efficient biological tags in fishes; among others as markers for pollution, stock separation and migration events. Within the framework of the project 'DEEPCON' the parasite fauna of the velvet belly lantern shark (*Etmopterus spinax*) from the Galicia Bank and the Avilés Canyon in the NE Atlantic was compared.

The main goal of the study was to evaluate possible differences in the parasite fauna (parasite higher taxonomic groups) of this species in these two areas, and assess the potential use of parasites as tags for different populations as well as for migration events. Sharks were sampled between 660 – 1140 m depth, during two scientific surveys carried out in July and August 2010. Sampling was conducted by means of an otter trawl.

Whole metazoan parasite fauna (ecto- and endoparasites) has been studied for 67 shark specimens (total length range: 15 – 46 cm) from both areas. Three parasitic taxa have been identified for this species: Monogenea, found on the gills; and Nematoda and Cestoda, mainly in the viscera.

Prevalence of Monogenea showed statistical significant differences between both areas (chi-square, 14.73; $p < 0.0001$), while quantitative descriptors (abundance, prevalence, intensity) of Nematoda and Cestoda presented non-significant differences. A significant relationship was found between host length and parasite abundance (Spearman's $\rho = 0.60$, $p < 0.001$). However, a general tendency of a distinct parasite fauna regarding quantitative descriptors in both areas could not yet be confirmed. Here we discuss the obtained results considering the usefulness of found parasites as bio-tags.

Keywords: biological tags, parasite fauna, deep-sea shark, NE Atlantic

Session: Biology, Ecology & Population Dynamics

Using genetic analysis to validate photo identification of individual basking sharks (*Cetorhinus maximus*)

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Photo identification (ID) is a common technique in the study of animal populations, utilising naturally occurring markings to distinguish individuals. The Manx Basking Shark Watch (MBSW), based on the Isle of Man, has been carrying out dedicated photo ID of basking shark dorsal fins since 2009. To date, the MBSW catalogue contains a minimum of eighty individuals, sub-divided into categories depending on the extent of fin identification markings. There are a large number of animals which only have small, ambiguous markings. This leads to increased subjectivity and introduction of potential errors when matching fins, which presently is done purely by eye. The flexibility of the basking shark dorsal fin, as well as the potential for re-growth, adds further difficulty when comparing images. In order to determine the reliability of dorsal fin matching, genetic matching was performed. MBSW collected samples (n=44) of the mucus that covers the sharks' epithelium, alongside the fin photos. This mucous contains extractable DNA, which was analysed independently of the ID images. Microsatellite analysis showed almost 95% concordance with photographic data. Genetic analysis also identified a match when no usable photographic data was available, as well as confirming or rejecting matches where the photographic data was inconclusive due to the lack of obvious identifying features. The use of both techniques in conjunction provides more robust results, potentially allowing more matches to be made. Therefore, concordance of the genetic data validates the results obtained by photo ID, confirming its suitability as a research tool for basking sharks.

Keywords: Basking shark, photo identification, microsatellite analysis

Session: Biology, Ecology & Population Dynamics

Population dynamics and habitat use of whitetip reef shark (*Triaenodon obesus*) at Cocos Island National Park, Costa Rica

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The Cocos Island was declared a national park in 1978, in order to protect and conserve the marine and terrestrial biodiversity of this unique island. The Cocos Island National Park (CINP) was declared a UNESCO World Heritage Site in 1997. The Committee justified its decision with the critical habitats that the island has for the marine life, especially for the pelagic species, like sharks. Actually, this island is one of the most important dive destinations in the world and it is famous for its large congregations of hammerhead sharks (*Sphyrna lewini*) and whitetip reef sharks (*Triaenodon obesus*).

The whitetip reef shark is a coastal species that lives in coral reef ecosystems; its distribution and presence are directly related to those of corals. Also, like corals, this species has a negative association with anomalous sea surface temperature related to global warming, such as El Niño events. Because of this, the project aims to study the population dynamics and habitat use of whitetip reef sharks, to gather baseline information by monitoring its population, which is very vulnerable to changes due to global warming.

In order to reach this aim, Mision Tiburon and the Cocos Island National Park started a shark tagging programme with conventional flexi-tags and a visual counts programme. In these programmes researchers tagged 58 whitetip reef sharks and reported 33 recaptures, confirming that the whitetip reef shark is a nocturnal species, resident with high fidelity to the tagging sites. The researchers estimated a growth of 1.9 cm/months in an adult whitetip shark and evaluated the population densities and relative abundances at the tagging sites.

Keywords: Cocos Island, *Triaenodon obesus*, population dynamics, global warming.

Session: Biology, Ecology & Population Dynamics



Poster Presentations

Assessing adaptive divergence and health in the thornback ray *Raja clavata*

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Elasmobranchs worldwide are facing increasing pressure from exploitation, environmental pollution and, in some cases, wildlife tourism and sport fishing. Understanding the relative impacts of these factors, how their effects might be ameliorated and the ability of fish to adjust to and persist in the face of these novel conditions is a major challenge to elasmobranch conservation. Yet little direct evidence of elasmobranch health, or their ability to adapt to these changes, has been gathered.

Over a relatively small and largely accessible area, UK coastal waters exhibit a variety of environments from almost pristine to heavily polluted, are heavily fished and used widely for a variety of recreational pursuits, many of which bring elasmobranchs into direct and indirect contact with man. Of the species common to the varying environments in the UK, one of the most accessible and tractable is the vulnerable thornback ray, *Raja clavata*.

Tagging data suggests migration is limited in this species, yet it occupies a variety of habitats along a considerable latitudinal gradient, factors which may contribute to genetic differentiation and local adaptation. Here we present the research outline for a large-scale assessment of adaptive divergence and health in an elasmobranch fish that will consider phenotypic and genotypic diversity as well as ecophysiology.

Keywords: *Raja clavata*, genotype, phenotype, health

How long to wait? Behavioural decisions and distributions of blonde ray *Raja brachyura* and spotted ray *Raja montagui* over temporal scales in waters off Plymouth, UK

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The dorsoventrally flattened morphology of benthic ray species is perhaps assumed to be a constraint on their locomotory ability, suggesting these sit-and-wait predators may exhibit reduced movement and low activity with all species exploiting similar niches. Advancing our understanding of ray behaviour and movement in relation to the environment is required however, because many elasmobranch populations are threatened by demersal fisheries. The k-selected life history and morphology of rays infer they are particularly vulnerable to the direct and indirect effects of fishing.

To investigate movement patterns and behaviour of rays off south-west Britain, blonde ray *Raja brachyura* and spotted ray *Raja montagui* were electronically tagged. Using custom-written software, time-series of waiting times (intervals between periods of activity) were analysed statistically, revealing complex movement patterns and behavioural structure over a wide range of temporal scales. Spatially, spotted rays displayed deeper, more restricted depth area preferences than blonde rays; although over seasonal scales there was substantial intraspecific variation in activity and waiting times in both species, and in terms of sex and size. Furthermore, certain degrees of diel behaviour were present, with more pronounced nocturnal activity in blonde than spotted rays.

This integrated statistical approach to understand the behavioural strategies of these ray species helps to assess aspects of behaviour such as decision-making (waiting time between activities) in relation to habitat availability and quality. A deeper understanding of spatio-temporal movements and behaviour, including where rays are, how long they stay there and why, will inform better management of ray populations.

Keywords: Behaviour, movement, telemetry, rays

An analysis of body rub marks on basking sharks: could they be a result of social swimming or courtship behaviour?

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Very little is known of basking shark mating ecology and behaviour. It is hypothesised that skin abrasion marks observed on the body and fins of NE Atlantic basking sharks may have been caused by mating or close social swimming.

This study utilises pole camera footage of 110 sharks, originally obtained to gender animals during Manx Basking Shark Watch research. 60% of these sharks were male. Male sharks were more often seen with marks on their rostrum and caudal keel than females. This is consistent with the hypothesis that such rub marks may be obtained during mating. Females were seen with marks on the fins on the underside of their bodies more often than males, again suggesting that they may be associated with mating. Surprisingly, there was no significant difference in the overall frequency of marks seen on sharks of different sizes. It was anticipated that immature sharks would not have marks caused by possible mating-type behaviour and, although small individuals had marks, they were not seen on the pectoral fins or the tail region.

It is the conclusion of this study that the locations of these abrasion marks are consistent with the hypothesis that they were possibly caused by social swimming or even by mating, but the mark occurrence on males and females of different sizes was not totally consistent with the hypothesis that they are caused by courtship behaviours. In an attempt to further investigate this issue we aim to obtain a larger sample size using HD pole-camera footage.

Keywords: basking shark, behaviour, abrasion marks

SHARKLIFE : Urgent actions for the conservation of cartilaginous fish in Italy

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The endangered status of sharks and rays in the Mediterranean Sea was highlighted by the IUCN study, 'Red List 2007: Assessment of the conservation status of cartilaginous fishes (Chondrichthyans) in the Mediterranean'. The study shows that although the Mediterranean is a semi-enclosed sea, it hosts a diverse range of chondrichthyans – about 80 species, including 45 species of sharks. At the heart of the Mediterranean region, Italy hosts 43 species of sharks. The IUCN study found that the region has the highest percentage of threatened sharks and rays in the world. Around 42% of the 71 species evaluated are included on the Red List of endangered species (under the categories 'Critically Threatened', 'Endangered' or 'Vulnerable'). The main threat to their survival is fishing, both commercial and leisure, in several bordering countries and in Italian waters in particular.

SHARKLIFE, a EU Life+ project which will begin in October 2011 and last for three years, aims to contribute to the conservation of cartilaginous fishes, particularly basking sharks and pelagic stingrays, in Italian waters by reducing the mortality rate caused by commercial and leisure fishing. In line with the European Plan of Action for Cartilaginous Fishes, which was approved in 2009, the project will promote the use of low-impact fishing devices for pelagic stingrays (circle hooks); develop a system to reduce accidental capture of basking sharks; implement a 'tag and release' policy for fishing tournaments; and carry out tailored training for fishermen, veterinarians and coast guard personnel who oversee controls on fishing.

Keywords: Shark conservation, bycatch, circle hook, Mediterranean sea

Preliminary results of elasmobranch bycatch in the Sub-Regional Fisheries Commission region, West Africa

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In the sub-region of the Sub-Regional Commission of Fisheries (SRFC) - Cape Verde, Gambia, Guinea, Guinea-Bissau, Mauritania, Senegal and Sierra Leona - the declared shark landings are estimated to be approximately 24,000 tons from artisanal fisheries. Meanwhile industrial scale fishing fleets catch important numbers of pelagic and demersal species as bycatch.

We therefore thought it is necessary to evaluate these incidental captures to establish how much they contribute to the shark fishing pressure in the sub- region. According to our estimations, bycatch reached a maximum of approximately 12,000 tons in 1996 in all SRFC countries - even though some figures are missing for Guinea-Bissau from 1995 to 1999. For the remaining period, Mauritania, Guinea and Cape Verde contributed most to the catch with more than 95% of the total catches.

Keywords: Elasmobranch, bycatch, West Africa

Shark conservation in the seven countries of the Sub-Regional Fisheries Commission, West Africa: Do we have any evidence of overexploitation?

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In West Africa, the intensive exploitation of shark populations since the 1990s has resulted in the collapse of fisheries and the loss of biodiversity of dwindling resources. Hence the Sub-Regional Action Plan for conservation and sustainable management of shark populations (PSRA-Sharks) project was launched in 2004 to promote a sustainable shark resource management strategy within the region of the Sub-Regional Fisheries Commission (SRFC)- Cape Verde, Gambia, Guinea, Guinea Bissau, Mauritania, Senegal, Sierra Leone.

The project contributes to the improved understanding of the situation, providing information on elasmobranch distribution and biology, bycatch rates and landings, as well as social and cultural uses. This is fundamental in the planning and the implementation of adequate conservation management strategies. The results relate to shark exploitation, the distribution of species in each country and their conservation status. The information was gathered through a review of the literature, the existing databases and scientific monitoring of shark landings. We have established the shark conservation status (IUCN Red List status) and landing development in the all countries across the region. Following these results, can we say that sharks are over-exploited in the sub-region?

Keywords: Selachians, West Africa, overexploitation

Conservation status of shark species in West Africa: strategy for the conservation of threatened shark species

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Sharks and rays have faced uncontrolled exploitation in West Africa for many years. In 2004 we began promoting the sustainable management of shark populations in seven countries of the Sub-Regional Fisheries Commission - Gambia, Cape Verde, Guinea, Guinea-Bissau, Mauritania, Senegal and Sierra Leone. The intensive exploitation of sharks over the last thirty years has resulted in a number of threatened populations. Some species are already extinct locally. This is the case for Pristidae (sawfish) in Mauritania, Senegal, Gambia, Guinea and Sierra Leone. Only Guinea-Bissau could still be a refuge for some individuals in the Bijagos Islands, although until now there has been no confirmation of recapture of these species. The Rhynchobatidae (guitar-rays) have also virtually disappeared throughout the Sub-Region, except on the Banc d'Arguin, Mauritania. Other species, like the great hammerhead shark *Sphyrna mokarran* or the lemon shark *Negaprion brevirostris* are also threatened. In the sub-region, the number of many shark species has decreased in all large species.

In general, there is a deterioration of the status of all species and clear risks for the larger species. The update of the IUCN Red List for the Sharks in West Africa in 2006, in part thanks to the project results from PSRA Sharks, shows that species that still seemed to have a reasonable overall status are already Endangered or Critically Endangered with extinction in the region. Thus, 35% of them are threatened - 5% are *Critically Endangered*, 7% are *Endangered* and 23% are *Vulnerable*. This work provides an analysis of the situation of threatened species in order to offer a better strategy for their conservation.

Keywords: Elasmobranch, threatened, conservation status, approach

Basking Shark Photo-Identification

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The Basking Shark was once a target species of commercial fisheries, yet it has emerged as an iconic, charismatic ambassador for marine wildlife. Seasonal visitors to the UK coastline, they feed on zooplankton at the surface during spring and summer months. These encounters provide researchers and enthusiastic amateurs with the perfect opportunity to photograph the normally elusive sharks.

Photo-identification is a powerful, non-invasive field technique for studying sharks in their natural environment. Many sharks display significant and recognisable markings on their fins, which can be natural (pigmentation) or acquired (injuries). These can be used to identify individual sharks, allowing researchers to re-identify them between seasons.

Using the Catalogue Protocol agreed upon at the 'Basking Sharks: A Global Perspective' conference held in the Isle of Man (2009), the Shark Trust has created an online centralised 'community' database which efficiently stores photo-identification data submitted by associated projects. It acts as a safe repository for images while allowing access for organisations participating in Basking Shark research. Search and browse functions will allow comparisons to be made between dorsal fin images, with the capacity for users to tag images as being of the same individual. The Shark Trust holds approximately 7,000 images in total; priority for analysis was given to Colin Speedie's data and all 4061 images have now been uploaded to the database, representing 419 shark encounters between 1998 and 2006. New public engagement materials have been developed in conjunction with the database, aiming to improve the quality of data submitted to the project by the public.

Keywords: Basking Shark, Photo-ID, Database, Matching

Passport for a Basking Shark

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Manx Basking Shark Watch (MBSW) has been collecting full 'Basking Shark Passports' for individual basking sharks (*Cetorhinus maximus*) since 2009. We have completed 59 to date.

This poster describes a methodology for obtaining a basking shark passport without over-stressing or frightening the animal mid-profiling.

To minimise disturbance of the shark all work is done from a boat carrying a team of four, a cox, a photographer, a note-taker and a person to do the gendering and genetic sampling. Firstly, the basking shark has multiple right and left HD dorsal fin photos taken. The fin photos are then checked for clarity and for distinctive features. MBSW carries a full fin catalogue on board to avoid repeating passports on the same shark. During all approaches a size estimate is obtained relative to the length of the boat. The shark is approached from behind along its right length. A pole-camera deployed at the front left of the boat is used to establish gender. Another approach with a swab on a long pole is made to obtain skin slime for DNA from the dorsal fin.

The complex profile obtained in each individual's 'passport' allows it to be reliably re-sighted throughout life and even after death. These 'passports' allow complex insights into real numbers of individuals visiting an area, as well as the seasonal choices of feeding and putative courtship areas of individual sharks and of schools of sharks over time.

All work is licensed by the Manx government from whom we received support and guidance.

Keywords: Basking sharks passports, DNA

Towards fully Automated Biometric Identification of Individual White Sharks using Computer Vision on Dorsal Fin Images

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This paper presents an experimental computer vision system which automatically assigns identity to digital images of individual white sharks (*Carcharodon carcharias*). Our approach utilises dorsal fin posterior edge morphology as a machine-recognizable biometric identifier for differentiating individual sharks. The system takes as input high-quality, high-resolution images of a side view of the fin, which can be routinely acquired during boat trips to the species' natural habitats. After applying lighting correction using histogram equalization, dorsal fin containing regions are identified using the Viola-Jones object recognition framework. Subsequently, fin area subregions are oversegmented using a network of shape-feature guided local optimisers, before exact fin outlines are implicitly described by the merger of image segments into semantic fin shapes, based on machine-learnt fin textures.

Finally, individual identity is assigned based on the statistical integration of evidence from multiple local and global shape features. The jagged pattern of the posterior edge of the dorsal fin is individually characteristic and its morphology is stable over decades.

Teams of human experts are able to accurately identify individuals from these patterns with a genuine acceptance rate of up to 98%. However, manual identification is highly labour intensive. Here we compare the performance of our algorithm on a reasonably large (N=1000) validation dataset of dorsal fin images of known individuals, with that of systems primarily designed to aid fin identification in terms of top ranked, and top 10 ranked matches.

Keywords: visual biometrics, white shark, computer vision, automated identification

First insight into the parasite fauna and diet of the deep-sea shark *Deania profundorum* (Smith & Radcliffe, 1912) from the Avilés Canyon (southern Bay of Biscay, northeast Atlantic): shedding light on host's role?

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Along with the host diet, parasite assemblages potentially reflect the ecological role of the host within the community at local scale, both as predator and prey. In this work we explore the possible relation between the parasite metazoan fauna and the diet of the arrowhead dogfish (*Deania profundorum*) from the Avilés Canyon (southern Bay of Biscay).

The main goal of the study is to gain knowledge on the parasite fauna and the trophic position of this species within the deep-sea community of this area. Sharks were captured between 600 -1000 m depth during two scientific surveys carried out in July 2010 and May 2011. Sampling was conducted by means of an otter trawl. A total of 29 specimens of *D. profundorum* were examined. Whole metazoan parasite fauna (ecto- and endoparasites) has been studied and three parasitic taxa were identified: only few monogeneans were found on the gills and in the nostrils, while nematodes (prevalence: 75.9 %, mean intensity 42.9) and cestodes (89.7 %, 10.2) were the most abundant groups detected mainly in the viscera and muscle.

Overall, parasite load increased with host size and males exhibited a higher mean intensity. The stomach content analysis revealed fishes and decapodes as main prey. The results exhibit *D. profundorum* as predator as well as prey, thus it acts as final and intermediate host but it also could be a dead end for some larval parasites. We discuss the obtained results considering existing literature.

Keywords: deep-sea shark, parasite fauna, trophic role, NE Atlantic



Divers love Sharks: The economic importance of sharks to dive tourism

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To give an indication of the economic value of sharks to the dive tourism industry we questioned 200 divers on their attitude towards sharks, their travel budget and if the chance to encounter sharks is important is a factor in choosing their holiday destination.

Our study gives a clear indication of the importance of sharks to divers. All participants in the questionnaire value sharks highly and there is a strong link between the amount divers are willing to pay for a trip to certain location and the possibility to dive with sharks.

Keywords: divers, ecotourism, shark

Hg and Zn levels in the muscle, liver, gonads and gills of small-spotted catshark, *Scyliorhinus canicula*, from the Aegean Sea

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Tissue samples from 491 small-spotted catsharks of various sizes (ranging from 194 to 517 mm in total length) caught in different areas of the Aegean Sea, were analysed for Hg and Zn contamination using atomic absorption spectrophotometry. The general tendency in trace element concentrations among the different tissues was: muscle > liver > gills > gonad for Hg and gonad > gills > liver > muscle for Zn.

Mean Hg concentration ranged from 0.35 ± 0.33 mg/kg in gonad tissue to 1.25 ± 0.83 mg/kg in muscle tissue, while mean Zn concentration ranged from 12.08 mg/kg in muscle tissue to 17.86 mg/kg in gonad tissue. Low correlation was found between the concentration of both metals and total length in all of the tissues. At the 95% confidence level, no statistically significant difference was found in Hg concentration between males and females in all tissues, while Zn levels showed a statistically significant difference between males and females in all tissues apart from liver. Different sampling sites showed a statistically significant difference in the concentration of both metals. From the view of public health, Hg levels in 54% of muscle tissue samples were above the limit considered as safe for human consumption by the European Commission (Hg: 1 mg/kg); instead Zn exceeded the safe limit of 50 mg/kg only in one muscle tissue sample.

Keywords: MED, *Scyliorhinus canicula*, Hg, Zn

Population Genetics of Basking Sharks *Cetorhinus maximus* on NE Atlantic Samples using mitochondrial and microsatellite DNA markers

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The filter feeding basking shark, *Cetorhinus maximus* (Gunnerus, 1765), is the world's second largest fish and is designated as 'vulnerable' worldwide on the IUCN Red list. Due to little available biological and ecological baseline data, it is currently accepted that the basking shark's global population structure is panmictic, exhibiting low worldwide genetic variability.

This study allowed for the first population assessment using Northeast Atlantic samples collected within one season via a non-invasive sampling method using skin mucus scrapings. Two sets of molecular markers, microsatellite and mitochondrial D-loop sequence, were compared to assess population connectivity for three sampling sites: Co Donegal, Co Cork, and Co Kerry.

In this study, 26 Irish mitochondrial sequences were aligned with six known global haplotypes. Two new polymorphic sites were detected and one new haplotype was defined. The Irish sample set revealed extremely low nucleotide, yet moderate haplotype diversity. Although these findings support a single global population, significant mitochondrial variation was found for one population (Co Kerry) using *Fst* pairwise comparisons and AMOVA revealed population structuring. Genotypes of 33 sharks were determined for five polymorphic microsatellite loci. Canonical discriminant analysis of nuclear markers suggested some significant isolation. Regarding the power of the molecular tools used, probability of identity indicated that there is a more than 1% chance of two individuals in the data set sharing the same multilocus genotype.

Keywords (max 4): Basking shark, mucus scrapings, population structure, probability of identity.



Chondrichthyans in the Arctic Ocean and adjacent seas

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Museum vouchers and published literature were consulted to assess the species richness of chondrichthyan fish species from 16 subregions within the Arctic Ocean and adjacent seas (AOAS). Although many regions are poorly sampled, the AOAS houses 45 chondrichthyan species: one in one holocephalan family, 17 in twelve shark families and 27 in one single family of skates. The zoogeographic distribution of the species is highly variable within the AOAS, with the Atlantic Arctic Gateway (the Norwegian Sea and the Barents Sea) being particularly species-rich. Here we review, compare and discuss the species richness and zoogeographic distribution of chondrichthyan fishes across the entire AOAS. Arctic fisheries are rapidly developing and the 45 chondrichthyan species are also examined according to the criteria given by the IUCN Red Lists.

Keywords: species richness, zoogeography, cartilaginous fishes

Isolation and Preliminary Characterisation of the MHC Class II Genes in the Blue shark (*Prionace glauca*, L. 1758)

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The major histocompatibility complex (MHC) is characterised by high levels of polymorphism making these the most diverse genes in vertebrates. The genes of the MHC code for cell surface proteins responsible for the binding and presentation of foreign pathogens to T cell lymphocytes, playing a vital role in the immune response. The antigen binding site (ABS) is considered to be the most diverse region within the MHC, and is believed to maintain its diversity through balancing selection.

In order to examine the MHC diversity of a non-model species, we have isolated and are characterising Class II genes from the blue shark, *Prionace glauca*. Isolation and characterization of these genes can yield valuable information for the assessment of individual and population health, providing valuable fisheries information. Ultimately use of these genes as markers of population health could illustrate the large-scale effects of shark fishing and the fin trade - 80% of the annual volume of which is composed of Blue sharks. Consequently, application of these markers may provide a vital element to the conservation and sustainable management of shark fisheries at both local and global scales.

Keywords: Blue shark, MHC, conservation, fisheries

Spatiotemporal distribution of great white shark (*Carcharodon carcharias*, Linnaeus 1758) along Italian coasts: Records from international Medlem program and other contributions

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The Great white shark (*Carcharodon carcharias*, Linnaeus 1758), is an apex predator living in almost all the seas of the world, preferring cold-temperate and temperate waters among the 8 and the 25°C. The Great White Shark occurs in both inshore and offshore waters. Known bathymetric range is from just below the surface to just above the bottom down to a depth of at least 1300 m. It is nevertheless present with important populations in only eight areas of the globe: California and Baja California, Mexico, central Chile, New England, Mediterranean Sea, Western South Africa, southern Australia, New Zealand and Japan. The biology and ecology of this shark is still quite misunderstood and it is one of the three elasmobranch species included in CITES Appendix II. It is listed as globally vulnerable in the IUCN red list.

This work presents data concerning the spatiotemporal pattern of distribution of great white shark along Italian coasts, collected by international LEM programme database and other contributions. 128 records are reported, from 19th to 21st century. The data analysis includes size, weight and distribution information. Many records come from Sicily, Calabria, Tuscany and Sardinia coasts. The number of records regarding newborns (size between 80 and 155 cm length) is also interesting: it represents about 10% of the total records.

Keywords: white shark, Italy

Husbandry of tropical benthonic sharks (*Chiloscyllium griseum*, *C. punctatum* and *Atelomycterus marmoratus*): First step to develop protocols for controlled breeding with conservation purpose

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In the IUCN Red List *Chiloscyllium griseum*, *C. punctatum* and *Atelomycterus marmoratus* are considered as "Near Threatened" species. Presently, there is a lack of information about their general biology, especially concerning reproduction and population structure. No monitoring measures are carried out by the fishing industry in order to enforce a suitable management plan for sustainable fisheries; additionally, Aquarium demand for these species is actually growing.

The development of protocols and programmes in order to breed sharks can be very important for conservation purposes. In the Aquarium Mondo Marino, the Shark Study Centre (Centro Studi Squali), is actually working with the aim to get several couples of parents of the three above mentioned species in order to formalise the protocols for correct husbandry for breeding. The programme plans several steps: A) acclimatise young sharks, controlling feeding and growth rate, B) test different reproduction techniques C) improve eggs development and D) to stabilise juvenile growth.

Keywords: shark breeding, *Chiloscyllium griseum*, *Chiloscyllium punctatum*, *Atelomycterus marmoratus*

Diving behaviour and movements of satellite tracked short fin mako sharks (*Isurus oxyrinchus*) in the North Atlantic: preliminary results

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The shortfin mako shark (*Isurus oxyrinchus*) is a highly migratory, pelagic species with circum-global distribution in tropical and temperate seas. This shark is common in Atlantic Ocean where it is mainly caught by longliners targeting swordfish (*Xiphias gladius*). Despite the high prevalence, economic importance, and vulnerability of this species, little is known about its population dynamics and habitat-use.

In this study, pop-up archival transmitting (PAT) tags were deployed, recording vertical and horizontal movements and temperature preferences of oceanic mako sharks. Satellite tags were programmed to detach 30, 60, 90, 120 or 180 days after deployment were set-up to. A total of nine makos (six males, three females) were caught and tagged in North Atlantic waters, northwest of the Azores islands, with seven tags reporting data. Tagged sharks ranged from 120 – 245 cm (fork length). Sharks were tracked for a total of 570 days and straight-line tracking distances varied between 523 and 3252 km.

Mako sharks displayed different movement patterns, moving south-west, west, north-east and east of the tagging area; including a trans-Atlantic migration into western Iberia waters. Tracked sharks also displayed deep diving behaviour into cold water, with maximum recorded depths of 1064 m (5.8 °C). Temperature preferences ranged from 5.8 and 27°C. More tags will be deployed during 2011.

Keywords: shortfin mako, habitat-use, diving behaviour, trans-Atlantic migration

New morphometric and meristic data on the pale ray *Bathyraja pallida* (Forster, 1967, Arhynchobatidae: Rajiformes) from the North Atlantic

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Using all known specimens, we compiled data for morphometric and meristic characters, as well as coloration of the rare deep-water pale ray *Bathyraja pallida* (Forster, 1967). For the first time, the morphometric measurements are expressed as a percentage of disc width. Presenting the data in this way will better facilitate future taxonomic studies of specimens with damaged snout or tail. Relationships between total length and disc width and other morphometric measurements are generally linear, except for clasper length and snout angle. Comparison of morphological characters of juveniles and adults revealed that adults have a wider disc compared to juveniles. These results in a larger interorbital distance, interspiracular distance, mouth width, internasal distance, nasal curtain length, gill slit lengths and distances between gill slits in adult specimens. Juveniles have a shorter disc length with a longer and blunter snout. Although adult specimens have a wider tail, juveniles have a longer tail with longer lateral fold, as well as a greater distance between dorsal fins and a longer caudal fin. There were virtually no differences in morphological characters between specimens taken from the north-eastern Atlantic versus the mid-Atlantic ridge. Coloration in pale rays appears to change with ontogeny. Juveniles have an overall darker coloration compared to adults. Both juveniles and adults exhibit species-specific patterns and markings on the dorsal and ventral surfaces.

Conservation genetics of white sharks: connectivity, nursery sites and health

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The depletion of top predators is of pressing global concern, especially large sharks, whose life history characteristics (slow growth, late maturity, low fecundity) make them especially vulnerable, yet are paramount to marine ecosystem health. Despite receiving international protection under the Convention on International Trade in Endangered Species (CITES), trade in white shark (*Carcharodon carcharias*) products remains, and alarming declines underscore the urgent need to protect nurseries of this wide ranging species.

Samples from nursery stocks suggest Mediterranean white sharks exhibit little mitochondrial diversity, and close ancestral affiliations are not with the adjacent Atlantic but the Pacific. Our findings of natal philopatry suggest such propagules establish largely closed populations, the absence of immigrant females increasing risk of local extinction, especially following fishing pressure and pollution.

The rapidly degrading Mediterranean ecosystem is mirrored by similar slower paced changes in ocean systems worldwide, yet low genetic diversity, coupled with slow evolution in sharks mean conventional genetic markers have insufficient power to determine population structure, information critical for effective management. Using high throughput sequencing and analyses of single nucleotide polymorphisms (SNPs) of contemporary and historical samples of this non-model, apex predator we aim to determine population connectivity within and outwith the Mediterranean, investigating environmental impact on genetic diversity and ecosystem sustainability.

Keywords: Shark, genetic diversity, population ecology, Mediterranean

Comparative genomics in Torpediniformes (Chondrichthyes, Batoidea)

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Due of their basal position in the vertebrate phylogenetic tree, the study on Elasmobranch genetics and cytogenetics can provide interesting information on the evolution of all vertebrates. In recent years, different molecular approaches, among them the physical mapping of specific nucleotide sequences on chromosomes and the use of these genomic portions for the construction of phylogenetic trees, were used to study the relationships between the different taxonomic groups of cartilaginous fishes. Particularly in Torpediniformes these are even more controversial. In addition, the species have different karyological parameters, the diploid number varies from 28 to 86 elements, with different morphology of the karyotype.

Our aim was to report all the molecular markers that were used to reconstruct the phylogenetic position of Torpediniformes respect to the other Batoidea and to discriminate between the various chromosome pairs in the endemic species in the Mediterranean Sea. The 5S and 18S ribosomal DNA, the *HpaI* and *Alu* SINE, the telomeric (TTAGGG)_n and the spermatogenesis-related sequences have proved particularly useful. These last genomic segments were also useful to differentiate between the male and the female karyotypes. Moreover the torpedoes showed a particular genomic organization, especially *Torpedo torpedo*; in this species large quantities of highly repeated DNA and a characteristic distribution of heterochromatin, which is never centromeric, were observed. The pattern of hybridization of these markers confirmed that the genome of Torpediniformes and particularly that of *T. torpedo* is now more than ever, unique, such as to consider this species as a "model species" to study.

Keywords: chromosome; evolutionary relationships; torpedo; molecular markers.

Importance of *Rhizoprionodon lalandii* (Chondrichthyes, Carcharhinidae) in Brazilian coastal fisheries and statistical data of the world and Brazilian capture of elasmobranchs between years 1970 and 2009

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The Brazilian coast is home to a wide variety of elasmobranchs, with about 85 known species of sharks. Due to their biological characteristics and life strategy, such as long life time, slow growth and late sexual maturity, shark populations are vulnerable to fishing. The species of the genus *Rhizoprionodon* (family Carcharhinidae) are some of the many shark species caught along the Brazilian coast. It stands out in southern and south-eastern Brazilian coasts as the most abundant, with the Brazilian sharpnose shark *Rhizoprionodon lalandii*.

This study aimed to review the fisheries data of these sharks in Brazil and trace a historical comparison of the capture of elasmobranchs in general and the family Carcharhinidae in the Brazilian coastal zone and the global total in the range of years from 1970 to 2009, showing the intensity of these catches. All data were obtained from recent publications on *R. lalandii* in Brazil, as well as official fishery statistics from IBAMA and FAO. In recent decades, *R. lalandii* represented 40 to 60% of shark catches in coastal regions around southern and south-eastern Brazil. The total world catch of elasmobranchs exceeded 27 million tons between 1970 and 2009, of which Brazil holds a share of about 3% of the total. It was also concluded that the lack of specific data makes it difficult to determine the fishing status of various species. Some measures have been proposed as the awareness of fishermen and consumers, the establishment of a minimum length of capture and the creation of protected areas (especially in areas known as nursery sites).

Keywords: Brazilian sharpnose shark, elasmobranch fisheries, sharks conservation.

New records of deep water chondrichthyan species caught in Galicia and the Cantabrian Sea (southern Bay of Biscay)

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A number of chondrichthyan species were caught in deep waters of Galicia and the Cantabrian Sea (southern Bay of Biscay) during two multidisciplinary surveys carried out in May and August 2011 respectively. A few of these species constitute first records in these waters and extends their limits of distribution. Some of these are: *Galeus murinus* (Collet, 1904) *Raja kukujevi*, (Dolganov, 1985) *Neoraja iberica*, (Stehmann, Seret, Costa and Baro, 2008), *Neoraja caerulea* (Stehmann, 1976), *Chimaera opalescens* (Luchetti, Iglesias and Sellos, 2011).

The specimens were caught using a bottom trawl net GOC-73. Surveys took place in Aviles Canyon and Galicia Bank. The first one is located 7 nm offshore from Asturias coast, (6° W), and specimens were caught between 784 and 1650 m depth. Galicia's Bank is a seamount located at 120 nm to the west from the Galician coast. Chondrichthyan species were caught between 757 and 1808 m of depth.

The geographic distribution of some of these species are not very well known, however most of the records of *G. murinus* in the Atlantic or *R. kukujevi* correspond to northern areas above 50° latitude, thus these catches represent a southern extension of its distribution. On the contrary *N. iberica* has been recorded and first described in south Portugal waters and Gulf of Cadiz (south Spain), thus its capture in the north of Spain represent a northern extension of its distribution, as well as an increase of its depth range, 784 m and maximum length recorded, a male of 35 cm.

Keywords: Records, Deep water chondrichthyans, Cantabrian Sea

FINET – A platform for young fisheries scientists

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Communication is fundamental in a world that interacts more and more on a global scale. However, it's easy to get lost in the ocean of information. The idea behind the Fisheries Research Network (Finet) is to create a strong connection between young fisheries scientists and to offer a platform for sharing knowledge, information and enthusiasm.

To provide a complete picture of the recent situation in fisheries research everybody is invited to transmit helpful and interesting news and knowledge. Finet collects, concentrates, organises and shares these information on its webpage www.finet.wordpress.com where you can find news on courses, conferences, job offers, and subscribe to the newsletter. The core objective of the project is to get the people connected on a personal base by creating a network of young scientists who will communicate and interact through weekly paper-discussions, meetings and ideally the development of a common project.

To enhance the distribution of specialised knowledge and skills Finet will organise workshops, and expertise can be exchanged in the forum. Finet is still in its beginning but it has an enormous potential and encountered so far positive feedback.

Keywords: open information platform, shared knowledge, common projects, connecting people

A hotspot for basking sharks in the Mediterranean Sea

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Operazione Squalo Elefante (OSE) is an ongoing public sighting scheme which started in 2005 that aims to contribute data on the presence, distribution and seasonal changes in numbers of basking sharks *Cetorhinus maximus* (Chondrichthyes) around North Sardinia (Central Mediterranean Sea). 55 records of 99 basking sharks were collected in an area where only 14 individuals had previously been recorded. Dorsal photo and tissue collection for further DNA analysis were collected. OSE has significantly improved scientific understanding as well as public awareness of this species in the Mediterranean Sea.

key words: basking shark, Mediterranean Sea, *Cetorhinus maximus*, Sardinia

Requ'IEP: a research programme on the sharks of the Eparses Islands (South western Indian Ocean)

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The Eparses Islands are French territories scattered in the Mozambique Channel (Europa, Bassas da India, Juan de Nova and Glorieuses) and in the north-east of Madagascar (Tromelin). They conceal exceptional ecosystems which put them in a privileged position with regard to the environmental challenges facing overseas island territories. For this type of ecosystem, the “shark” component is an important regulating element owing to the terminal position of sharks in tropical marine networks.

The project has several objectives: 1) Biodiversity: to acquire or improve on the knowledge of sharks and rays from these islands by proposing an initial reference status of the diversity of elasmobranches of the zone by way of a multi-component quantitative approach compared with their habitats: coastal, pelagic and deepwater (external slopes of reefs); 2) Bio-ecology and behaviour: to estimate relative abundance, collect behavioural and biological data on the most common species; data required to manage their populations; 3) Impact of anthropogenic factors: to compare the abundance and diversity of elasmobranches between the “preserved” and “exploited” zones and to define reference statuses.

Keywords: Sharks, Ecology, SW Indian Ocean

Visual approach tactics by white sharks (*Carcharodon carcharias*) under baited conditions and effects of cloud cover

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Understanding white shark feeding habits and the influence of environmental factors on feeding is an important step for modelling its behaviour and making decisions about the management of aquatic habitats. To better understand what factors drive variation in shark feeding habits and decisions, we studied feeding and attack behaviour in Dyer Island Nature Reserve (South Africa) in two consecutive years. Specifically, we examined variation in approach patterns and preference using two types of bait (seal decoy and raw tuna) and asked whether these approach patterns and preferences were affected by changes in cloud cover.

We found a significant association between approach type and sharks' length such that large animals mainly performed vertical approaches, while smaller sharks preferred horizontal approaches. Horizontally-oriented approaches were the most often performed approaches. In addition, for the first approach, white sharks significantly preferred the seal-shaped decoy to the bait, but this preference disappeared with subsequent approaches. We observed effects of variation in cloud cover on both approach frequency and approach patterns. Approaches were more frequent as cloud cover increased, and we observed a transition from horizontally oriented approaches to vertically oriented approaches when cloud cover increased. As demonstrated for other environmental factors, cloud cover may affect the white shark's ability to detect and approach a target, especially during the earliest stages of predation cycle.

Keywords: behaviour, *Carcharodon carcharias*, cloud cover, Dyer Island

A review of the evolution of potamotrygonid freshwater stingrays (Chondrichthyes, Myliobatiformes)

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Myliobatiformes form a monophyletic group characterized by one to several serrated tail spines. The phylogenetic relationships among the major lineages of myliobatiforms are still poorly resolved. The evolutionary history of South American freshwater Potamotrygonidae remains ambiguous. This is mainly because of the lack of fossils and because their sister group remains unsettled, with both *Urobatis* and *Himantura* being candidates.

Potamotrygonidae includes four living genera, *Heliotrygon*, *Paratrygon*, *Plesiotrygon*, and *Potamotrygon*. The fossil record of freshwater stingrays is very patchy and includes rare isolated bucklers, tubercles, spines, and oral teeth occurring in the Middle Miocene of central Colombia, the Late Miocene of Brazil and the Late Miocene of Argentina. These very patchy occurrences may indicate a time of origination in the early Neogene, probably related to extrinsic factors such as plate tectonics.

Three different scenarios are conceivable: (1) change from a marine to euryhaline lifestyle in the ancestor of the clade including *Himantura* + *Potamotrygon* and then a second change to a freshwater lifestyle in the *Potamotrygon* lineage; (2) the ancestor of the *Himantura* + *Potamotrygon* clade also was marine and each lineage made an independent change to a euryhaline (*Himantura*) or a freshwater (*Potamotrygon*) lifestyle; and (3) direct change from a marine to freshwater lifestyle in the ancestor of the *Himantura* + *Potamotrygon* clade, and then a second change to euryhaline lifestyle in the *Himantura* lineage. If *Paratrygon* represents the most basal potamotrygonid, it might have been the first true freshwater member of this group and the onset of their radiation.

Keywords: Batomorphii, Phylogeny, Taxonomy, Fossil

Phylogeny of whole mitochondrial genomes from Hexanchiform sharks

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The order Hexanchiformes (frilled shark and cow sharks) is regarded as a monophyletic taxon, but the morphological and genetic relationships between the five extant species within the order is still uncertain. In this study, we determined the whole mitochondrial DNA (mtDNA) sequences of seven sharks including five Hexanchiformes (Frilled shark, Sharpnose sevengill shark, Bluntnose sixgill shark, Bigeye sixgill shark and Broadnose sevengill shark), one Squaliformes (Pacific sleeper shark) and one Carcharhiniformes (False catshark) to infer the phylogenetic relationships between those species and nine other published cartilaginous fishes.

We used 3,569 amino acids of 12 mtDNA genes, excluding ND6, for the phylogenetic analysis based on the NJ, ML and BI methods. The size of the complete mtDNA sequences in five Hexanchiformes species ranged from 16,990 bp to 18,909 bp, due to the presence of varying numbers and compositions of tandem repeats in the control region. The monophyly of Hexanchiformes was strongly supported by all three methods, as was the monophyly of all other sharks, suggesting that Hexanchiformes is a sister group to all other sharks. This indicates that the traditionally-accepted superorder, Squalomorphi (Hexanchiformes + Squaliformes) needed to be reconsidered. In addition, our phylogeny supports the hypothesis that the Hexanchiformes is the oldest shark lineage and frilled shark is the oldest shark species. Based on our phylogeny, we propose new evolutionary scenarios for the evolution of the jaw suspension mechanism and gill slits that are significant features in the sharks.

Keywords: Hexanchiformes, mitochondrial genome, comparative genomics, phylogeny

Growth of young smooth hammerheads, *Sphyrna zygaena*, in the inner area of Suruga Bay, Japan

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Between 1992 and 2010, 1307 smooth hammerheads, *Sphyrna zygaena* (614 males; 354-1054 mm precaudal length, PCL; 693 females; 342-1260 mm PCL) were collected in the inner area of Suruga Bay, Japan. We estimated their age from the vertebral sections and analysed continuous size shifts. Neonate sharks occurred mainly in June and July, and possessed none or one band. The first band was considered to be formed before or after birth. Marginal increment analysis showed that growth bands form annually between June and August. Collected samples of hammerheads were 0 to 4 years old and young of the year sharks occupied 77.4 % of the whole. Based on these observations, we assumed that the birth date is the first of June, and analysed somatic growth parameters using the von Bertalanffy growth function (VBGF), the VBGF with periodicity and the Richards function with periodicity. Both growth functions with periodicity showed best-fit to the several data by sex, years or year-classes. For the post three years old, females and the 1990s year-classes grew faster than males and the 2000s year-classes, respectively. Higher growth rates were detected from June to December. Condition factor and hepato-somatic index decreased between December and May, corresponding to lower growth rate. Catch of large set net fishery in the study area, which may designate a food condition of sharks, was decreasing from November to April. These results suggest that smooth hammerheads utilize the inner area of Suruga Bay as one of the nursery.

Keywords: Growth model with periodic function, Condition factor, Hepato-somatic index, Nursery habitat

Predicting the spatial distribution of blue-spotted mask ray *Neotrygon kuhlii* (Müller & Henle, 1841) on the Australian North and Northwest Shelf comparing two different methods of habitat modelling

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For the first time the spatial distribution of *Neotrygon kuhlii* on the Australian North and Northwest shelf was predicted using statistical habitat models. Two different types of habitat suitability models were used for the predictions, namely logistic regression and maximum entropy modelling. The results of the predictions obtained with both methods were compared. Catch data of *Neotrygon kuhlii* from many Australian trawl surveys combined with randomly selected pseudo-absences were used for the modelling together with data sets of important environmental parameters like water depth, water temperature, salinity, oxygen, nitrate, and silicate and phosphate concentrations.

During modelling, the parameters temperature, oxygen, nitrate, silicate and phosphate concentrations were excluded from further analyses because they were all highly correlated with the water depth (Spearman rho values > 0.7). Consequently only the parameters water depth and salinity were used for further habitat modelling.

Both used modelling methods yielded plausible and validated models. The model-based predictions of the probability of occurrence of *Neotrygon kuhlii* were similar for both modelling methods and thus emphasized the goodness of the models. Following the predictions, *Neotrygon kuhlii* has its highest probability of occurrence in water depths between about 60 to 65 m and at a salinity of about 35.

The results of this study indicate that it is possible to attain new perceptions for biodiversity research and prognostic habitat modelling through the conjunction of existing field records as well as collection material with present or newly generated environmental data. Such models can also be valuable for predictions of habitat suitability in the framework of management and protection programmes.

Keywords: Habitat modelling, logistic regression, maximum entropy, *Neotrygon kuhlii*

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