SHARKS INTERNATIONAL

JOÃO PESSOA 2018

June 3-8, 2018

Abstract Book

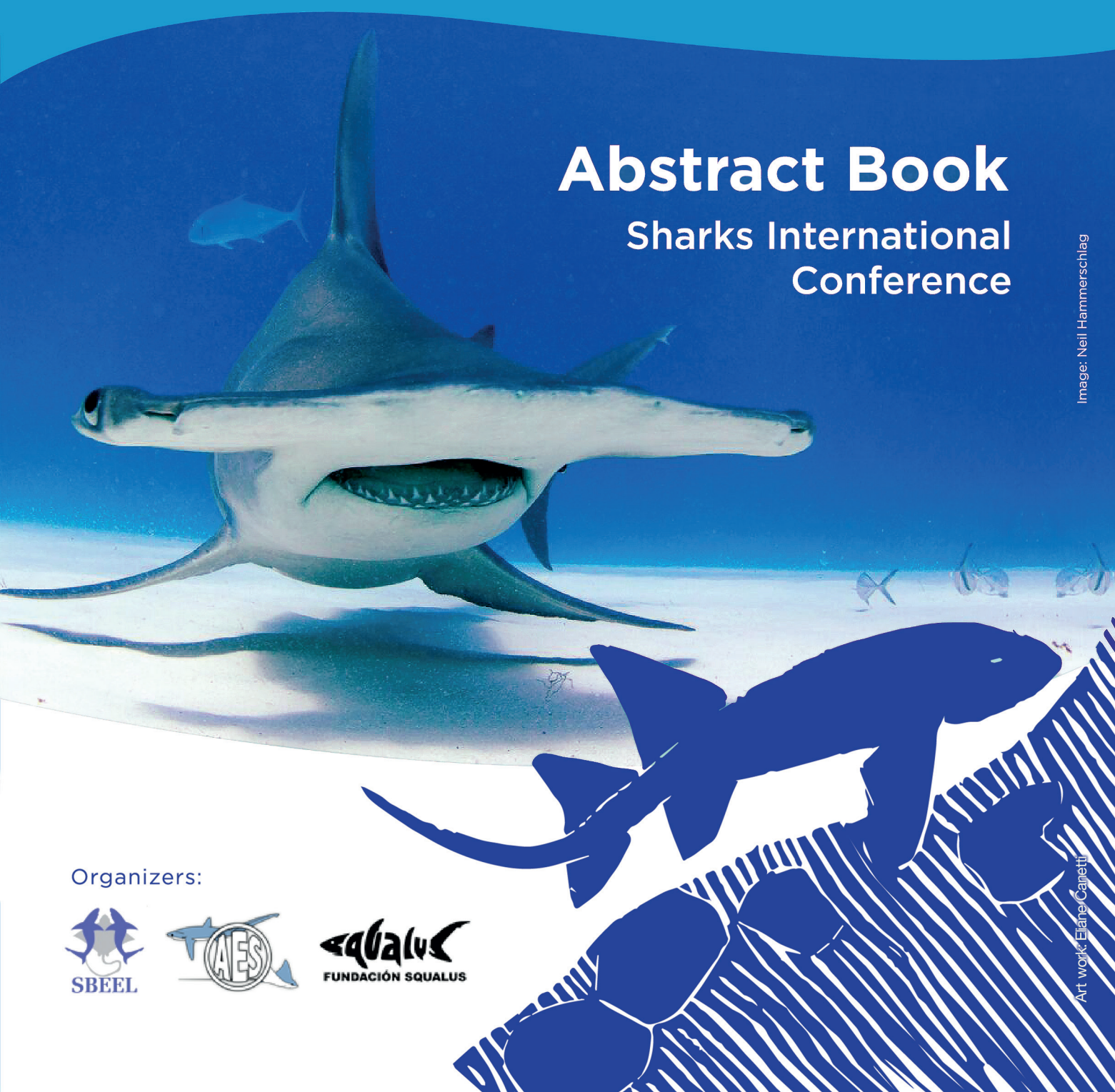### Sharks International Conference

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Abstract Book

Sharks International Conference

Edited by
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Sharks International Conference

Abstracts for the 2018
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João Pessoa, Brazil

3-8 June 2018

Sharks International Conference 2018

34th Annual Meeting of the American Elasmobranch Society

X Reunião da Sociedade Brasileira para o Estudo de Elasmobrânquios

VI Encuentro Colombiano sobre Condrictios

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The porbeagle shark (*Lamna nasus*) in the Southern Hemisphere: searching for biological patterns among oceans and regions

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Lamna nasus is a species with a wide geographic distribution in the Sowuthern Hemisphere, inhabiting a circumglobal band of temperate waters in southern regions of all oceans. In 2013, the porbeagle was included in CITES Appendix II, which specified several necessary actions for exporting countries, among them to prepare a Non-Detrimental Finding for the species. This requirement necessitates the collection of a variety of biological information from the sharks. The Chilean Fisheries and Aquaculture Research Fund (FARF) issued a request for proposals for a project aimed at characterizing the spatial variability in reproductive cycle, size structure, sexual maturity proportion, and mean size at maturity of the porbeagle shark in Chile. In addition, the winning proposal offered to expand the scope of the study by including information from other regions across its Southern Hemisphere distribution. In January 2018 a workshop involving researchers from New Zealand, Uruguay, Brazil, the Falkland Islands, and Chile was held in Coquimbo, Chile to initiate the project, with sessions organized around the following topics: Existing Fisheries, Spatial and Temporal Distributions, Biological Information (particularly Reproduction), and Other Information such as Tagging, Genetics, and Parasites. In the Southern Hemisphere, porbeagle sharks have not been targeted, but are bycatch of several longline and midwater trawl fleets from Japan, New Zealand, Chile, Brazil, Uruguay, Argentina, the Falkland Islands, and Portugal, among others. Life history data for Southern Hemisphere porbeagle sharks derive primarily from studies in New Zealand and Australia; there is scant information for *L. nasus* in other areas. It is not known whether there is a single circumpolar Southern Hemisphere population or whether there are multiple stocks spread over this wide range. Recent studies have considered it unlikely that the population comprises a single well-mixed stock for management purposes. We intend to use available and new biological data to understand spatial patterns in life history information. Samples covering the latitudinal distribution of the species will provide basic biological parameters, and supporting information from genetics and parasite studies.

Keywords: geographical distribution, temporal distribution, reproductive biology, sex ratios, size composition.

Population genetic structure of the endangered species *Pseudobatos horkelii* (Chondrichthyes: Batoidea) using mitochondrial marker

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Pseudobatos horkelii is a species of stingray known as guitarfish, that occurs from Rio de Janeiro (Brazil) to Argentina and there are a few studies describing their biological characteristics, which could involve a lack of critical parameters such as movement patterns, population dynamics;. *P. horkelii* suffers a great deal of fishing pressure because it is accidentally caught as an accompanying fauna. As a consequence of the crescent predatory fishing, a large number of species was included in the Red List of endangered species of the International Union for Conservation of Nature and Natural Resources (IUCN), and according to this list, *P. horkelii* is classified as "critically endangered". So, this work aims to analyze about the population structure of the *P. horkelii* through molecular marker of the mitochondrial DNA (control region) and to test hypothesis of panmixia, to contribute with conservation programs. In order to generate information on the population dynamics of the species, samples of muscle tissue were collected from individuals of different locations in the coast of Brazil, in Rio de Janeiro(n=8), São Paulo (n=19), Paraná (n=4), Santa Catarina (n=8), Rio Grande do Sul (n=41) and Argentina (n=2), in a total of 82 individuals. The fragments of muscle were removed of the animal and fixed in alcohol, which were used for extraction of the total DNA and amplification of the control region of the mtDNA by the PCR method, which were then sequenced. The sequences were analyzed with the use of Geneious, DNAsp 5.1, MEGA 6.0, ARLEQUIN 3.01 and Network 4.6. The alignments of 82 sequences generate a consensus 702 bp, and it was identified of 10 haplotypes, which were distributed among the 6 locality analyzed, being that the H9 haplotype was the most frequent with in total 23 individuals, from the locations Rio Grande do Sul (n=9) and São Paulo (n=14). Analysis of molecular variance (AMOVA) demonstrated variability within populations of 68%, with FST=0,31 and values of haplotype diversity were of 0.854 present among the specimens. This result shows that this species has a high population structure, therefore refuting the hypothesis of panmixia, that is, even with the population decline of this species, it still presents an important genetic diversity for the maintenance of this species, but conservation programs must be developed.

Keywords: D-loop, guitarfish, conservation.

Migratory behavior and habitat use of tiger sharks (*Galeocerdo cuvier*) in the Gulf of Mexico

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Large sharks serve as apex predators in marine ecosystems around the world, yet the habitat requirements and migration patterns of these species remain poorly understood throughout their range. The growing demand for shark habitat use information has supported a proliferation of satellite biotelemetry studies across the world; however, these studies are relatively underdeveloped in the Gulf of Mexico where tri-national initiatives (i.e., U.S., Cuba, and Mexico) have burgeoned within the context of heightened anthropogenic pressures (illegal fishing, oil spills, etc.) in a shared large marine ecosystem. We fitted 36 Tiger Sharks (*Galeocerdo cuvier*) with Smart Position or Temperature (SPOT) transmitters in the northern Gulf of Mexico to explore the degree of international connectivity and general habitat use patterns exhibited by this species. Multi-year tracks were achieved for several individuals, which demonstrated some important ecosystem connections between nearshore locales and open waters of the Gulf of Mexico. Additionally, we found some evidence of sex-based differences in distribution patterns with male Tiger Sharks exhibiting larger dispersal patterns than females, who exhibited more restricted movement in waters overlying shelf-edge bank habitats such as the south Texas hard banks and the Flower Gardens National Marine Sanctuary. A single male exhibited cross-basin movement towards the Campeche escarpment (Mexican waters) and a subsequent return to the Texas shelf, demonstrating the potential for international connectivity. Our work highlights the connected nature of many seemingly disparate habitats within the Gulf of Mexico by Tiger Sharks and the potential role of existing NOAA-designated Habitats Areas of Particular Concern (HAPC) to sustaining these top predators.

Keywords: tiger shark, satellite telemetry, Gulf of Mexico, habitat use.

Muscle fatty acid profile of white sharks (*Carcharodon carcharias*) from Guadalupe Island.

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Due to their limited capacities for elongation and desaturation of super-unsaturated fatty acids (SUFA), elasmobranch must consume preformed SUFA or polyunsaturated fatty acid PUFA from diet in order to satisfy their requirements. However, while the marine food web is known to be rich in omega-3 fatty acids, it provides low levels of omega-6 SUFA; despite of which elasmobranch tissues have been reported to have high contents of omega-6 SUFAs especially arachidonic acid (ARA) in several tissues including brain, muscle and skin. This study describes for the first time the fatty acid profile of *Carcharodon carcharias* from Isla Guadalupe with specific consideration into their ARA contents. As expected, white shark FA profiles were dominated by SUFA (especially docosahexaenoic acid-DHA, eicosapentaenoic acids-EPA and ARA), with limited contents of their precursors. Results coincides with previous white shark FAs profiles, in which high contents of ARA and DHA together with limited or absent precursors (18:2n6, 18:n3 respectively) contents were found. The high mean contents of ARA and low contents of their precursors in muscular tissue of White sharks of Isla Guadalupe along with a revision made for other species suggest ARA is a nutritionally critical molecule for elasmobranchs. Also, it is suggested that *Carcharodon carcharias* migrates into Isla Guadalupe in order to hunt on ARA rich prey (such as marine mammals and squid) in order to fulfill this SUFA requirement for reproductive purposes.

Keywords: muscle, fatty acids, ARA, DHA, *Carcharodon carcharias*, Isla Guadalupe.

Muscle fatty acid composition and its implications in Lollipop catshark *(Cephalurus cephalus)* physiology and ecology

Maria José Alderete-Macal[1], Javier Caraveo-Patino[1], Mario Jaime-Rivera[1]

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Cephalurus cephalus is a little-known catshark from the Scyliorhinidae family. Studies on the biology of this species are scarce, restricted to general morphological descriptions and notes on their reproductive biology. The present study describes the fatty acid (FA) profile of the muscular tissue of *Cephalurus cephalus* for the first time; with specific considerations into highly unsaturated fatty acids (HUFA) and their possible ecologic and physiologic implications during its ontogenetic development. Fatty acid clusters (16:0 + ARA, 16:0 + DHA) suggested 16:0 + DHA as the dominant phospholipid combination in muscle cell membranes. While high mean monounsaturated fatty acid (MUFA) contents found, could have been a response to the habitat of the species, a deep water ecosystem characterized by low temperatures and high pressures. Comparative results using analysis of variance showed significant differences with regard to ontogeny for several FAs. Results corroborated previous findings of HUFA conservation in cell membranes for later use in physiological processes such as reproduction. In parallel, increases of the variability of several FAs in specific size classes suggested FA profile changes since birth possibly because of the intake of HUFA from diet and their posterior mobilization from the muscular cell membranes in order to prepare for the first reproductive event. Therefore, results presented suggest knowledge on FA content along the ontogeny can be a useful tool to identify key life stages in the reproduction and development of sharks.

Keywords: fatty acids, ontogeny, *Cephalurus cephalus*, physiology, elasmobranch, Deep-water.

Insights on the trophic ecology of twelve commercially important elasmobranchs of northern Peru through stable isotope analysis

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Elasmobranchs play an important role in the trophic web of marine ecosystems, though little is known about their dynamics and interactions. The present study analysed the isotopic niches, diet composition and trophic position (in terms of $\delta^{13}C$ and $\delta^{15}N$) of twelve elasmobranchs commonly landed by small-scale fisheries in three sites of northern Peru. Muscle samples were collected from eight shark species (*Alopias* spp.,*Carcharhinus brachyurus*, *Galeorhinus galeus*, *Isusurus oxyrinchus*, *Prionace glauca*, *Sphyrna zygaena*, *Mustelus whitneyi*, and *Squatina californica*) and four ray species (*Mobula mobular*, *Mobula munkiana*, *Myliobatischilensis* and *Myliobatis peruvianus*) between January and December 2015. Based on their habitat, species were grouped into two communities: demersal or pelagic, which were analysed accordingly using Permutational Analysis of Variance (PERMANOVA) and Bayesian statistics. The isotopic niche differed between the two communities in both location and dispersion. Demersals showed high trophic redundancy compared to pelagics (distance to centroid: 0.34 and 2.15, respectively), also having a high intraspecific variation in terms of carbon, with a total range slightly wider than pelagics ($\Delta\delta^{13}C$: 5.28‰ versus 4.63‰). In terms of nitrogen, demersals had a total range that was almost half as the pelagic community ($\Delta\delta^{15}N$: 6.41‰ versus 12.98‰), which showed less overlap altogether. Only *P. glauca* showed significant differences in terms of body size and sex, which could be attributed to differences on migratory patterns between groups. Despite low certainty in the model results, *Doryteuthis gahi* and *Merluccius gayi* were identified as important prey species for the pelagic and demersal communities, respectively. Furthermore, the study suggests that some pelagic sharks might be feeding on demersal fish such as *M. gayi,* which attests to their high versatility. The range of trophic position values was much wider in the pelagic community, being the highest the sharks *P. glauca* and *I. oxyrinchus*, and the lowest the mobulid *M. mobular* (meanTP: 5.06, 5.11 and 3.35, respectively). In the demersal community, *S. californica* showed the highest meanTP (4.21). These results provide insights into the complex and broad trophic niches of elasmobranchs, as well as with the issues that need to be addressed when dealing with fisheries impacts and management plans. Further studies are necessary to improve our understanding of the trophic ecology of elasmobranchs and to better label all the by-products consumed, as well as changes in their trophic dynamics in relation to stressors such as fisheries.

Keywords: sharks, rays, stable isotopes, isotopic niche, Pacific Ocean.

Sharks trade and consumption in Peru: need for an integrated management in a value chain were nothing is wasted

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Peru has a strong fisheries tradition, where also sharks are caught, traded and consumed. They play an important role in the livelihoods of many fishermen and in the businesses of middlemen, processors, retailers, restaurants and exporters. However, little is known on the socio-economic importance of these fisheries across their value chains. The present study shows a first view on the value chains of shark products and by-products in Peru. Ninety-four semi-structured interviews were done between January and February 2018 to mainly fishermen and traders from 15 landing sites and 4 important seafood whole sale markets in northern and central Peru. Preliminary results show 387 small-scale vessels catching sharks using either long-lines (18%) or drift and bottom nets (82%), which capture them together with other fish. Sharks are usually landed without their head and gut, but generally with their fins still on. Vessel owners sell either the whole animal or the meat and fins separately. Full use of the specimens has been seen so far in all cases, satisfying a localised demand for meat and providing fins for mostly outside markets. The main market concentrates in the northern Region of Lambayeque, were shark meat is gathered from nearby Regions, and were species landed are also highly diverse. Meat products are mainly sold fresh via local markets, retailers and restaurants. Fins are mainly gathered and dried by middlemen, and distributed to exporters or restaurants. Fins from *Alopias* spp., *I. oxyrinchus*, *P. glauca* and other pelagic sharks are almost entirely exported. Fins from demersal species such as *M. whitneyi* are exported as low-quality products, or sold at local Chinese restaurants. Three formal nutraceutical companies that offer shark-based cartilage products have been identified in Peru, though their importance in the value chain, as well as the trace ability of their products, is still being studied. During 2017, a total of 23 companies exported shark fins, meat and cartilage, for a value of US$5'799,395, US$240,217 and US$6,865, respectively; while 11 imported shark-based products for a value of US$2'831,636. Even though data is still being gathered and processed, local and foreign market dynamics show how complex are the value chains of sharksin Peru. Furthermore, internal trading and consumption of sharks seem to be more important than expected, though there is a lack of knowledge in species composition, especially higher up the chain. Incoming data should allow for a clearer picture of these fisheries ecological and socio-economical dynamics.

Keywords: value chains, sharks, market, fins, meat.

Knowledge, Attitudes and Practices (KAP) in Trinidad and Tobago Regarding Sharks and Shark Consumption

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Trinidad and Tobago is home to at least 34 shark species, of which three are endangered. Shark is also a popular culinary delicacy. Despite this, there is a lack of data concerning shark consumption trends, consumer attitudes, and public knowledge regarding shark species. A Knowledge, Attitudes, and Practices survey was conducted via researcher administered questionnaire to address this gap. The response rate was 93.5% producing an N = 592. N = 492 (83.1%) for questionnaires conducted in Trinidad and N =100 (16.9%) in Tobago due to the former's larger population size. Two hundred and twenty-three (223) (37.7%) of participants were knowledge-able, 425 (71.8%) displayed good attitudes and 232 (39.2%) displayed good practices. A logistic regression was performed to test the association between mean scores and demographic categories. Island (AOR = 2.375, CI = 1.52, 3.65) and age range (Under 20 years AOR = 1 ref.; 30-39 years AOR = 4.070, CI = 2.12, 7.82; 40-49 years AOR = 2.380, CI = 1.22, 4.66) significantly impacted attitude. No demographic categories significantly affected practices. A key finding was that despite prevalent good attitudes, knowledge and practice levels were both poor. Although there is a lack of demographic association with practice levels, it is possible that greater public knowledge concerning sharks could lead to an increase in more sustainable consumption practices in a population with good attitudes. It is recommended that a large scale public awareness initiative be devised and implemented, after which public KAP levels could be reassessed.

Keywords: Shark consumption, Knowledge, Attitudes, Practices, Trinidad and Tobago.

Exploitation of *Rhizoprionodon* sharks in Trinidad's artisanal fishery: an initial assessment

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Sharks are commonly caught and consumed in Trinidad and Tobago, however, there is little data in terms of their biology and information needed for evaluation of their populations. This study investigates the exploitation of *Rhizoprionodon* sp. sharks in Trinidad's artisanal fishery. Two species, *R. lalandii* and *R. porosus* are found in Trinidad, however, neither fisheries records nor fishermen distinguish between them. This study is a genus level assessment addressing the lack of focused shark data and what is currently treated as a single stock. Two hundred and fifty-one (251) *Rhizoprionodon* sp. sharks were collected from landing sites and fish markets in Trinidad over a period of 20 months. Species, their maturity and gravidity were recorded. Length-weight parameters (b=3.029 and a=0.007053) were calculated and used to determine mean condition factor (Kmean). Males began maturing in the 36-40cm FL size category (41-45 TL) before females, which began maturing in the 41-45cm FL size category (51-55cm TL). Greater than 50% of both females and males attained maturity at 51-55cm FL. A χ2 test showed no significant difference between the proportion of males and females at different maturity stages (df= 2, χ2 statistic= 2.020, p= .364, alpha = 0.05). Approximately seventy nine percent (79.45%) of females were found to be pregnant. Embryos approached birth size (approx. 30 cm) between December and February of both 2016 and 2017. This corresponded with a decrease in Kmean for females, suggesting parturition between December and May. However, embryos were present throughout the year, suggesting continuous reproduction. Published literature suggests exploitation of small coastal sharks may be more sustainable than larger species since they mature faster. In countries like Trinidad and Tobago where shark is regularly consumed, harvesting more resilient species using effective management strategies could offer better alternatives to harvesting more vulnerable species. However, small size at first maturity and the high number of pregnant females observed also indicate heavy fishing pressure. A full assessment of fishing pressures on *Rhizoprionodon* sp. and other shark species is recommended to evaluate their vulnerability and devise appropriate management strategies.

Keywords: *Rhizoprionodon*, Trinidad, artisanal fishery.

One fin too many: using DNA barcoding to identify illegal, unreported and unregulated (IUU) chondrichthyan fishing in Morocco

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The world is rife with illegal, unreported and unregulated (IUU) fishing. It is estimated that up to 40% of the fish caught in West Africa is from an IUU source, with sharks, rays and chimaeras (Chondrichthyes) at the highest risk due to the fin, wing and ratfish liver oil trades. Though this has increased regulations, generally leading to higher levels of protection, such regulations are often left unenforced due to regional economic climate and lack of resources. The country of Morocco (North West Africa) is one of the least researched countries for chondrichthyan landings and IUU fishing, despite internationally recognised trade and fisheries partnership agreements of around €30 million per year with the European Union. Morocco is also a part of the Conservation for Migratory Species (CMS) and Convention on International Trade in Endangered Species (CITES) which provide specific levels of protection for certain chondrichthyan species. However, there are no published records of these protections being applied. Here, we present our investigations of the exploitation of chondrichthyans in ports and markets along the Atlantic and Mediterranean coast of Morocco. We visited a total of 6 fishing towns/cities in June 2015 and 2016 for a duration of 8 weeks. Documentary evidence and 231 tissue or fin samples of chondrichthyan individuals were collected with the aim of uncovering the levels IUU chondrichthyan fishing in Morocco, to analyse the application of barcoding techniques as a method of identifying species and to contribute findings to The Fish Barcode of Life Initiative (FISH-BOL). Using the FISH-BOL primers (F1, F2, R1 and R2 combinations) we successfully barcoded 201 samples of chondrichthyan individuals equating to 17 species of shark, 13 species of ray and 2 species of chimaera. Through intelligence with local fishermen we recorded a demand for the trade of bigeye thresher sharks, *Alopias superciliosus*, in 50% of the towns/cities visited. With the use of DNA barcodes we recorded a new landing of the Tortonese's stingray, *Dasyatis tortonesei*, in an Atlantic port from an artisanal fishery. Lastly, we analysed the levels of misidentification and error rate of field biologists over time and we reviewed the importance of applying DNA barcoding as a method to reduce, deter and record IUU fishing of chondrichthyan species in Morocco and other developing countries. From this study we strongly recommend an immediate enforcement of current protection measures and increased scientific research/monitoring of all chondrichthyan fishing in the region.

Keywords: fisheries, management, genetics, FISH-BOL, species diversity.

Embryonic development of lymphatic organs blue shark, *Prionace glauca*, Elasmobranchii, Carcharhiniformes*

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The blue shark, *Prionace glauca* (Linnaeus, 1758) is a cosmopolitan species of high commercial value, easily caught by vessels operating on the high seas and sold in markets and street fairs. Few biological data are available on this species, mainly from their sanity. Studies on development of these lymphoid organs can provide important information in this regard. Thus, the aim of this study is to describe the embryonic development of lymphoid organs: thymus, epigonal organ, spleen and Leydig organ (this one not yet described in blue shark) as to its structure and macroscopic architecture, microscopic and ultrastructural, by light microscopy and transmission electron techniques. Five specimens were collected from each representative stage of embryonic development: II, III and IV. So far five embryos (total length of term of 43-45 cm) were analysed. We observed the presence of all lymphoid organs described above. Among these, Leydig organ was confirmed in this species, which showed lymphocytes and erythrocytes maturing states in its parenchyma. The thymus presented population of thymocytes at various stages of maturation, and melanomacrophages erythrocytes. Spleen presented lymphocytes and erythrocytes at various stages of maturation, neutrophils and platelets. The epigonal body showed large numbers of immature cells, lymphocytes and polymorphonuclear cells. Thus it's possible to suggest that these organs have a hematopoietic function in this early stage.

Keywords: thymus, epigonal organ, spleen, Leydig organ, embryogenesis.

Presence of the protein Indoleamine 2, 3-dioxigenase (IDO) on the maternal-fetal interface of *Prionace glauca**

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The cosmopolitan blue shark, *Prionace glauca* (Linnaeus, 1758), is a viviparous placentary species in which the yolk sac develops along pregnancy turning into a placenta with a matrotrofic role. The Indoleamine 2 3-dioxygenase (IDO) is a protein usually described in mammals, which, among other functions, participates on the maternal-fetal tolerance process. Although it has also been reported in bony fish, no information is available regarding its function. Therefore, the purpose of this study was to investigate the expression of IDO in *P. glauca* maternal-fetal interface and describe its distribution. Thus, placental/uterine and embryonic materials from three different stages: pre-placenta, middle and late gestation of pregnant females were processed for immunohistochemistry. The results showed IDO labelling during the yolk sac/placenta development in ectoderm along the three development phases and at endoderm only at phases I and II. In uterine epithelium, IDO was observed in the last two phases. These interface tissues are major contact areas between the mother and the conceptus that would induce an immunological response against the semialogeneic conceptus. The sum of these factors may contribute as an indication to the possible IDO role as a mechanism of maternal-fetal tolerance in *P. glauca* placentary interface, as described in eutherian mammals.

Keywords: placenta, matrotrofic, pregnancy, tolerance, blue shark.

A nose by any other name would smell the geomagnetic field? Evidence for an olfactory-based magnetoreceptor in sharks.

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Perception and use of magnetic fields has been proposed and demonstrated across diverse taxa. While much of the evidence for this capability has been gleaned from behavioral studies, evidence to support putative receptor mechanisms remains markedly scant. This is particularly the case in the elasmobranch fishes, where the electrosensory system is implicated almost by default, despite a lack of empirical and physiological evidence. Other candidate mechanisms include a light-based system attributed to specific proteins within the retina, and an iron particle-based system. The debate about the means and mechanisms by which an iron-based magnetoreceptor might function continues unabated, with no single methodology seemingly able to unilaterally define a receptor and its structural components, and those studies that have claimed to identify magnetite containing structures being confounded by false-positive data. Thus, a correlative approach that combines and integrates techniques to succinctly describe and characterize the necessary components of a such a magnetoreceptor is needed. Here, we present the results of just such an approach, designed to investigate and describe the principal required components of an olfactory magnetoreceptor in scalloped hammerhead (*Sphyrna lewini*) and sandbar (*Carcharhinus plumbeus*) sharks. We used a step-wise combination of neural tract-tracing, histology, magnetic resonance imaging, flow cytometry, Raman spectroscopy and electron-microscopy, to test the hypothesis that sharks possess an olfactory based magnetoreceptor, homologous to that described in some teleosts. Olfactory tissues of sandbar and scalloped hammerhead sharks were found to receive widespread supply from superficial ophthalmic rami of the trigeminal nerve, in a manner similar to that described in the rainbow trout (*Oncorhynchus mykiss*). Iron-oxide (magnetite) containing cells were found throughout olfactory tissues and occurred in sufficient quantities and concentrations to potentially function in magnetoreception. Analysis of the magnetic nature of iron found suggest single-domain magnetism, as is required for the physical transduction of magnetic field information. The evidence presented supports the olfactory magnetoreceptor hypotheses, although the ultrastructure of iron containing cells was not described. Feasible suggestions are made for continued investigation to further complement this approach.

Keywords: magnetoreception, magnetite, shark, olfactory.

Morphologic variations in rectal gland of three species of stingray (Batoidea; Chondrichthyes)

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The elasmobranch Rectal Gland (RG) is essential in the osmoregulation of elasmobranchs. This organ is in the dorsal mesentery above the intestine and is generally located in the post-valvular region. The Batoids occur in a diversity of environments both in freshwater and marine realms. This study aimed to identify the morphological variations in the RG of Myliobatiformes stingrays in different phylogenetic position and habitat use: *Hypanus marianae* (n=3), *Hypanus guttatus* (n=10) and *Aetobatus narinari* (n=6). The RG was measured (length, cm), removed and processed to routine histology and analyzed under a light microscope. The RG length of *H. guttatus*, *H. marianae* and *A. narinari* had an average and standard deviation (sd) of 1.87 ± 0.57 cm; 1.26 cm ± 0.27 cm, 3.1 cm ± 0.66 cm, respectively. Histologically the RG consists of connective tissue (CT) capsule, which invaginates inward to the medial secretory parenchyma and divides the organ into lobes. Inside each lobe, secretory blind tubules radially oriented compose the glandular layer. The tubule is lined by cuboidal epithelial cells, with basal nuclei, characterizing the cells secretory nature. Among the tubules, the distal branch part of a central duct is present. The duct lining epithelium changes from simple cubic in the branched duct in distal portion to stratified in the central duct. The differences observed in the RG structure were related to the species phylogeny position and habitat use. The marine stingray *H. marianae* is the most basal species analyzed. It has an RG with a thin capsule and a thin layer of lobes division. The euryhaline *H. guttatus* is an intermediary species; the RG capsule is more enlarged when compared with *H. marianae*. The RG has well-divided lobes with a thick layer of CT. Both species are benthonic. However, *H. guttatus* move between habitats with brackish water to saline water. This behavior requires the ability to adjust the NaCl secretion by RG in different salinities environment. The marine benthopelagic *A. narinari* is the most derived species, the RG is more complex than others, with a large thick capsule of CT and a distinct lobe division. The data obtained indicate that the RG varies at the histological level according to the environment in which the animal lives. In higher salinity habitat, the rectal gland acts more actively in the osmoregulation. The function of the gland is reduced in brackish water.

Keywords: elasmobranch, histology, osmoregulation, habitat, phylogeny relationship.

Estimation of length-weight relationship and condition factor of *Squalus* cf *albicaudus*, off Pernambuco, northeast Brazil

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The length-weight relationship and the condition factor are indicators of great ecological importance since they help to understand the relationship between the animal and the environment, its nutritional condition and energy balance, besides giving information about its growth. The objective of the present work was thus to analyze the length-weight relationship and the condition factor of *Squalus* cf *albicaudus* caught off Pernambuco, northeast Brazil. Were analyzed 76 individuals, 27 females and 49 males, divided into adults and young, capable to reproduce and immature, respectively. The animals were weighed and measured (total weight in grams-TW; total length in centimeters- TL). The potential regression was made between these two parameters to obtain the value of the allometric exponent (b), and the factor of condition for the species. The Shapiro Wilk test was used to test normality, while the non-parametric Wilcoxon test was used to assess the statistical significance of the differences. The length-weight ratio showed a positive allometry, with a "b" value of 2.7353, indicating that the weight follows the growth increase, but the growth rate is higher. The coefficient of determination (r) was 0.75, indicating a strong and positive relationship between the parameters. The mean values of the condition factor found for females (1.177) and males (1.116) were not normally distributed and were significantly different (W= 1,015; p= 0.00007), indicating a higher energetic expenditure by females. There was no statistically significant difference, however, between adults (1.169) and young adults (1.047) (W= 105, p= 0.06455), which shows equality in energy use for development in youth and reproductive activities in adults. The condition factor for females increased in the second half of the year, as well as for males, although in a less pronounced manner. Also during the second half of the year, catches of individuals capable of reproducing increased, indicating a possible seasonal cycle in reproductive activity.

Keywords: capable to reproduce, immature, south Atlantic ocean, Brazilian whitetail dogfish.

The cryptic lives of tiger sharks – hidden complexities and enigmatic behaviours in a three-dimensional realm

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Tiger sharks (*Galeocerdo cuvier*) are a keystone predator in the food chains of many tropical reef systems worldwide. The development of new biologing technologies have increased our capacity to investigate the movement ecology of these animals. In May 2017, we deployed CATS camera and diary tags on 20 tiger sharks at Ningaloo Reef, Western Australia for durations of 7-48 hours. The tags were clamped to the dorsal fin and recorded both physical parameters such as depth and temperature, and, through the use of accelerometers and compasses, in situ measurements of animal trajectory and locomotion, which enabled calculation of dive geometry, swimming energetics and path tortuosity. Concurrent videos enabled behavioural validation, habitat mapping and interactions with prey to be recorded. We found high individual variation in vertical and horizontal paths, and no relationship between path tortuosity and vertical movement behaviour. Tiger sharks moved differently among habitats, with the most striking differences found between reef (depth <15 m) and offshore environments (15-85 m depth), with the amount of time spent moving vertically, dive angle and predicted energy expenditure all increasing with habitat depth. Tiger sharks displayed a high affinity for sandflat environments, where a number of prey species were encountered and relative energy expenditure was predicted to decrease. Interactions with prey were found in all habitats, with a majority observed when sharks were level swimming, and eliciting varied responses including burst swimming and highly tortuous movements. Lastly, we describe a new behaviour termed "surface bobbing" in which tiger sharks appeared to exploit oceanography to float and reduce energy expenditure in surface waters. Collectively, our methodology allowed us to discriminate among behavioural modes, and describe new behaviours that would otherwise be misclassified using traditional approaches.

Keywords: biologging, tiger shark, movement ecology.

Population structure of the nurse shark (*Ginglymostoma cirratum*) in coastal reefs of Paraíba State, northeastern Brazil, using photo-identification

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The nurse shark, *Ginglymostoma cirratum*, is a coastal species found in tropical and subtropical waters on the Atlantic Ocean, frequently close to reefs, both coral and rocky. The species was reported as one of the most abundant shark species in coastal waters in Brazil, with the northeastern region possibly holding the greatest numbers of nurse sharks. Despite this, local extirpations and population declines resulted in the evaluation of the species as threatened (Vulnerable) in Brazil. The lack of baseline data on its population traits precludes well-elaborated management actions, reinforcing the importance of studies directed to the species. Thus, the objective of this study was to estimate the size and structure of the nurse shark population on coastal reef environments in Paraíba State. Three natural and three artificial reefs were selected based on previous knowledge of nurse shark's occurrence. Sites were sampled between May 2016 and May 2017. Data recorded included total sharks present during sampling, total of sharks photographed and their estimated total length and sex, as well as water temperature. Photographs of the shark's first dorsal fin were taken and high quality images were used on Interactive Individual Identification System – Contour. Population size estimates were undertaken using Jolly-Seber and Schumacher-Eschemeyer estimators. Seventeen sharks were positively identified during 38 field excursions, of which 76% were juveniles. There were 36 recaptures of 13 individuals (76% of the total captured sharks) of which 88% were juveniles. Both estimators led to an upper population size around 50 individuals, and the population was composed mainly by juvenile sharks, with a sex ratio close to 1:1. The results point to a low population size, however, the high proportion of juvenile individuals probably highlights a sampling error due the limited number of sites and their small geographic range, especially in depth, as all sites were between 12-35m. The high recapture rate emphasizes the site fidelity of the species in the area, which sums up with its low population size to an increased vulnerability. Even though the results are more relevant towards the juvenile size class, they reinforce the need for more populational studies on this endangered species in Brazil, showing as well the need for conservation measures for the species and its environment, particularly on less studied and protected regions, such as Paraíba State.

Keywords: population size, mark-recapture, endangered species, photography, conservation.

Population dynamic and nursery area determination through the use of LA-ICPMS of *Hypanus marianae* (Chondrichthyes: Dasyatidae) captured in the Northeastern coast of Brazil

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Hypanus marianae presents sexual and ontogenetic segregation (Gomes, Rosa & Gadig, 2000). This work aimed to determinate the *H. marianae* population dynamic and its habitat used in Pernambuco coastal area. The specimens obtained at the artisanal fishing landings were taken to DIMAR laboratory where they were measured (DW-disk width) and sexed. The minimum maturation size (DW 50) was estimated from the macroscopic analysis. The age composition was estimated by vertebrae growth rings reading. The vertebrae elemental composition of three samples of *H. marianae* was determined through the LA-ICPMS use, for the age validation and the nursery area determination. The analyzed elements were Ba138, Sr86, Sr87, Ca43, P31 Mn55, Mg24, and the results of the measurements along the vertebral body were expressed in the ratio of the element of calcium. Strontium (Sr) usually has relatively high concentrations and is uniform in marine environments, whereas Barium (Ba) has high concentrations in rainfall periods, and in low salinity environments. The DW50 for males and females was 26.97 cm and 28.95 cm, respectively. Females presented a biannual reproductive cycle, with the fecundity of 1.0/embryo/female. The gestation period was four months, and the birth size range was 15.1-15.9 cm DW. The species presents two birth periods one in the dry season (November-December) and other at the beginning of the rainy season (April-May). The Ba138: Ca43 ratio average in the center of the vertebra (indicated nursery area) was slightly higher than the Ba138: Ca43 mean, in the edge of the vertebra, but there were no significant differences (p = 0.81). The opposite result was found for Sr86: Ca43 and Sr87: Ca43, but without significant differences between vertebra regions analyzed with p = 0.22 and p = 0.24 respectively. These results are due to the influence of the freshwater plume in the rainy season, which coincides with the second birth period of the species. The number of rings ranged from 0 to 6. There was a correspondence between the position of the opaque bands and the Ca43 peaks. The estimated growth parameters were L∞ = 36.45 cm, k = 0.24, t0 = -2.18. *H. marianae* is captured as bycatch in all phases of the life cycle, and has a nursery area in regions near the coast, in water of lower salinity, which is subject to anthropic impacts. Management measures that include marine protected areas will only take effect if anthropic activities such as tourism, are eliminated.

Keywords: microchemistry, myliobatiformes, conservation.

Intervention by the state of Pernambuco, Brazil in mitigation of shark attack.

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The increase in the number of occurrences of shark attacks today may be related to the popularization of aquatic activities and sports, due to the greater possibility of interaction between humans and sharks. In this context, Brazil ranks fourth among the countries with the highest occurrence records in the world, with records of shark attacks in at least 10 of the 17 coastal states. Pernambuco State is responsible for more than half of the cases of shark attacks that occurred in that country. According to the State Committee for Monitoring Sharks Incidents (CEMIT), between 1992 and April 2018, 64 shark attacks were recorded, distributed by municipalities Goiana (1), Paulista (1), Olinda (4), Cabo de Santo Agostinho (6), Jaboatão dos Guararapes (22), Recife (27) and Island of Fernando de Noronha (3). The years with the greatest number of occurrences were 1994 (10) and 2004 (6). In order to mitigate this problem, between 1995 and 2014 legal instruments were sanctioned, through state decrees (18.313/95; 21.402/99; 26.729/04; 28.794/05; 29.486/06; 37.897/12; 40.923/14 e 41.251/14), by aspects such: the delimitation of places of risk for attacks, the creation of CEMIT, the prohibition of water sports and the limitation on the practice of aquatic activities such as diving and swimming. The objective of this work was to investigate how these state actions may have contributed to reducing the number of incidents with sharks. The research was done through a bibliographical survey and documentary analysis. It was sought to establish the relationship between the number of incidentes every year and the actions imposed by the legal instruments. It could be verified that the prohibition of the practice of nautical sports allied to actions of research, monitoring and environmental education were key to to elucidate factors associated with the increase of shark attacks in Pernambuco, and translate into accessible language information about the marine ecosystem and how to prevent a shark attack.

Keywords: Northeast of Brazil, shark attack, state intervention.

Environmental factors related to incidents with sharks in the state of Pernambuco: Brazil.

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According to the International Shark Attack File in Brazil we have recorded 103 incidents with sharks distributed from 10 coastal states. However, in the state of Pernambuco alone, 64 occurrences are cataloged between 1992 and April 2018. The increase in the number of shark attacks in this region can be favored by natural factors, by anthropic changes in the environment and by the population increase related to the recreational use of the beaches. The natural aspects and environmental impacts related to the increase in the number of incidents with sharks in the Northeastern Region of Brazil. As for the natural factors, the local bathymetry indicated the presence of a deep channel parallel to the beaches of Boa Viagem in Recife and Piedade in Jaboatão dos Guararapes, it has also been reported to exist return currents, which are natural threats to bathers, taken to deeper water. The influence of the seasonality and the tides of sizigia were important factors, since most of the occurrences notified in the rainy period and with a greater amplitude of tide. As for impacts of anthropogenic origin in the 1980 in Pernambuco, the construction of the Suape Port Complex south of the Metropolitan Region of Recife used explosives to remove coral reefs, destroying habitats and decimating populations of marine animals living there; also caused a decrease in the phytoplankton community of the region; there was destruction of a large mangrove area, altering the course of estuaries; Subsequently, the increase in ship flow is among the factors that corroborated the presence of sharks in the region, since these animals are known to follow boats. Therefore, both the environmental impacts on the marine ecosystem and natural factors corroborate the presence of sharks in the vicinity of the Pernambuco Coast.

Keywords: sharks attacks, natural aspects, impacts environmental, Northeastern Brazil.

Age, growth and reproductive biology of the spotted eagle ray *Aetobatus narinari* in Pernambuco coast, Northeastern of Brazil

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The spotted eagle ray, *Aetobatus narinari*, occurs in tropical coastal and island regions around of the world. This species displays matrotrophic viviparity with lipidic histotrophy. Recently *A. narinari* was considered as a complex of species; therefore the available literature on the biology and fisheries is scant, hindering its conservation status definition which in Brazil is Data Deficient (DD). This present work aimed to study the reproductive biology and age and growth of *A. narinari* in Pernambuco coast (7° S/ 34° W), Northeast of Brazil. The samples were monthly collected from autumn of 2016 and summer of 2018 by artisanal fishing. The individuals were identified, the disk width (DW, cm), the sex, the state of maturation, and gonad weight (g) were taken. The age was estimated in vertebrae and reading growth bands. To assess the state of maturation, macroscopic aspects of reproductive tract and the sexual secondary characters were analyzed. *A. narinari* was captured in all seasons of the year. Of the total sample 46% were female (DW = 95.3-149 cm) and 54% were male (DW = 44.2-136 cm). Individuals with only the birth band were represented only by males (DW = 44.2-85.5 cm) in autumn and winter. Assuming the annual formation of each growth band, the maximum age observed was 7 years. Mature females (DW = 101-149 cm) were between 3 and 7 years and mature males (DW = 115-131.2 cm) were between 3 and 6 years, both sampled in all seasons except in autumn. For females, the largest vitellogenic follicle varied between 1.1 and 3.1 cm in diameter; the width of the oviducal gland was between 0.4 and 2.7 cm; the number of ovarian follicles was from 2 to 46; the width of the left uterus between 0.9 and 9.2 cm and the weight of the ovaries from 18.56 and 199 g. For males, the clasper length varied between 2.4 and 18.4 cm; length of the clasper gland between 2.6 and 6.9 cm and the weight of the testicles between 17.3 and 155 g. In Pernambuco coast *A. narinari* is targeted by small-scale fishing, therefore the goal of this study is to contribute to management of fisheries and to species conservation in the region.

Keywords: Aetobatidae, age estimation, reproduction, northeast of Brazil.

SHARKS INTERNATIONAL

Capture of Myliobatiformes by artisanal fishery in Pernambuco coast, Northeastern of Brazil

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In Northeast of Brazil various species of elasmobranchs are captured by the artisanal fleet. The Pernambuco coast is composed by coastal reefs, estuaries and mangroves that sustaining the local biodiversity and the artisanal fishing activities, as fishing traps, fishing weirs, gillnets and longlines. The present study aimed to describe the capture of Myliobatiformes by artisanal fishing in north Pernambuco coast (7° S/ 34° W). For monitoring the fishing gears (ray net, fish-weir, gillnet and longline) the samples were monthly collected from autumn of 2016 to summer of 2018. Specimens were identified; the disk width (DW, cm), the sex, and total weight (g) were taken. A total of 160 individuals of six species of Myliobatiformes were captured *Aetobatus narinari* (N = 59), *Hypanus guttatus* (N = 29), *H. americanus* (N = 22), *H. marianae* (N = 10), *Gymnura micrura* (N = 1), *Rhinoptera* sp. (N = 39). During autumn, *A. narinari* (DW = 44.2-136 cm), *H. guttatus* (DW = 22-61 cm) and *Rhinoptera* sp. were catches by ray net; and *H. guttatus* (DW = 44.2-54 cm) and *H. marianae* by fish-weir. Winter landings were composed of *A. narinari* (DW = 80-148 cm), *H. americanus* captured by ray net; *Rhinoptera* sp. by fish-weir; and *A. narinari* (DW = 49.6 cm) by gillnet. During spring, *A. narinari* (DW = 101-149 cm), *H. guttatus* (DW = 10.4-67 cm), *H. americanus* (DW = 84.3 cm) and *Rhinoptera* sp. were catches by ray net; and *A. narinari* (DW = 39.5 cm), *H. guttatus* (DW = 44-66 cm), *H. marianae* (DW = 26-30.5 cm) and *Rhinoptera* sp. by fish-weir. Summer landings were composed of *A. narinari* (DW = 98-139.5 cm), *H. guttatus* (DW = 58-59 cm) and *G. micrura* (DW = 64.3) captured by ray net; *H. guttatus* (DW = 43.5-57 cm), *H. marianae* (DW = 32.5 cm) by fishing weir and *H. americanus* by longline. The Myliobatiformes are captured as target or incidentally catch by artisanal fishing along the Pernambuco coast year round, especially in spring and summer, when the mature individuals are more frequent. So, fisheries management is needed for the species conservation when reproduction and parturition occur.

Keywords: Myliobatiformes, artisanal fishing, catch composition, northeast of Brazil.

Metal and metalloid contamination in Southeastern Brazilian electrical rays *Narcine brasiliensis*: implications for the ecology and conservation of the species.

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Narcine brasiliensis OLFERS (1831) electric rays are not well-studied, but ecotoxicological research can be of great value to contribute to knowledge regarding their ecology and vulnerability to environmental contaminants, due to their feeding and behavioral habits. This species occurs in coastal or estuarine habitats with muddy bottoms, and presents benthic habits with a diet is based on crustaceans and polychaetes and, therefore, vulnerable to metal and metalloid bioaccumulation. This study aims to determine essential (Cu, Zn, Se) and non-essential (As, Cd, Hg, Pb) elements in *N. brasiliensis* specimens captured at Itaipu, Rio de Janeiro, Brazil, adjacent to one of the most polluted areas in Brazil, Guanabara Bay. These contaminants were determined in muscle, liver, gill arches, gonads and electrical organs of four adult females and six neonates and juveniles. About 150 mg of each sample were weighed in sterile polypropylene tubes, which were then subjected to acid digestion with HNO3, and determinations by ICP-MS, in triplicate. Quality control was performed by the analysis of a certified reference material (CRM DORM-4). Average recovery values of the CRM were always> 90% of the certified values. In adults, As, Cd and Pb were determined in extremely high concentrations in most organs, indicating environmental contamination sources at Itaipu. Hg was higher in adult muscle than liver, indicating probable environmental bioaccumulation. In addition, Hg and Cd in adults were shown to accumulate in higher concentrations in gonads, indicating reproductive concerns for the species. In neonates, Pb, Zn and Hg were higher in muscle compared to liver, indicating bioaccumulation processes. As the neonates were born in the aquarium, the metals detected in their tissues probably originated from maternal transfer, corroborated by several statistically significant correlations between metals and metalloids between the adults and the neonates. Differential metal accumulation was observed for different neonate developmental stages, indicating potential for toxic effects at this early stage. Interestingly, the electric organ of all analyzed individuals, even neonates in development, showed accumulation of several metals and metalloids, which may incur in future difficulties regarding prey capture if biochemical pathways are disrupted due to metal contamination. Further studies on the detoxification efficiency of these animals through other biochemical pathways, such as the metallothionein-mediated metal detoxification pathway are being conducted by our group to elucidate possible toxic effects of these contaminants. In addition, Se:Hg molar ratios shall also be calculated, to verify the possible protective role of Se regarding Hg toxicity.

Keywords: metallomics, bioaccumulation, *Narcine brasiliensis*, neonate developmental stages.

Morphological variation in trophonemata of four Myliobatiformes species (*Chondrichthyes-Elasmobranchii*) captured in freshwater and the marine environments

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Myliobatiformes are the most diverse group of batoids in tropical waters. These batoids occur in a variety of habitats (marine, estuarine and freshwater). Stingrays present as reproductive mode matrotrophic viviparity with the development of vascularized uterine villi named trophonemata which secrete a nutrient fluid that nourishes the embryo during the pregnancy. The purpose of this work was to describe the morphological variation in trophonemata of four stingrays species that occur in freshwater, estuarine and marine environment. The uterine samples of *Potamotrygon motoro* (n=5), *P. wallacei* (n=5), *Hypanus guttatus* (n=5) and *H. marianae* (n=3) were removed after anesthetic procedures. The samples were fixed in buffered formalin 10% and processed by routine histological techniques and stained with HE, PAS and Mallory. Besides samples were prepared for analysis in scanning electron microscopy (SEM) in FMVZ-USP. Macroscopically, in the fresh uterus, was possible to visualize two distinct regions in villi a yellowish base area and an apical reddish area. The gravid uterus is composed of an inner mucosa which forms the villous endometrium (trophonemata), a middle, smooth muscle layer named myometrium and the perimetrium formed by a serous membrane. The most distinct part is trophonemata which are composed of secretory crypts alternate with the peripheral blood vessel. The trophonemata development increased during the gestation in all species. In early gestation, the trophonemata exhibit modest central vessel and small peripheral vessels lined by cubic epithelium cells. The secretory crypts are modest in this period. In later gestation when the respiratory demands from embryos are higher, trophonemata vascularity increases with the established of a large central vessel and dilated peripheral sinusoids lined by simple squamous epithelium cells. The crypts are well developed and extremely active in uterine milk secretion. Despite these share features, the trophonemata in the late gestation of *P. motoro* and *P. wallacei*, the yellowish color in trophonemata basal area was less prominent than observed in trophonemata of marine (*H. marianae*) and estuarine (*H. guttatus*) stingrays. This finding agreed with the observation of secretory crypts be more developed in *H. marianae* and *H. guttatus* than potamotrygonid species. However, the potamotrygonid species exhibited a higher complexity in blood vessel branch than marine (*H. marianae*) and estuarine (*H. guttatus*) stingrays. The variation observed can indicate differences in embryo metabolic demand based on mothers osmoregulation needs in a distinct type of habitat and/or difference in phylogenetic position.

Keywords: villi, stingrays, histology, habitat.

Coloration changes, their potential mechanism and evolutionary significance in giant manta rays (Mobulidae)

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Natural body coloration and spot markings of giant manta rays are used to identify individuals and to distinguish species. However, recent observations revealed rapid and long-term coloration changes of giant manta rays, suggesting that their body pigmentation is not permanent over their lifespan as assumed before. Such rapid coloration changes that happen within a few minutes have not been described in other elasmobranch species yet and the mechanism is unknown. Skin samples were taken from the middle of the head (black area) and from the shoulder bar area (white area) of a female *Manta birostris*. The samples were stained with hematoxylin and eosin (HE) and were examined using an Olympus light microscope. Pigment translocation within melanophores and difference in the degree of dispersion and aggregation of melanin granules were observed in the manta ray skin. In the black skin sample more and dispersed melanosomes were found, while in the white skin sample much less, aggregated melanosomes were found in the epidermis. These preliminary results suggest that color changes in the manta ray skin likely occurred as a result of the changes in the degree of melanophore and melanosome aggregations. The relatively rapid physiological color changes imply the possible neurohumoral regulation that was described in other fish chromatophores, although the regulation and physiology of pigment cells in manta rays is yet unknown. These rapid color changes happen during feeding, during intense social interaction, suggesting that it might contribute to social signaling in addition to other possible functions, but further studies are needed to understand the mechanism and role of such changes in giant manta rays.

Keywords: melanophore, melanosome, pigment, skin, *Manta, Mobula birostris.*

What can we learn from deep-diving elasmobranchs to help humans adapt to extreme underwater environments?

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Morphological and physiological adaptations to extreme underwater environments are present in deep-diving animals. Understanding these adaptations may help us develop physiological countermeasures for humans exposed to such environmental extremes, as operational and commercial divers are often exposed to high pressure for extended periods while conducting deep dives. Therefore, studying the morphological, physiological and behavioral adaptations of deep-diving elasmobranchs can lead to the development of new technologies to aid humans underwater. Ketone bodies in the blood have proven to serve as alternative fuel for the brain, elevated ketone levels were shown to enhance physical and cognitive performance and delayed the onset of CNS oxygen toxicity seizures in pre-clinical animal models. Some elasmobranchs developed adaptations to preserve and maintain brain function during repeated dives at extreme depths, in environments with low temperature and oxygen. We hypothesise that elevated blood ketone levels might serve as alternative fuel and neuroprotective mechanism in deep diving animals. Brain morphology of shark and ray species was examined on a GE 3T MRI scanner. 3D volumetric reconstructions were used to analyze brain volume and geometric morphology. Histological studies determined astroglia to neuron ratio and biochemical analysis of blood measured ketones and glucose levels. Our results demonstrate that some of the deep-diving elasmobranchs, such as Mobulids, have brains with largest weight, volume and surface area of all fish, high glia to neuron ratio and remarkably high blood ketone levels. Considering these observations, we speculate that ketone utilization may be an important physiological adaptation to preserve brain metabolism in deep-diving animals with large brains. These preliminary observations offer insights into physiological countermeasures of elasmobranchs to better understand the evolutionary significance of these adaptations that may be exploited for extending human performance and resilience in extreme environments.

Keywords: brain morphology, astroglia, MRI, adaptations, *Mobula*, manta ray.

Marine forensics: a tool for trade monitoring and compliance in Southern African fisheries, with focus on commercially exploited elasmobranch species.

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Marine forensic science can be described as protecting fisheries resources, marine mammals, and endangered species based on enforcement of the nation's laws. The main problem is that species identification becomes challenging when morphological features (such as fins, scales, and heads)re missing or samples are from different stages of processing. In South Africa, the harvesting of sharks is driven by the trade of shark meat for consumption and the international shark fin trade. Furthermore, seafood fraud on the South African market regarding the mislabelling of fish species is a reality, particularly at the retail level. The aim of this study is to assess marine forensics as a tool for complementing traditional identification methods through the development of a mini-barcoding assay relevant to the species occurring in the region. This will involve the testing and optimisation of the full barcoding region of the cytochrome oxidase c subunit 1 (*COI*), using traditional barcode primers as well as two sets of nested PCR primers. Preliminary results based on a forensic case study involving unidentified seized shark fins illustrated the limitations of using only the traditional *COI* primers, with a 40% species identification success rate. This warrants the inclusion of additional regions for species identification in future forensic cases. Based on the results which corroborate the use of the *COI* as a barcoding gene, a mini-barcoding multiplex assay will be developed and optimised in order to be applied to a wide range of marine forensic case studies. This will ultimately develop a protocol that can be applied successfully to identify, if not all, but most marine species involved in trade or seafood fraud regionally.

Keywords: mini-barcoding, nested PCR, species identification, multiplex assay.

Age and growth of the zipper sand skate *Psammobatis extenta* (Garman, 1913) (Chondrichthyes, Rajidae)

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The zipper sand skate, *Psammobatis extenta*, is a deep-sea small species belonging to the Rajidae family and endemic to the continental shelf of the western South Atlantic. Its distribution ranges from Cabo Frio - Rio de Janeiro, Brazil to Patagonia, Argentina, often found at depths up to 160 meters. The species is not a fishing target, but individuals are frequently caught accidentally and few studies about the species are available in the literature. For this reason, it is necessary to collect information about the biology of the species. Studies of age and growth in elasmobranchs are essential for the assimilation of species life histories, constituting the support for calculations of growth rates, mortality, longevity and maturation age. The age determination is based on examination of hard anatomical parts, which is fundamental in fisheries research and management. For this, the cartilaginous vertebra is the most used structure in these studies through the counting and analysis of the growth bands. The objective of the study was to provide information about the age and growth parameters of *P.extenta*, using their vertebral structure. For this study, 36 specimens (19 females and 17 males) were used, with a total length ranging from 95 to 271mm for females and 106 to 282mm for males. The relationship between disc width and vertebrae radius was significantly linear (r^2 = 0.75). The Akaike's Information Criterion (AIC) indicated that von Bertalanffy growth model with two-parameters (VBGM-2) provided the best fit. Growth parameters estimated were L∞= 166.8mm and k= 0.34 year^{-1} for females; and L∞= 158.0mm and k= 0.43 year^{-1} for males. Age estimates ranged from 0 to 7 years, for both sexes. The estimated value for growth coefficients (k) showed slower growth compared to other elasmobranch species, which is expected for a deep sea species.

Keywords: age structure, batoids, rajiformes, fisheries management, vertebral ageing.

Chondrichthyan research in South America: research trends over 50 years (1967-2016) compared with the rest of the world

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Research interest in chondrichthyans has been gradually increasing over the last 50 years, with the number of scientific outputs on chondrichthyan research undertaken globally increasing about 12 times from 1967 to 2016. However, to date there is a limited knowledge and understanding on how the different chondrichthyan research areas have evolved overtime. South America has a large concentration of Chondrichthyan species with scientific publications on Chondrichthyans slowly increasing from about six during the 1967-1981 period to about 112 in 2016. However, as with the rest of the world, the specific progress of chondrichthyan research in South America remains limited. Understanding the growth and trajectory of research of a specific scientific discipline and its so-called 'hot topics' assists researchers and stakeholders in making strategic decisions regarding which research areas require further attention and potential funding investment. Undertaking bibliometric studies of scientific publications enables an understanding of trends in specific research fields. Further, visualisation techniques based on bibliometric analysis of data are used to generate so-called term maps to assist in the understanding of the structure and trends of research areas overtime. In the current study, term maps were created and analysed from Chondrichthyan research publications using the VOSviewer software to gain an understanding of the trends and active growth areas of Chondrichthyan research undertaken in South America over the past 50 years and compared with the rest of the world for the past 15 years.

Keywords: VOSviewer, bibliometric analysis, text mining, Elasmobranchii, *Holocephali.*

Advances of the elasmobranch research in Brazil

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The present work aims to contextualize the research on elasmobranchs conducted in Brazil in recent years, based on the analysis of papers presented at the meetings of the Working Group on Fisheries and Shark Research in Brazil (GTPPTR) and the Brazilian Society for Studies on Elasmobranchs (SBEEL), between 1985 and 2016. The themes of the abstracts were grouped into ten categories: (1) Biology / Growth / Reproduction / Food / Ecology; (2) Occurrence Records/ Biodiversity / Populations / Scientific Collections; (3) Fisheries; (4) Morphometrics / Taxonomy / Physiology / Genetics / Anatomy; (5) Utilization of Elasmobranch Products and Byproducts; (6) Traditional Knowledge / Environmental Education; (7) Conservation / Management; (8) Attacks; (9) Captive Maintenance / Aquaria; (10) Non-Lethal Research Methods. During the study period, seven meetings of GTPPTR (Phase 1) were held (1985-1995) and nine meetings of SBEEL (Phase 2) (1997 – 2016), where 227 and 759 abstracts were presented, respectively. During this period there was an increment in the number of presented abstracts, indicating the advance of the elasmobranch research in the country. A predominance of the categories 1, 2, 3 and 4 was observed in the two phases. The category of Utilization of Elasmobranch Products and Byproducts presented a marked decrease over the years in Phase 1 and did not occur in Phase 2. An increase over the years was observed in the categories 6, 7 and 8. The categories 9 and 10 occurred only in Phase 2. A high dependence on fishing activity was noted as the main source of data, which is indicative of resource exploitation and is critical when a fishery collapses, impacting ongoing studies and historical series, leading to changes in the research themes. In Phase 1 elasmobranchs were viewed as a fishery resource, whereas in Phase 2 the focus changed from exploratory to conservationist. The concern with the conservation of elasmobranchs and the need to popularize their environmental importance may have contributed to increment works in Traditional Knowledge / Environmental Education in Phase 2, along with the emergence of new themes such as Non-Lethal Research Methods and captivity studies. There are bottlenecks in the elasmobranch research in Brazil and the contents presented in Phase 2 are a reflection of the current research in the country. The themes related to the conservation of this group cannot remain exclusively linked to the traditional research methods, and broadening the research approaches can be strategic for that purpose.

Keywords: Research history, research trends, state of knowledge, research impediment, Brazil.

Status of elasmobranchs kept in captivity in Brazil 2016-2017

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Besides entertainment source, aquariums and oceanariums are important tools to promote environmental education and scientific research around the world. On these establishments, the elasmobranchs are highlight attractions. To know this panorama in Brazil, the census of elasmobranchs in captivity was carried out with data available for the years 2016 and 2017. The sources of information used were the direct contact with enterprises and the Federal and State licensing Government agency such as the Secretariat of Environment of the Government of the State of São Paulo and the Wildlife Directorate of Instituto Chico Mendes de Conservação da Biodiversidade - ICMBIO. Thirteen, of the 34 accredited enterprises in Brazil showed elasmobranchs on display for public visitation. A total of 227 fish were recorded in captivity which 58.6% of specimens were rays, and 41.4% were sharks. Rays were represented by 6 families, and 17 species and the most frequent species were *Dasyatis hypostigma*, *Rhinoptera bonasus*, *Potamotrygon falkneri* and *Rhinobatus percellens*. The sharks were represented by 11 families and 11 species and the most frequent specie were *Ginglymostoma cirratum*, individuals of the genus *Scyliorhinus* and *Chiloscyllium punctatum*. The species *Ginglymostoma cirratum*, *Dasyatis hipostigma* and *Rhinoptera bonasus* together accounted for 52.4% of the total number of specimens. Considering the environment where they live, the most species are from marine environment, 93%, and only 3% are freshwater species, standing out those belonging to the genus *Potamotrygon*. This genus corresponded to 12% of the all captive rays recorded. Among the sharks, most species on display are exotic (37%), while for the rays most are native species (94%). According to the IUCN classification, of the total number of species, it was observed that: 5.9% correspond to the vulnerable category (VU), 26% almost threatened (NT), 1.2% least concern (LC), 57.2% data deficient (DD) and 2% corresponds to the species was not evaluated (NE). The number of aquariums and oceanariums has increased in the last decades in Brazil, being necessary up to date this census to know the elasmobranchs' species exhibited, the number of captivity individuals, threated status and other issues regarding the captivity conditions. Those procedures will contribute to better understand the biological aspects of these animals, as well as to improve techniques of maintenance in captivity.

Keywords: Aquarium, Oceanarium, Census, sharks, rays.

Migration and potential habitat of Dusky sharks *(Carcharhinus obscurus)* along the United States Atlantic coast

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The Dusky shark (*Carcharhinus obscurus*) is a highly migratory large coastal shark with a depleted population on the United States Atlantic coast due to overfishing. Despite significant fishery management efforts including a prohibition on landings, recovery for this species remains slow. Dusky shark migration behavior and habitat preferences are currently little-known, though a time-area closure was established on the coast of North Carolina with the goal of protecting overwintering juveniles from fishery interactions. To determine the extent of Dusky shark movements and identify important habitat areas, 23 Dusky sharks ranging in size from 1.06-2.20 m in length were surgically implanted with Vemco 69-kHz acoustic transmitters, with tagging locations near the mouth of the Chesapeake Bay, nearshore off of Ocean City, Maryland, and in the New York Bight. Tag transmissions were detected on acoustic receivers deployed between Long Island, New York and Cape Lookout, North Carolina. Satellite-recorded sea surface temperature (°C) and chlorophyll-a concentration (mg/m3) data were extracted at dates and locations of tag detections and distance from shore (km) was measured at each tag detection point. These variables were used to identify preferred environmental ranges using boosted regression tree modeling. Most tag detections occurred in the New York Bight during summer and south of the Chesapeake Bay during winter. Dusky sharks were detected within 10 km of shore during the summer and winter but ranged as much as 70 km from shore during the fall and spring. Tagged sharks occupied an approximately 14-24 °C sea surface temperature range. Potential Dusky shark habitat overlaps several areas currently being assessed for offshore wind energy development.

Keywords: Dusky shark, acoustic telemetry, remote sensing, boosted regression trees, offshore development.

Occurrence of *Carcharhinus longimanus*, *Isurus oxyrinchus* and *Prionace glauca* in two Ecologically or Biologically Significant Marine Areas (EBSAs) of western Mid-Atlantic

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Ecologically or Biologically Significant Marine Areas (EBSAs) are classified by the Convention on Biological Diversity (CBD) as rare areas in need of protection in open-ocean waters and deep sea habitats that have important purposes to support the healthy functioning of oceans, which provides many services for human beings. The criteria for identification of EBSAs are: uniqueness or rarity; special importance for life history of species; importance for threatened, endangered or declining species and/or habitats; vulnerability, fragility, sensitivity, slow recovery; biological productivity; biological diversity and naturalness. In this study, we focus in two EBSAs of western Mid-Atlantic, the Banks Chain of Northern Brazil and Fernando de Noronha (1° S to 4° S; 37° W to 39° W), and the Atlantic Equatorial Fracture Zone (0°58' N; 29°27' W). *Carcharhinus longimanus*, *Isurus oxyrinchus* and *Prionace glauca* are included in IUCN Red List as Vulnerable and Near-Threatened species, and these three species are found in those particular areas of western Mid-Atlantic. Between 2005 and 2011, on-board observers recorded geographical coordinates and biometric information, as sex and length, of 227 individuals of *C. longimanus* (107 females, 92 males and 28 unknown), 278 individuals of *I. oxyhinchus* (81 females, 129 males and 68 unknown), and 6809 individuals of *P. glauca* (2735 females, 2831 males and 1243 unknown) that were caught by pelagic longline fleet chartered from Honduras, Morocco, Panamá, Portugal, Spain and United Kingdom. The lengths registered were converted in ages for each species and sexes using the inverse von Bertalanffy growth equation, and software QGIS (version 2.18.16) were used for plotting the dataset and creating several maps. According to recent studies, these species are declining due to uncontrolled fisheries, since there is few or no fiscalization in Brazil's exclusive economic zone. The results of the present study can demonstrate how uncontrolled fisheries affected these species during the years analyzed, and with that, propose a management plan, prohibition of fisheries and protection of the EBSAs of western Mid-Atlantic.

Keywords: open-ocean, sharks, longline, conservation, fisheries.

Distribution of deep-sea sharks in the MesoAmerican Region

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The deeper waters (>150 m) of the western Caribbean Sea are largely unexplored, and the distribution and ecology of species in the deep sea is virtually unknown in the region. Though coastal resources are becoming depleted in the MesoAmerican countries of Belize, Guatemala, and Honduras, demand for fish continues to increase among local populations and tourists, leading to increasing fishing effort in the deep sea. Fishery-dependent and –independent surveys were conducted over three years in Belize, Guatemala, and Honduras starting in 2015 to determine the scope of the deep-water fishery in the region and the extent that sharks are targeted and landed. Fishery-independent vertical longlines and baited remote underwater videos deployed in eight sites in the region provided data on the occurrence, distribution, and life history of deep-sea sharks. Fishers in Belize largely do not target deep-sea sharks, while those from Honduras and Guatemala actively target and land deep-sea sharks; fishing gear in Belize and Honduras is mostly vertical longline, and Guatemalan fishers also employ bottom long-line trammel nets. Transboundary fishing, border disputes, and increased fishing effort were identified as the greatest threats to deep sea sharks in the region. Preliminary results from fishery-independent surveys indicate that species diversity and capture rates are fairly high in relation to results from other deep-sea surveys in the greater Caribbean. At least nine species of deep-sea sharks from six families and two species of pelagic/coastal pelagic sharks have been captured in Belize and Honduras, with capture rates in northwestern Honduras more than three times higher than that in Belize. Five species could not be identified beyond genus using taxonomy alone, though many represent new locality records and some are potentially new species. Conventional tagging of 102 sharks has resulted in two recaptures and one documented post-release mortality event. Continued taxonomic and genetic analyses along with monitoring efforts will provide additional species resolution and shape nascent regional deep-water fisheries policies.

Keywords: Caribbean Sea; vertical longline; BRUV; small scale fisheries; *Centrophorus; Hexanchus; Etmopterus; Squalus*.

Residency, home range, and habitat use patterns of Caribbean reef sharks at a remote atoll in Belize, Central America

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Network analysis is an increasingly popular tool for the exploration of animal movement and interactions among individuals. In conjunction with conventional home-range and residency analysis, these tools can be applied to assess the "social" behavior of conspecifics. From 2007-2009, a total of 87 Caribbean reef sharks (*Carcharhinus perezi*) were tagged internally with acoustic transmitters at Lighthouse Reef Atoll, Belize. An array of 17 passive acoustic receivers were positioned on the forereef locations around the atoll that recorded the detections of tagged sharks for a period of five years. Network analysis, home-range, and residency patterns of 75 sharks that were detected at least 50 times within the array revealed wide variation in individual movements and spatial partitioning of the atoll. Most sharks monitored (88%) had large home-ranges and were transient, while 12% of individuals were highly resident with very small home ranges. Highly resident sharks were primarily large mature females that had the highest level of interactions among other sharks, and social network metrics indicated that they drove partitioning of space and resources at Lighthouse Reef Atoll. These sharks' home-ranges often encompassed highly productive areas of the atoll, including fish spawning aggregations. Reef sharks showed ontogenetic shifts in atoll use, with females' home-ranges shrinking with maturity, while males' home ranges expanded as they grew and matured. This study highlights the importance of large, highly resident females in maintaining social structure; the loss of these individuals along with smaller individuals with high betweenness centrality network measures, could cause fragmentation of the network and reduce the population's resilience at this site.

Keywords: network analysis; *Carcharhinus perezi*; telemetry; resource partitioning; ontogeny.

Life history, demography, and conservation concerns for South Atlantic pelagic sharks

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Population declines of several shark species have been widely attributed to longline fisheries in many ocean basins including the South Atlantic. Recently, Brazil, which has the largest coastline in the South Atlantic, has become one of the largest consumers of shark meat in the world, elevating global conservation concerns. Here we reviewed information on the life history of 7 pelagic shark species caught by longlines in the South Atlantic to assess their relative vulnerability (i.e. exposure vs. resilience) to fisheries. To this end, we converted data collected by longline fisheries observers into age information using empirically derived age-length keys. Then we used age-structure data to estimate mortality rates and survivorship curves. Finally, three demographic analysis methods were used to infer population trends under different scenarios (unfished and fished). Our results indicate that the vast majority of the individuals caught were below age of maturity and most species experience levels of mortality that they cannot withstand. Also, we have identified the shortfin mako and hammerhead sharks as particularly vulnerable species requiring immediate conservation actions. Some methodological complications were also addressed, in particular the inapplicability of some methods widely used for fish to estimate the natural mortality in sharks and poor adjustment of catch curves for species with low sample size and/ or taxonomic resolution. Importantly, our elasticity analyzes revealed for all species and scenarios addressed that the protection of the early life-stages of species is crucial for the maintenance of healthy population levels. Finally, in order to aid spatial management approaches in the region, we mapped out the distribution of vulnerable age classes for each species. We conclude that the available information indicates significant intrinsic vulnerability of large pelagic sharks in the South Atlantic Ocean, and highlight improved protection of critical life stages and their habitats as a conservation solution.

Keywords: sharks, scientific observers, longline fisheries, age-length keys, Leslie matrix.

Macroplastic ingestion in blue shark (*Prionace glauca*) caught in Brazilian longline fisheries

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The improper ingestion of plastic debris by marine wildlife like turtles, birds and marine mammals are often documented and negatively affects the survival of many animals. For sharks however, these interactions are poorly reported and little is known about its effects on these animals. In July 2017, a young female of blue shark was caught by a surface longline vessel, which directed its catches for this species and also the swordfish (*Xiphias gladius*). The female was approximately 150 cm TL and weighed about 32 kilos. During its desiccation, a 65-gallon black trash bag was found in her digestive tract. The object was carefully removed, which certified the ingestion by the specimen possibly together with the prey and not by accidental ingestion since other food items were observed. This is the first documented incident of macroplastic ingestion by sharks off the Brazilian coast. Based on this record, it can be said that it is a phenomenon that can also affect the sharks that correspond to the largest group of marine predators and play an important role in energy exchange of high trophic levels. This pelagic species is widely captured in longline fisheries and currently corresponds to the largest share of shark meat imported by the country, raising concerns about this specie conservation.

Keywords: blue shark, macroplastic, ingestion, pollution, Brazilian coast.

First investigations into whitespotted eagle ray *(Aetobatus narinari)* diet using molecular techniques

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The whitespotted eagle ray (*Aetobatus narinari*) is a large, durophagus marine ray found in coastal and estuarine habitats in the Gulf of Mexico, Caribbean Sea and northwest Atlantic basin. Past studies on the diet of these rays have used visual observation techniques of gut contents and revealed a primarily molluscan diet consisting of a variety of bivalve and gastropod prey. This current study gathered gastric samples from live rays captured off southwest Florida using gastric lavage and then analyzed using COI barcoding approaches to evaluate diet. Between September 2015 and November 2017, 17 rays were sampled using gastric lavage. For each ray, we extracted genomic DNA from 20 prey items and amplified a 313-bp section of the COI gene using previously published primers. Positive PCR products were sequenced at the University of Arizona Genomics Core. The identity of each successfully sequenced prey fragment was established using the Barcode of Life Database (BOLD Systems v.3) using previously established criteria. Initial findings indicate *Strombus alatus*, *Spisula solidissima*, and *Macrocallista nimbosa* as most prevalent in gut contents of several rays. Additionally, blood, fin clips, and potential prey were collected for stable isotope analysis. Preliminary stable isotope data suggest animals are feeding on a combination of gastropods and bivalves. Further sampling of rays and prey availability in habitat will help solidify preferred diet in these large rays. These findings are important to determine the potential impacts these rays may have on mollusk fisheries in coastal environments.

Keywords: *Aetobatus narinari*, diet, stable isotope, COI barcoding.

Morphological description of the heart of three pregnant females of *Squalus* cf. *mitsukurii* (Jordan & Snyder 1903) caught off northeast Brazil.

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This work aimed at describing the morphology of the heart of three pregnant females of *Squalus* cf. *mitsukurii*, collected at depths of around 300 m, in the coast of Pernambuco, northeast Brazil. The specimens were identified, eviscerated and had their total length (cm) measured. Their hearts were removed, weighed and measured, as well as their internal structures, such as myocardium, atrium and artery (conus arteriosus). They were then fixed for 24 hours in formaldehyde 10%, cleaved, re-immersed for more 24 hours, and stored in 70% alcohol. For histological analysis, the methodology described by Thomaz was applied. All hearts were photographed both after removal and after cleavage. Female total length (cm) ranged between 77.9 and 85.2 cm and total weight from 2035 to 2940 g. The myocardium length of the hearts ranged from 3.2 to 3.7 cm, while their weight varied between 2.87 to 3.80 g, with all of them exhibiting the apex flattened. All hearts presented two lateral veins located on the left and right to the conus arteriosus, surrounding their base, where they branch through the entire myocardial structure, giving rise to coronary circulation, these veins are called respectively left coronary trunk and right coronary trunk. The hearts that had greater weight had a greater degree of coronary vascularization. The diameter and length of the conus arteriosus ranged, respectively, from 0.5 to 0.7 cm and from 1.6 to 1.8 cm. The width and length of the ventricle varied from 1.8 to 2.0 cm and from 1.6 to 2.1 cm, respectively. Histological analysis showed the presence of loose connective tissue with a polyhedral to a cubic morphology in the epicardium. In the myocardium there was a varied spacing in relation to the fibers, where they were surrounded by polyhedral cells ranging from pavement to cubic. It was also possible to observe the presence of amorphous material and of cartilage rings, possibly indicating the animals already had an advanced age.

Keywords: Anatomy, circulatory system, internal morphology, shortspine spurdog

Visual ecology of the great white shark and shortfin mako

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Visual function in the high-performance and regionally endothermic sharks is assumed to be superior to that of their ectothermic counterparts. These migratory lamnid species, including the white shark (*Carcharodon carcharias*) and the shortfin mako (*Isurus oxyrinchus*), are thought to be visually guided predators with eyes adapted to a wide range of visual habitats. Though shark vision has been of interest to researchers for several decades, most studies are limited to smaller, more accessible species. More recently, greater access to large, predatory species enables us to address outstanding questions regarding the role of vision with respect to their life history traits. To examine visual performance of the white shark and the shortfin mako, we used a visual range model developed by Nilsson et al. (2012). The input parameters included pupil diameter and focal length, photoreceptor length and peak retinal ganglion cell density, light level, and target size and contrast. For sharks viewing a human diver in a black wetsuit in clear, oceanic water, we calculated a visual range of approximately 20m, similar to human vision under the same conditions. However, shark vision is coarser than humans, so less detail is available to sharks for identifying objects using their visual system. Because eye size positively correlates with both sensitivity and acuity, further investigation across both species size ranges will address the functional significance of the visual system with respect to ecological patterns.

The diet of the narrowmouthed catshark *Schroederichthys bivius* in Argentine sea

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The narrowmouthed catshark *Schroederichthys bivius* is an endemic species of the southwest Atlantic and southwest Pacific continental shelf. It is distributed from Brazil to Argentina and Chile. In Argentina occurs from 50 to 360 m depth. Food habits of *S. bivius* were studied based on analysis of stomach contents. Specimens were collected from three research cruises carried out by (INIDEP) during winter 2016 and summer 2017 on the southern Argentinean continental shelf (ACS, 41oS – 48oS), and during spring 2016 on the northern ACS (35°S – 41°S). Prey items were identified to the lowest possible taxon, counted and weighted. The percentage of the index of relative importance (%IRI) was used to evaluate the contribution of each prey. The hypothesis that the consumption of each prey group is influenced by total length, sex, maturity stage or season was assessed by fitting generalized linear models (GLM).

From the 452 catcharks analyzed, all stomachs (100%) contained food. On the southern ACS the species fed mostly on cephalopods (36.90%) and crustaceans (33.18% IRI), followed by fish (20.36% IRI) and polychaets (24% IRI). On the northern ACS *S. bivius* fed mainly on crustaceans (56.60% IRI), followed by polychaets (18.65% IRI), fish (18.09% IRI) and cephalopods (4.71%). The consumption of polychaets and crustaceans decrease as the narrowmouthed catshark grew in size, and they were more consumed during winter than summer. On the other hand, the consumption of cephalopods increased with the total length of *S. bivius* and they were more consumed in summer than in winter. The trophic level was estimated 3.94 and 3.57 on the southern and northern ACS, respectively. The traditional IRI and the new PSIRI indexes are compared and discussed.

Keywords: trophic ecology, Scyliorhinidae, Argentina, benthic, opportunistic.

Shrimp trawling bycatch of sharks and rays (Elasmobranchii) in the southeastern region of Cuba

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Elasmobranchs are found in multi-specific fisheries and more than half of their catch is reported to be related to bycatch. In recent years, shrimp trawl fisheries are the main source of bycatch of these species, which report high percentages of juvenile and neonate sharks and rays. In Cuba, research on the bycatch of elasmobranchs in the shrimp trawl fishery has not been carried out. The objective of this work was to characterize sharks and rays bycatch in the pink shrimp trawls that operate in the southeastern region of the country. The monitored was between January 2015 and August 2016 in four industrial fishing enterprises. The specimens were identified, measured and sexed; for pregnant females the number of embryos was counted and the sex was determined. Four orders, six families, eight genera and nine species were identified. Rays made up the majority of the catches (95.7% of the total elasmobranch catch), with *Hypanus americanus* and *Styracura schmardae* being the most prominent. The species *Narcine bancroftii* was registered for the first time in the southeastern region of Cuba. The females predominated in the catches and their sizes were larger than the males. Seventy-seven pregnant females were registered with a greater number of female embryos than male embryos. The identification of three vulnerable zones for elasmobranchs suggests a possible nursery area. The results obtained is very useful for compare with another countries and is the beginning for the elasmobranch bycatch research in Cuba.

Keywords: Southern stingray, Gulf of Ana María Cuba, Caribbean Sea.

Shark detection probability from aerial drone surveys across multiple environmental contexts within temperate estuaries

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Advances in the use of unmanned aerial vehicles (drones) have given rise to a number of studies of wildlife ecology and behavior across terrestrial and marine ecosystems. Drones are easy to maneuver and operate over a small range of distance scales and altitudes, making them potentially useful to monitor species distributions and habitat use in shallow-water estuaries. Due to widely varying environmental conditions found in temperate estuaries, determining effects of environmental conditions on detection rates by drones is important for understanding the efficacy of this approach at estimating true patterns of distribution and abundance. To investigate the utility of drones in surveying bonnethead sharks (*Sphyrna tiburo*) within temperate estuaries, we used manipulative field experiments involving decoys fashioned to mimic the overhead appearance of bonnetheads. Decoys were placed in two flight areas (0.8 km2) in shallow (< 2 m) waters near Beaufort, NC on five survey days during 2015-2016. Survey flights were conducted using a fixed-wing drone (senseFly eBee®) equipped with a digital camera to capture images from overhead. Images were indexed for combinations of 5 factors (environmental conditions) present across survey flights: 2 categorical (cloud presence, spectral filter) and 3 continuous (time of day, wind speed, decoy depth). PDF files containing images representative of all possible factor combinations were sent to a group of fisheries scientists (n = 15 scorers), who were asked to identify the presence/location of sharks in each image. Correctly identified decoys were quantified and used to calculate detection probability across representative environmental conditions. Factor-level comparisons were conducted using non-parametric rank sum tests (Mann-Whitney U test for two-level factors and Kruskal-Wallis H test for three-level factors). Regression tree analysis was employed to further examine the relative importance of factors. Detection probability for decoys ranged from 0 (never detected) to 1 (always detected) with an overall mean value of 0.27 +/- 0.38. Depth and time of day had the largest impact on detection probability (p values </= 0.00001). Conversely, wind speed, cloud presence and spectral filter appeared to have little effect. Despite a failure to detect significant differences across wind levels, our regression tree utilized decoy depth followed by wind speed (continuous), creating splits that best explain variance in detection probability. Our study shows that depth likely has the greatest effect on detection probability from drone surveys in temperate estuaries, limiting the range of estuarine habitats over which this method can reliably predict distribution and abundance of sharks.

Keywords: unmanned aerial vehicles, UAV, bonnethead shark, photo identification.

Chondrichthyan fisheries, conservation and management in the southwest Indian Ocean

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The southwest Indian Ocean (SWIO) represents a global hotspot for chondrichthyan diversity, with 130 shark, 86 batoid and 11 chimaera species identified species to date. Yet the area is also a hotspot for Threatened (54 species, 23%) and Data Deficient (71 species, 31%) chondrichthyan species (IUCN Red List of Threatened Species). There is a high demand for and legal and illegal trade in shark and ray products (particularly fins). Sharks are also incidentally taken in a variety of industrial and small-scale fisheries throughout the region. There is thus a critical need for improved data and corrective management, particularly for threatened species. Through collaboration among conservation, academic, research and management organizations, a regional roadmap for the conservation and management of sharks and rays in the SWIO was developed, which identifies the major issues relating to these species, as well as actions required to improve their conservation status and ensure sustainability at the regional level. Scheduled for presentation at an intergovernmental meeting in 2018, the roadmap indicates a critical need for the collection of fishery and ecological data for chondrichthyans in the SWIO region, and for policy aimed at their conservation and management. Landing site and market surveys at several sites throughout the SWIO have provided valuable data on chondrichthyan catches and diversity. However, to overcome a lack of standardization in data quality from past surveys, a standardized catch monitoring system was developed, including a suite of questionnaires focusing on landings, trade, socio-economics and collection of biological data on chondrichthyans, and has been trialed and implemented at selected sites. To complement the fishery data, a region-wide collaborative baited remote underwater video (BRUV) field study was implemented at selected sites in the SWIO, and has provided much-needed data on the diversity and relative abundance of chondrichthyan communities. This holistic, multi-disciplinary, collaborative approach, including a desktop gap analysis, development of chondrichthyan-directed guiding documents, collection of ecological data, development of a suite of fishery survey questionnaires to collect standardized fishery data, and management actions at both community and government levels, has set the platform for the improved conservation of chondrichthyans in the SWIO. This initiative has also extended to country level, facilitating the development of national roadmaps in two SWIO countries, namely Madagascar and Kenya, and could provide a useful model for other regions or countries that exhibit similar importance for chondrichthyan biodiversity.

Keywords: baited remote underwater video (BRUV), elasmobranchs, fishery surveys, threatened species, policy development.

What is more important: the size or age at maturity? Evaluating the reproductive life-history traits of three chondrichthyans species of the San Matías Gulf, Northern Patagonia, Argentina.

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The main cause for the vulnerability of chondrichtyans of commercial fishing is explained through their life-history. Some of the key parameters are the growth coefficient (K), maturity age (A50%) and longevity (Amax), for which there have been empirical relationships described or life history invariants, such as the size at maturity (TL50%) and A50% being a percentage of total length (TLmax) and of the Amax respectively. In the present study were analyzed the reproductive parameters estimate for three chondrichthyans species of the San Matías Gulf and included in different taxonomic groups: the chimaera *Callorhinchus callorynchus*, the shark *Mustelus schmitti* and the skate *Atlantoraja cyclophora*. The objective was to compare the relations between the parameters with the general patterns proposed for chondrichthyans. The age and growth were estimated from the reading of the vertebral sections of the narrow nose smooth-hound shark and the eyespot skate, and from length frequency data for the chimaera elephant fish. The age readings were fitted to five growth models and the growth-parameters selected by the Akaike weight and biological criteria. The TL50% was estimated fitted to the logistic model. The TL50%:TLmax proportion for the elephant fish and narrow nose smoth-hound shark were 63-71% of the TLmax, similar or slightly lower that described for chondrichthyans. The same pattern was observed for A50%:Amax, where it was 42-44% for the elephant fish and 27% for the shark, near to 38% described for chondrichthyes. In contrast, for the eyespot skate, the relation estimated were higher, TL50%:TLmax= 82-83% and A50%:Amax= 57-60%, near the percentages described for batoids. In conclusion, between the studied species it was observed larger differences in the A50%: Amax ratios (27-60%) compared with TL50%: TLmax (63-82%). These results show that the A50% is more important when the chondrichthyans populations are assessed and compared. The general pattern described for chondrichthyans indicate that TL50% increases with the TLmax and the A50% increases with the Amax. These patterns were not observed in the studied species. For the eyespot skate the TL50% is greater than for the elephant fish, even though its TLmax is smaller. Furthermore, the A50% estimated for the smooth-hound shark was the lowest even though the shark had higher longevity. The results obtained show that different combinations exist and it is important to study the parameters at specific level when we perform assessments of populations and analyze their vulnerability.

Keywords: life history invariant ratios, maturity, elephant fish, narrow nose smooth-hound shark, eyespot skate.

Landings and catches analysis of the main holocehpal of the Argentinean Sea (33° -57°S): the elephant fish, *Callorhinchus callorynchus* (Holocephali: Callorhinchidae)

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The holocephals species are generally caught as by-catch in several fisheries of the world where the teleost fishes and crustaceans are the target species. The elephant fish, *Callorhinchus callorynchus*, is the species of chimaera mainly caught as by-catch and exploited commercially in the Argentinean Sea. In this work, the reported landings evolution was analyzed considering logbooks data during 1989-2016. Furthermore, the type of fleet, ports of landings and most important fisheries regions for the elephant fish were detected for the last period. The vessel monitor system (VMS) data (2015/2016) was used to detect and validate the main areas where the catches of elephant fish are declared. The evolution of the reported landings observed was increasing, with annual fluctuations. The last period 2006-2016 had the highest level of landings [annual average: 2.000 t, and landings peaks in 2008 (2.690 t), 2009 (2.780 t) and 2015 (2.680 t)]. During the analyzed period (2006-2016) were detected three areas/regional fisheries where the elephant fish landings come from: 1-San Matías Gulf (SMG) (total 2006-2016 landings: 9.000t), 2-El Rincón and external zone (6.300 t), 3- Chubut coastal (3.300 t). These regions had the 85% of the total landings, followed by another three areas with lowest tons (13%: San Jorge Gulf 1.900 t, Argentinean-Uruguayan Common Fishery Zone 800 t (AUCFZ) and Grande Bay/San Julián 118 t). The maps generated with the VMS data showed the same three main areas of elephant fish catches. Regarding the landings ports, San Antonio Oeste (catches of SMG) and Mar del Plata (catches of El Rincón and AUCFZ) accumulate between 60-92 % of the annual landings according to the year evaluated and exchange the first position between years. The most important fleet that capture elephant fish during 2006-2016 were the Trawl coastal vessels ("Costeros") and Trawl bigger vessel ("Fresqueros de altura") with fresh fish, occupying the first and second place with 80-96% of the total annual landings. Finally, the fleet analysis landings by region showed: 1-GSM: "Costeros" 58% (lenght 17-26m), "Fresqueros de altura" 37% (24-38m) and Artisanal small vessels "Rada/Ría" 5% (13-17m); 2-El Rincón: "Fresqueros de altura" 81% (19-65m), "Costeros" 17% (13-26m); 3-Chubut coastal: "Fresqueros de altura" 58% (22-68m),"Costeros" 51% (12-26m) and "Rada/Ría" 8% (8-19m) where the frequency of occurrence of bycatch by haul has been described between 24-64%. The results of these work allows to identify the fleet that interact with *C. callorynchus* and the priority areas/regional fisheries regarding research and management.

An overview of three years of conservation and research efforts on sharks in the Dutch Caribbean

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In 2015 the Save Our Sharks project was launched by the Dutch Caribbean Nature Alliance with the aim to stop the decline of sharks and rays in the Dutch Caribbean. The project focuses on I) education on the importance of sharks in the marine ecosystem; II) working with local fishermen to find solutions workable solutions to decrease shark (by) catches; III) working with government to realize effective management of shark populations; and IV) enhancing the scientific knowledge needed for conservation and management. A baseline study of reef-associated shark assemblages around Aruba, Bonaire, Curaçao, Saba, Saba Bank, St. Eustatius, and St. Maarten using Baited Remote Underwater Videos (BRUV) systems was conducted. Species composition and relative abundance of sharks appeared in reasonable good state, most likely due to a lack of a fishery targeting elasmobranch on the islands. Wave exposure and habitat complexity had a positive effect on shark abundance. Acoustic telemetry studies on nurse sharks and Caribbean reef sharks were conducted on Saba, St. Maarten, St. Eustatius, and the Saba Bank. Most of the studied reef sharks have localized movements with a relatively small home range and inter-reef movements appear to be scarce. In addition, a satellite tracking study of tiger sharks in the Caribbean Sea yielded its first results. An assessment of the overall status of sharks in the Dutch Caribbean will be presented with an emphasis on their relevance for conservation and management.

Keywords: Dutch Caribbean, conservation and management, BRUV, acoustic telemetry, satellite tracking.

Abundance of sharks of the genus *Carcharhinus* in Saint Peter and Saint Paul archipelago, Brazil

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From October 2010 to June 2015, 101 drumline sets were made at two locations in Saint Peter and Saint Paul archipelago (SPSPA), in the east (0°54'952"N, 29°06'956" W) and west side (0°55'062" N 29°20'187"), aiming at catching sharks for tagging and telemetry. The lines used a circle hook, size 16, and flying fish (*Cheilopogon cyanopterus*) as bait. Catch per unit effort (CPUE) was calculated as the number of sharks caught by every 10 hooks deployed. The yearly mean nominal CPUE was calculated to evaluate the temporal variation of catches. Sexual ratio between males and females was compared by Chi-square test. A total of 129 elasmobranchs were caught: 121 sharks and 8 rays. The Carcharhinidae family accounted for 90% of the catches. *Carcharhinus falciformis* was the species most frequently caught (66.9%, n= 81), followed by *Carcharhinus galapagensis* (16.5%, n= 20) and *Carcharhinus obscurus* (6.6%, n= 8). The elasmobranchs caught also included: bentfin devil rays (*Mobula thurstoni*, 6.6%, n= 8), scalloped hammerhead shark (*Sphyrna lewini* 5.8%, n= 7), mako shark (*Isurus oxyrinchus* 2.5%, n= 3), smooth hammerhead shark (*Sphyrna zygaena* 0.8%, n= 1) and a shark that could not be identified because it escaped the hook (0.8%). The CPUE averaged for all years was 0.43, 0.11 and 0.04 for *C. falciformis*, *C. galapagensis* and *C. obscurus*, respectively. The CPUE of *C. falciformis* declined continuously along the years, while the CPUE value of the two other species showed a marked increase, starting in 2013 (*C. galapagensis*) and 2015 (*C. obsurus*). Of the 109 *Carcharhinus* caught, 103 were sexed (95% of the total), resulting in a sex ratio (♂:♀) of 1.00:1.05 for *C. falciformis*, 1.00:1.25 for *C. galapagensis* and 1.00:3.00 for *C. obscurus*. The differences in sex ratio, however, were not statistically significant ($p > 0.05$). These findings confirm the presence of *C. galapagensis* in SPSPA vicinity and indicates that the prohibition of the catch of sharks in the area in 2012 had a very positive effect in its local population. The reduction in the CPUE of *C. falciformis*, on the other hand, is likely a consequence of the dominance and more territorialist behavior of *C. galapagensis*, which tend to drive the *C. falciformis* away from the archipelago.

Keywords: elasmobranchs, SPSPA, Carcharhinidae, CPUE, drumline.

How fast can the scalloped hammerhead shark swim?

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Satellite transmitters were used to determine the speed of swimming and diving profile of scalloped hammerhead sharks (*Sphyrna lewini*) in the vicinity of the Saint Peter and Saint Paul Archipelago (SPS-PA). Between March 2012 and May 2014, two female and two male hammerhead sharks were tagged with PSAT (MK-10, Pop-up satellite archival tags). Daily geographic positions of the tagged animals were estimated from luminosity levels using the geolocation tool in WC-GPE© of the Wildlife Computers adjusted with Kalman filter routine in R program (Nielsen and Siebert, 2007; Lam et al., 2008). The horizontal swimming speeds were calculated point-to-point (geographic positions) per days travelled (km.day–1). In a visual inspection of shark diving behavior, the shark was considered to perform a full dive, when leaving the mixed layer (0-50 m) descending bellow the thermocline (50-150 m) and only then returning to the mixed layer or to the thermocline layer. The mean diving ascent and descent speeds (m.s-1) and their duration were calculated for those dives with complete records. A Student's t test was applied to compare them. The average swimming speed for all sharks was 16.08 km/d-1 (range= 0.25–85.0 km.day–1). Although the speed has been low, our results indicated daily movements of departure and return to the archipelago. Visual inspection of the diving records showed that deep dives (>500 m) typically occurred consecutively with a return to the mixed layer between dives. These deep dives lasted a estimated time of 10 to 40 minutes, during which the shark travelled at a mean speed of 0.80 m.s–1. The descent rates were always faster (mean descent speed= 0.50 m.s–1) than ascent rates (0.32 m.s–1) but this difference was not statistically significant (Student's t test, p> 0.05). Descent and ascent diving rates were proportionally faster when greater depths were reached. The results suggest that the hammerhead sharks use the SPSPA like a refuge, performing incursions at greater depths in search of food likely while on the bottom or during ascent movement. A better understanding of habitat use by hammerhead sharks is fundamental to develop management strategies for the conservation of the species.

Keywords: *Sphyrna lewini*, movements, speed, diving behavior, SPSPA.

Assessment of blue sharks *(Prionace glauca)* in the Southeastern Pacific Ocean

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The blue shark *Prionace glauca* is the primary pelagic shark species caught in the Southeastern Pacific Ocean, being of great importance for the Asian market as shark meat and fin. While it is relatively fast-growing and fecund, remains to be a species with k-strategy and with the time its population is decreasing notoriously. At the beginning of the fishery exploitation, the catches of *P. glauca* came from by-catch but then it starts to be targeted by the fishery, in spite of being the most fished shark, there is a lot of missing information about its status. Also, there is concern over the removal of such large numbers of this likely keystone predator from the oceanic ecosystem. For all these reasons, it is necessary to have adequate management strategies to improve the situation of *P. glauca*. One of the starting points to propose coherent management strategies is to know the state of the population, often the catches do not reflect correctly what is happening with the population evaluated, so it is necessary to make estimates of abundance and propose fisheries reference points. Thus, the aim of this work was to estimate the biomass and the reference points for *P. glauca*. For it was used the Catch-MSY method proposed by Froese (2016), which it was made for poor-data fisheries. The method estimates biomass, exploitation rate, MSY and related fisheries reference points from catch data and resilience of the species. We worked with reconstructed catches from 1950 to 2014 obtained from Sea Around Us for the Southeastern Pacific Ocean for which we considered all the countries of the coastal edge, the high sea and the islands in that region. We compared two values (0.062; 0.359) for the maximum intrinsic rate of population increase (r), one less conservative than the other, obtaining as a result 7.2 and 12.4 for the MSY, 232 and 68.9 for the BMSY, 0.031 and 0.179 for FMSY, 2.96 and 1.92 for the exploitation rate, respectively. These values are interesting because when analyzing them they show us what could be a useful and easy to use model for poor-data fisheries.

Keywords: blue shark, biomass estimation, poor-data fishery, Catch-MSY model.

Genetic struture of the global populations of Blue shark - *Prionace glauca*

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The blue shark (*Prionace glauca*) is a globally distributed and highly migratory species. Throughout history, *P. glauca* has been a consistent and frequent feature of by-catch in long-line and swordfish fisheries with recent population studies revealing localized declines in numbers and stock assessments are uncertain. As such, *P. glauca* is now categorized as "Near Threatened" on the IUCN Red List of Threatened Species. Studies to date have largely focused on single oceans despite the large dispersal capacity and likely high rates of gene flow within *P. glauca*. Our study is the first to characterize the molecular biodiversity and population structure of *P. glauca* globally. We used 534 individuals across 15 locations, including 2 localizations provided by literature within the Atlantic, Indian and Pacific Oceans. Using a DNA control region (CR), we found 43 haplotypes and the haplotypic diversity was Hd = 0,772 the nucleotide diversity p= 0,005, and the population structuring index ΦST global = 0.049. Genetic variation within populations (AMOVA) indicates 94% of similarity between basins. We estimated the genetic differentiation between the oceans, when compared the Indian Ocean x Atlantic Ocean we obtained the value of ΦST = 0.0557 (P value = 0.00001), and when we compare the difference between only the populations of the Atlantic in north and south we obtained the value of ΦST =0.042 (P-value = 0.00001). Two common CR haplotypes are present and correspond to 64% of the total found. Another eighteen haplotypes correspond to 31% of the total and twenty single haplotypes was removed from the network for clearer visualisation. Haplotype 2 found predominately in Indo-Pacific Ocean with more significant samples contributions from the localities close to Indonesia, Mozambique and Madagascar. And the Haplotype 4 predominately in the Atlantic Ocean. This is evidence for past evolution in isolation combined with gene flow between oceans basins. We will also obtain SNPs data to test this hypothesis with the global samples to provide new information about molecular biodiversity and conservation of blue sharks.

Keywords: Conservation genetics, Molecular markers, Control region.

Dietary interactions determined from fatty acid profiles of sympatric coral reef mesopredators

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Previous research has suggested a degree of dietary overlap in coral reef mesopredators, suggesting functional redundancy among reef sharks and large predatory reef fishes. These findings raise questions about the ecological influence of reef sharks, and about energy flow among high order mesopredators in coral reef ecosystems. Fatty acids (FA) are useful in trophic ecology as dietary biomarkers for transfer of materials. FA analysis is rarely used in coral reef studies, and to our knowledge have never been applied to reef sharks. Dorsal muscle tissue and plasma samples were taken from a selection of sharks and large coral reef fishes including *Triaenodon obesus*, *Carcharhinus amblyrhynchos*, *Lethrinus miniatus*, and *Plectropomus leopardus*. FA profiles of muscle and blood samples were determined through two methods; (1) direct transmethylation and (2) traditional lipid extraction followed by methanolysis to identify more detailed sources of dietary overlap in coral reef mesopredators. Multivariate analysis identified niche separation between some species through significant differences in FA profiles such as docosahexaenoic acid (DHA, $22:6\omega3$), arachidonic acid (ARA, $20:4\omega6$), oleic acid ($18:1\omega9$), stearic acid ($18:0$), and palmitic acid ($16:0$). All mesopredators sampled exhibited high proportions of polyunsaturated fatty acids (PUFA, ie DHA & ARA) (28.62-50.43) linking each species sampled to carnivory, but the differences of specific PUFAs and mono-unsaturated FAs suggest distinctive dietary sources. These results demonstrate that while there is previous evidence of trophic overlap in mesopredators, finer scale inter-specific differences exist in diet between species which should be considered for future study.

Keywords: lipids, fatty acids, reef sharks, mesopredators.

The respiratory basis of metabolic rate in elasmobranchs and other vertebrates

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Metabolic rate is the speed at which organisms assimilate resources from the environment into available energy, allocate this energy to survival, growth, and reproduction, and excrete waste back into the environment. Thus, metabolic rate underpins life histories as it governs the rate of resource uptake and allocation and therefore is linked to survival, growth, and reproduction. Yet, few studies have explicitly explored the relationships between metabolic rate and life history. As metabolic rate is most commonly assessed by measuring oxygen consumption in the laboratory, this methodology often precludes collecting metabolic data for large-bodied, aquatic organisms. Previous work has suggested that metabolic rate and respiratory morphology are linked, and that respiratory morphology, such as the surface area of the lungs or gills, can act as a proxy for metabolic rate. To date, the relationship between metabolic rate and respiratory surface area has not been explicitly explored. Here, we analyze the utility of using respiratory surface area as a measure of metabolic rate using the theoretical framework of the Metabolic Theory of Ecology in a phylogenetic comparative context. We first ask if respiratory surface area is important in explaining the scaling of metabolic rate. Second, we ask if these relationships differ for fishes, particularly the elasmobranchs. We find that respiratory surface area explains significant variation in the scaling of metabolic rate and significantly improves model fit (AICc = 88.2 compared to 95.8). Secondly, we find that the body-mass scaling of metabolic rate and respiratory surface area are indistinguishable from each other. We also find that respiratory surface area is still important in explaining the scaling of metabolic rate in fishes, including elasmobranchs (AICc = 41.9 compared to 45.7). Our results indicate that respiratory surface area could serve as a measure of metabolic rate and provide the opportunity to examine relationships of metabolic rate and life histories.

Keywords: metabolic rate, phylogenetics, respiratory surface area.

Over fifty years of tagging skates: Using mark-recapture data to assess management units for skates (Rajidae) in the northeast Atlantic

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Conventional identification tags have been used to study the movements of fish for over 100 years. Mark-recapture tagging studies have been used to estimate exploitation rates, population abundance, mortality rates, and migration patterns of various fish stocks. Understanding the movement behaviours of fish stocks is important for establishing and monitoring effective spatial management areas. In European waters, advice on the status of fish stocks is provided by the International Council for the Exploration of the Sea (ICES), which assess stock units that may be based on biological stock units or management units that broadly encompass commercial exploitation of the stocks. Here we use 59 years of conventional tagging data held at the Centre for Environment, Fisheries and Aquaculture Science (Cefas) in the UK to assess the current appropriateness of stock management areas for nine commercially exploited skate species. Comparing the spatial information relating to tag releases and returns, it was possible to determine the extent of movement between current management areas. The longest time at liberty was from a thornback ray *Raja clavata* that was returned 6069 days (16.6 years) after tagging from a site 28 km from the original release position. The longest straight line distance travelled was also from a thornback ray, which was recaptured 675 km from the release position during 4.4 years at liberty. Most tags were returned from locations less than 50 km from their release position, which suggests dispersion patterns in most of these skates is limited. There were, however, examples of considerable distances recorded in several species, demonstrating the capacity for some species to undertake long-term, long-distance movements. There appeared to be regular connection from multiple species of skates tagged in northwest Scotland to more southern areas, including the Irish Sea, which indicates that these stocks are less discrete than current management units suggest. These results imply that the dispersion patterns of many European skate species agree with current spatial management units but several gaps in spatial tag coverage should be addressed to improve this. It would also be beneficial to deploy electronic tagging technologies in areas close to boundary areas to fully understand if long distance movements are related to philopatric migrations, stock recruitment or transient excursions.

Keywords: Rajidae, tagging, movement, fisheries management.

The distribution of juvenile stages and eggcases of skates (Rajidae) around the British Isles

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Elasmobranch spawning grounds include the egg laying grounds of oviparous species and parturition grounds of viviparous species. These may serve as 'primary nursery grounds' for the very earliest free-living life history stages (neonates), whilst larger juveniles often range over broader geographic scales ('secondary nursery grounds'). Skates (Rajidae) are important commercial species around the British Isles, yet there is currently limited information to aid the identification of potentially important habitats, such as spawning and nursery grounds. Information on critical nursery ground habitats could be vital for establishing conservation and management strategies that ensure the protection of these early life history stages from over exploitation and habitat loss. Here we use 24 years of fisheries-independent trawl survey data from the Centre for Environment, Fisheries and Aquaculture Science (Cefas) survey series to determine the distribution of nine skate (Rajidae) species across the survey area. Length-frequency data were used to distinguish length cut offs for primary (neonates) and secondary (juvenile) cohorts for each species. Where surveys sample the same stations over time, it was also possible to determine the consistency of the occurrence of "juvenile" skates in these areas. Distributional data on the occurrence of juvenile skates was further supplemented with the distributional data on 90,582 egg case records as collected by the Shark Trust's Great Eggcase Hunt citizen science recording project further helping define potential nursery areas. The juveniles of most skate species were found in the most coastal survey stations, although cuckoo skate (*Leucoraja naevus*) and starry skate (*Amblyraja radiata*) were distributed further offshore in deeper water. Although regular occurrences of neonatal skates were limited across the survey period, most likely due to gear selectivity issues and potentially shallower distributions, there were regular occurrences of larger juvenile skates across the survey area. Furthermore, the proposed nursery areas coincide with eggcase data but suggest that egg laying areas may be more broadly distributed than the occurrence of juvenile skates in surveys. These results allude to the occurrence of several important secondary nursery areas around several parts of the British coastline, which were often associated with large riverine outputs. The Great Eggcase Hunt project is a great example of how citizen science engagement can support broader scientific initiatives in areas where data may be otherwise limited.

Keywords: skate, nursery, eggcases, Citizen Science.

A global perspective on the trophic geography of sharks

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Stable isotope analysis has been a popular tool for marine ecologists for several decades now. Recording the ratios of natural occurring stable isotopes of carbon and nitrogen in the tissues of animals can provide information on trophic and spatial dynamics of individual animals to whole ecosystems. Around the world, there have been many studies using stable isotope analysis to better understand the ecology of chondrichthyan fishes. The Chondrichthyan Stable Isotope Data Project (CSIDP) aims to collate published stable isotope data on sharks, skates and chimaera into a centralised data bank. It is hoped that the resultant dataset can be used as a tool to catalyse collaborations between scientists and support on-going global research initiatives across the scientific community. We will present the results from the first analysis of these data. By tracking the original site of photosynthetic fixation of carbon atoms ultimately assimilated into muscle tissues of 5285 sharks from 110 species, we identified globally consistent biogeographic traits between sharks found in different habitats. We show that populations of shelf-dwelling sharks likely derive a substantial proportion of their carbon from regional pelagic sources, but contain individuals that forage within additional isotopically diverse local food webs. In contrast, oceanic sharks appear to utilise energy and nutrients that have originated from a relatively narrow latitudinal range. We also use this opportunity to invite further collaborations and contributions, and outline some of the next projects we are hoping to address using these data. This will be a great opportunity for interested scientists to learn how they can contribute data to the project and explore potential future collaborative opportunities.

Keywords: Stable Isotope. Carbon. Nitrogen. Chondrichthyan. CSIDP.

Are they ghosts or real? Cutting-edge science to assess the conservation status of smalltooth and largetooth sawfishes in Mexico.

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Reliable information about the distribution and abundance of species is essential for the sound planning of management and conservation. However, obtaining this information for endangered, rare species is challenging. Sawfishes are considered the most endangered group of marine fishes worldwide due to large population declines and range contraction caused by incidental fishing, direct fishing, and habitat destruction. In Mexico, two species were formerly known, the smalltooth sawfish (*Pristis pectinata*) and the largetooth sawfish (*P. pristis*); both are Critically Endangered according to the IUCN Red List. Information gathered during 2015 in the first-ever study for sawfishes in Mexico, indicated that both species were common in the 1960s, declined in the 1990s, and might be nearly or already extirpated from Mexican waters. Our study aims to contribute to the ecological knowledge of both sawfish species in Mexico and evaluate their current conservation status. Environmental DNA or eDNA is a novel technique the allows the detection of species by finding sections of their DNA in samples of water, sediments, ice or air. Since 2016, we have used aerial transects with Unmanned Aerial Vehicles (UAVs or Drones), eDNA, and conventional fishing techniques to assess the conservation status of sawfishes in Mexico. Five field campaigns covering the estuary of Tecolutla in Veracruz, most of the course of the Usumacinta River and the coastal lagoons and estuaries in Tabasco, the coast of Campeche, and all the coastal lagoons and bays in Quintana Roo (all areas where sawfishes were formerly abundant) have been surveyed. Genus-specific mitochondrial cytochrome c oxidase subunit I (COI) primers were used to identify and confirm *Pristis* DNA in water samples. Sawfish DNA has been found at several sample stations in Tecolutla, Veracruz, and the Campeche coast. However, DNA degradation has prevented identification to species level for most sites. Our results show that eDNA is the best, and perhaps only way to determine the presence of sawfishes in very low abundance situations such as we have currently in Mexico. Future plans include surveying the remainder of the former range of smalltooth and largetooth sawfishes in Mexico in order to have sound scientific information about their current distribution and relativa abundance and set the baseline upon which the recovery of their populations can be planned.

Keywords: eDNA, UAVs, low-abundance detection, endangered species.

Changing tides: contrasting spatial dynamics of two sympatric shark species at a remote coral atoll.

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Understanding how animals move around their environment is essential to manage and protect species and ecosystems efficiently. Movements in time and space are triggered by various physical, biological and environmental factors. Animal-borne tags are increasingly been used by scientists to collect data to track animal movements and establish where, and for how long, animals spend their time. Network analysis using acoustic telemetry provides a way to monitor animals and study long-term, fine-scale spatial dynamics of multiple reef shark species. In D'Arros and St Joseph Atoll in the Amirantes (Seychelles), Sicklefin lemon sharks (*Negaprion acutidens*) share their activity space with the smaller Blacktip reef sharks (*Carcharhinus melanopterus*). Our study aims to understand how these two species co-occur at this location without one outcompeting the oth-er. With these objectives in mind, 91 sharks were tracked between 2012 and 2017 using passive acoustic tags (Vemco, Ltd) and an array of over 80 acoustic receivers. The analysis considered factors such as tidal height, sex and size. We present findings of sexual segregation in both species and evidence of the tidal cycle as a driver of activity space use within the atoll. The Indian Ocean is currently data deficient in many areas of elasmobranch research and the work carried out here contributes to filling in these gaps. While the studied atoll is currently protected by a Marine Protected Area, understanding reef sharks' movement ecology here provides us with a model that can, in turn, be used to advise on management and conservation in similar locations in the Indian Ocean and tropical reef ecosystems globally.

Keywords: sicklefin lemon sharks, blacktip reef sharks, movement ecology, network analysis, passive acoustic monitoring.

Habitat use, seasonality and demography of an apex predator in a marine temperate environment: the case of the sevengill shark *Notorynchus cepedianus* in northern Patagonia

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Understanding patterns of habitat use and seasonal dynamics of marine species, and gaining insight on how they relate with the environment and other members of the community is critical for their management. This study investigates the habitat use, seasonal patterns of abundance and population structure of the broadnose sevengill shark, *Notorynchus cepedianus*, in a marine temperate environment of a northern Patagonian bay (Argentina). A suit of baited remote underwater video stations (BRUVS) derived and catch-and-effort data indices were constructed to estimate the seasonal abundance of the species inside the bay. Reproductive hormone levels were used to determine reproductive status and maturity stages of the population. Results indicated that *N. cepedianus* uses the bay year-round, with a peak of abundance during the spring season when the species aggregates. This peak of abundance coincides with the presence of mature adults, a high frequency of regurgitation of pieces of southern elephant seal (*Mirounga leonina*), and the presence of mating scars on large females suggesting that sevengill sharks aggregate in Caleta Valdés with feeding and mating purposes. In this time of the year, elephant seals arrive to Valdés peninsula to breed and moult, and by late spring pups get into the sea for the first time and hence are vulnerable to predation by sharks. Male and female sizes at maturity occurred at 170 and 190 cm of total length respectively. Conversely to other studies in the Southwest Atlantic, population composition remained similar throughout the seasons with adult individuals dominating over juveniles and adult females prevailing in the population at all times. All recaptures (~7%) occurred inside the bay suggesting both long- and short-term site fidelity in the timescale covered by the study (i.e. between field trips, and seasons). Considering the historical abundance decline recently reported for the species, protection and enforcement within protected areas across the Southwest Atlantic must remain as high priority action in government initiatives.

Keywords: BRUVS, reproductive hormones, seasonal occurrence, Caleta Valdés, Southwest Atlantic.

Biology of the elephantfish (*Callorhinchus callorynchus*) in the coast of Chubut province and adjacent waters of Argentina, Southwest Atlantic.

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Of the species of holocephalans in the Southwest Atlantic, the elephantfish *Callorhinchus callorynchus* (Linnaeus, 1758) is the most important species in the landings of the commercial fleets that operate in different ports of Argentina. Moreover, the elephantfish is a target species in the recreational fishing that takes place in the Patagonian coastline between spring and summer (between 40°S and 48°S). From the monitoring of the coastal recreational fishing and the commercial fleets, samplings of catches of both fisheries were carried out to obtain biological information of the elephantfish. In the recreational fishing 1500 specimens were sampled of which 78% were juveniles. The body length was considered from the tip of the snout to the origin of the upper caudal lobe; this length ranged from 90 mm to 680 mm with an average of 328.6 mm. Six hundred specimens were sampled from the commercial fishery and 60% were juveniles. The length range were from 90.0 mm and 690.0 mm and the mean length was 362.0 mm. The body length is considered from the tip of the snout (flattened) to the origin of the upper caudal lobe (LPa-PC). The size at first maturity (L50) in males was 379.19 mm and in females was 419.18 mm. The females have spermatophores in their cloaca between the months of November and April; while the presence of egg capsules in the uterus was observed between October and April. Of the total egg capsules recorded in the seabed, 92.4% were layed in depths between 20 and 50 meters. Between the months of October and April the adults congregate in the coastal areas of Bahía Engaño and San Jorge gulf for mating and egg-laying. The egg-laying period is not in a specifical time and occurs continuously over year. So far the data obtained would indicate that this reproductive event would take place for at least six months and the coastal areas of the Chubut province in Patagonia function as mating, egg-laying and breeding areas for neonates and juveniles.

Keywords: breeding areas, recreational fishing, neonate, egg capsules.

Poleward shift in the migratory pattern of the western Atlantic blacktip shark, *Carcharhinus limbatus*

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Migration occurs across all animal taxa from lower invertebrates to mammals. The commonality between all migratory species is some motivational driver that affects their movement. Sharks follow narrow ranges of environmental parameters when migrating over large distances. Blacktip sharks, *Carcharhinus limbatus*, migrate south from their summer mating grounds in Georgia and the Carolinas when water temperatures drop below 21°C. They overwinter off the coast of southeastern Florida in dense aggregations when sea surface temperatures are below 25°C. At the same time as the vernal equinox, they depart from this region and head north again toward Georgia and the Carolinas. Only rare strays travel north of Cape Hatteras, NC, a boundary that was described over seventy years ago. Since that time, sea surface temperatures have increased 0.85°C. Many marine species have shifted poleward as oceans have warmed globally. The overarching goals of this research are to assess whether shifts in the migratory pattern of the blacktip shark in the western Atlantic have occurred and if these changes are due to global climate change. Blacktip sharks were passively tracked using acoustic telemetry. Preliminary acoustic telemetry data suggest poleward shifts in the migratory pattern of the blacktip shark. If poleward migratory shifts occur, the seasonal influx of top level predators, like the blacktip shark, into increasingly higher latitudes may cause cascading effects through the trophic levels of ecologically and economically important species. This research will inform stock assessment of the breadth of migratory range exhibited by the blacktip shark in the western Atlantic. Additionally, the results will be an indicator of the resilience of a top marine predator in a rapidly changing system.

Keywords: migration, climate change, acoustic telemetry.

Weight-of-evidence framework for assessing shark stocks in Western Australia

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Sharks are generally taken in multispecies fisheries worldwide but, in most cases, it is logistically infeasible and cost prohibitive to assess the impact on all the species caught. 'Indicator' species can therefore be used to assess the risk to sustainability of all 'like' species susceptible to capture. Risks of fishing impacts to the sustainability of the indicator species can then be determined within a weight-of-evidence framework that takes in consideration all lines of evidence, from simple catch series to biomass-trend predictions from complex integrated population dynamics models. This paper exemplifies this approach using sharks taken in Western Australia (WA) as a case study. Gummy (*Mustelus antarcticus*), whiskery (*Furgaleus macki*), dusky (*Carcharhinus obscurus*), and sandbar (*C. plumbeus*) sharks are the main shark species taken in WA (~80% of the catch) and had been selected as 'indicator' species as they represent the range of life history strategies of the other shark species caught in WA. Available lines of evidence include temporal and spatial trends in fishing effort and catch, temporal trends in standardised catch rates and size composition, biological vulnerability, and reconstructed trends in stock biomass. Based on these lines of evidence, the current (2015-16) risk level for whiskery, dusky and sandbar sharks was medium –i.e. it was unlikely (5-20% chance) that there is a high level of stock depletion–whereas the current risk level for gummy sharks was low–i.e. it was likely (87% chance) that there is a minor level of stock depletion. The current status of the four indicator species is therefore acceptable.

Keywords: integrated model, stock assessment, movement, population dynamics.

Dusky sharks undertake large-scale migrations between tropical and temperate ecosystems

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Understanding the large-scale migrations of marine predators can allow better representation of their population dynamics. The migration biology of dusky sharks (*Carcharhinus obscurus*), a cosmopolitan large marine predator with very low resilience to fishing, was quantified using a large-scale network of acoustic receivers deployed across Western Australia. Time-series plotting of individual shark detections and modified logistic modelling were used to determine the timing of acoustically-tagged sharks' seasonal migration, the proportion of the population migrating and the size at which sharks start to migrate. Large (>200 cm fork length) dusky sharks migrated between areas closed (north) and open (south) to commercial shark fishing. There was limited evidence that smaller sharks occurred in the northern study area, whereas several larger individuals of both sexes undertook repeated north–south displacements, moving between disparate ecosystems within the Indian Ocean (21.7–35.4 °S) and covering round-trip distances of 2,000–3,000 km per migratory event. For migrating individuals, the probability of occurring in the north was high in the austral winter/spring and low (males) to moderate (females) during the austral summer/autumn.

Keywords: ontogenetic shift, acoustic tagging, reproduction, migration.

Incidental and intentional capture of manta rays in Brazil

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Manta rays (Mobulidae) are currently listed as Vulnerable to extinction on the Red List of Threatened Species by the International Union for the Conservation of Nature (IUCN). They are highly susceptible to overexploitation, mainly due to their biological characteristics as late maturity, low fecundity, long gestation and slow growth. In Brazil, manta rays are protected by law since 13th March 2013, which prohibits directed fishing, retention on board, transhipment, landing, storage, transport and commercialization of products or sub-products in Brazilian Jurisdictional Waters and in all national territory. However, despite the prohibition, incidental and intentional catch still occurs. Moreover, it is not uncommon to observe individuals of manta rays dragging fishing artefacts or bearing injuries like severed body parts and scars that were clearly caused by fishing gear. The aim of this study was to gather information to elucidate potential risks manta rays have been susceptible in Brazilian waters despite being protected by law. We analysed many fonts in search of records of manta ray fishing, bycatch by artisanal fishing and entanglement with fishing gear. Our sources included peer-reviewed scientific literature, newspapers, video and photographic records available online and the Brazilian Manta Ray database, an imagery bank maintained by the Project Mantas do Brasil. We considered reports from 2001 to 2017. Most years contained 1 or 2 isolated cases. The largest number of reports were in 2007, 2015 and 2016 (8, 10 and 7 records respectively). Across the 41 instances of entanglement and injury caused by fishing gear, 41% occurred in the state of São Paulo, 12% in Espírito Santos, Bahia and Rio de Janeiro, and the remaining occurrences corresponding to the states of Santa Catarina, Rio Grande do Norte, Ceará and Pernambuco. It is concerning that in some states (Espírito Santos and Bahia), all records of manta rays were individuals either killed by fishermen, with body scars or dragging fishing artefacts. This is probably the most dangerous threat for the species. The animal may suffer body cuts, or even have parts of the body amputated. Depending on the type and size of the fishing gear they are dragging it can hinder ray's swimming and feeding abilities, limiting breathing capacity and ultimately leading the individual to death. Even being protected, 27 of 41 (66%) considered records occurred after the creation of the law that protect manta rays in Brazil.

Keywords: entanglement, illegal fishing, manta ray, Brazil.

The fishing and illegal trade of the angel shark: DNA Barcoding against misleading identifications

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Morphological identification in the field can be extremely difficult considering fragmentation of species for trade or high similarity between congeneric species. In this context, the shark group belonging to the genus *Squatina* is composed of three species distributed in the southern part of the western Atlantic. These three species are classified in the IUCN Red List as endangered, and they are currently protected under Brazilian law, which prohibits fishing and trade. Molecular genetic tools are now used for practical taxonomic identification, particularly in cases where morphological observation is prevented, such as that which occurs during fish processing. Consequently, DNA barcoding was used in the present study to track potential crimes against the landing and trade of endangered species along the São Paulo coastline, being characterized the angel sharks *Squatina guggenheim* (n=75) and *S. occulta* (n=5), as well as the Brazilian guitarfish *Pseudobatos horkelii* (n=5). Thus, DNA barcoding revealed the continuous fishing and trafficking of these protected species, clearly indicating that the current conservation models and methods of monitoring are not working.

Keywords: conservation, endangered species, fishing monitoring, forensic genetics, mislabeling identification.

An all-inclusive Smart Tag combines active tracking, biologging, and animal motion sensors to observe the fine-scale, short-term behavior and habitat use of juvenile white sharks

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The Southern California Bight is a known nursery area for juvenile white sharks (*Carcharodon carcharias*). While juveniles have been consistently spotted at the same hotspots for weeks, how these sharks use the nearshore beach habitat is not yet understood. Passive acoustic telemetry has provided a foundation of presence/absence data, but fine-scale movement data and associated environmental data are limited. Our lab developed a "Smart Tag" equipped with an inertial measurement unit data logger (with a 3D accelerometer, 3D gyroscope, and 3D magnetometer logging every second), a continuous V13 63 kHz pinger (pulsing every 1-3s) and a video logger. In May 2017, we deployed the Smart Tag on three juvenile white sharks off Belmont Shore in southern California to acquire higher resolution behavioral data. Two individuals remained in Belmont Shore for the duration of the track and remained at shallow depths (3.17 ± 2.25 m and 1.31 ± 1.32 m, respectively), at consistently warm temperatures (18.39 ± 0.49°C and 18.73 ± 0.40°C) and had similar tail beat frequencies (44.5 ± 6.56 beats/min and 40.17 ± 4.66 beats/min). Both sharks exhibited a novel circling behavior at both sunrise and sunset, in shallow (<1 m) and deeper depths (~5 m), and in clockwise and counter-clockwise directions. The third shark left this hotspot area and traveled 57 km in 24hr before taking up residency at another hotspot nursery area. During transit, this shark made repeated dives (to a max depth of 40 m, with a mean of 4.86 ± 6.38 m) and experienced cooler temperatures (as low as 11°C, with a mean of 16.47 ± 1.23°C) but showed a similar tail beat frequency to the other two sharks (45.38 ± 4.70 beats/min). It is still unclear why sharks are using these nursery beach habitats and why they move between them. Additional tracks in the coming year will allow us to build a larger dataset to help understand the nearshore behavior and habitat use of juvenile white sharks.

Keywords: juvenile white shark, acoustic telemetry, inertial measurement unit, biologging.

An interdisciplinary rapid assessment framework to study elasmobranch biodiversity, occurrence, exploitation and bycatch in coral reef small-scale fisheries

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Many elasmobranch populations are declining around the world, but conservation and management in some countries is hindered by a lack of data on the status of populations and the distribution and severity of fisheries and other anthropogenic threats. Globally, more than 95% of fishers are artisanal and the potential impact on elasmobranch populations is high, but the effects of global small-scale fisheries on elasmobranchs is poorly known. To fill this data gap, we used a simple and easily replicable rapid assessment framework to study elasmobranch biodiversity, occurrence, and exploitation in small-scale fisheries of coral reefs by conducting fishery-dependent interviews and collecting fishery-independent data via Baited Remote Underwater Video surveys (BRUVs). We conducted in-person structured interview surveys (n=200) during the fall of 2016 at eight main fishing towns around Cartagena and the Natural National Park (NPP) Islas del Rosario y San Bernardo (Colombia). We also deployed BRUVs along four different reefs (n=50/reef) in the NPP. The BRUVs recorded three sharks species (*Ginglymostoma cirratum*, *Carcharhinus perezi* and *Negaprion brevirostris*) and two ray species (*Dasyatis americana* and *Urobatis jamaicensis*). However, this only represents a subset of the total elasmobranch species fishers identified during the interviews as part of their catch. This is due to artisanal fishers exploiting more oceanic areas than those sampled with the BRUVs. Shark presence or absence on the 200 BRUVs deployed at Isla Tesoro and Mangle (both protected from artisanal fisheries) and Isla Grande and Tintipan (both allow artisanal fisheries) showed that the factor marine reserve was positively correlated with shark and ray presence, while human density was negatively correlated. Using a Productivity-Susceptibility Analysis on the most common gears (handlines and beach seines) reported, we found that bull sharks (*C. leucas*) were at risk from artisanal fisheries in the area sampled. Two hammerhead species (*S. lewini* and *S. mokarran*) and the ray *A. narinari* were also found to be at risk from artisanal exploitation in the Natural Park System. Using BRUVs and fisher surveys allowed us to assess the biodiversity and occurrence of local coastal elasmobranch species, as well as identifying the species that are being exploited and are of particular socioeconomic importance to artisanal fishers. Therefore, the addition of interview surveys provided an important and inexpensive tool to complement fisheries-independent research methods.

Keywords: caribbean, artisanal,small-scale, fisheries, BRUVs, Colombia, coral reef.

The neural basis of olfactory sensitivity in elasmobranchs compared to teleosts

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The olfactory system of elasmobranchs remains understudied compared to other sensory systems, although olfaction plays a vital role in the natural history of this group. The size (volume or mass) of the olfactory bulbs in relation to the whole brain is currently used as a neuroanatomical proxy for olfactory ability in a range of vertebrates, including elasmobranchs. Sharks are generally understood to have acute olfactory abilities compared to other fishes despite significant interspecific variation in the relative size of their olfactory bulbs. Although there is evidence to support that the size of a sensory brain area reflects its relative importance, the olfactory inputs to the brain have not yet been quantified in any species of fish. Here, we present a comprehensive study of the ascending olfactory pathway of the brownbanded bamboo shark (*Chiloscyllium punctatum*) and the common goldfish (*Carassius auratus*) using bioimaging, electron microscopy and immunohistochemistry. The surface area of the olfactory epithelia, the volume of the olfactory bulbs, the telencephalon and the whole brain, as well as the length and diameter of the olfactory nerves and tracts were assessed using diffusible iodine-based contrast-enhanced computed tomography (diceCT). Primary and secondary olfactory neurons (axons) were quantified using transmission electron microscopy to estimate the level of convergence (ratio) between the afferent inputs to the olfactory bulb (within the olfactory nerves) and the inputs to the telencephalon (within the olfactory tracts). Quantitative comparisons were made between the number of olfactory inputs and the volume of the olfactory bulbs in the two species to provide an anatomical proxy for olfactory sensitivity. We found that the bamboo shark has a relatively larger olfactory bulb than the goldfish, with a relatively higher convergence ratio of olfactory input to the telencephalon. This suggests that the bamboo shark may possess a higher sensitivity to water-borne odours than the goldfish, based on the number of inputs. Other parameters such as the volume of the olfactory cavities, the morphology of the olfactory rosettes and the olfactory lamellae, the immunohistochemical characterisation of olfactory receptor neurons (ORNs), as well as the axon diameter and myelination patterns of the primary and secondary olfactory axons are also examined with respect to anatomical indicators of olfactory sensitivity. This neuroanatomical comparison between elasmobranch and teleost model species is fundamental to improving our understanding of the evolution of the olfactory system in early vertebrates and the neural basis of olfactory abilities in sharks.

Keywords: comparative neuroanatomy, olfaction, electron microscopy, immunohistochemistry, diceCT.

When shark science meets shark conservation - K.I.S.S. (Keep It Simple, Scientists)

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Academic research into shark and ray populations is an extremely broad field with countless methods for acquiring and analysing numerous data fields. Well understood methodologies such as various tagging techniques, underwater video projects, DNA analysis and stock assessments can provide high-quality information on a wide variety of shark and ray characteristics and behaviours. For many coastal states with developing economies, there is a fundamental lack of even the most basic information on sharks and rays, with the problems exacerbated for species associated with coastal fisheries. This lack of information hinders the development of appropriate sustainable management plans, and a disconnect between common research techniques and research needs in countries such as Pacific Island states often contribute towards the production of inappropriate conservation and management measures. WWF is currently developing a Rapid Assessment Toolkit for sharks, which will produce a compendium of common data acquisition techniques to be used by fisheries management agencies to develop conservation measures tailor-made for that country. This presentation outlines how to align shark and ray research with a countries; specific conservation and management needs.

Keywords: conservation, fisheries management, NPOA, research techniques.

Preliminary evaluation of Cu, Cd and Pb in elasmobranchs captured by industrial fleet from Itajaí and Navegantes (Santa Catarina State, Brazil) and its influence on human health.

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Trace metals in the water environments can originate from natural sources or through anthropic activities, have high chemical reactivity, resulting in biomagnification and bioaccumulation. Thus, organisms that are at the top of the trophic chain and have a long life, such as elasmobranchs, tend to have high concentrations. The quality control of these organisms for human consumption is regulated by ANVISA, through Resolution N°. 42 (08/29/2013) which defines maximum levels of inorganic contaminants in food. The aim of this work was to evaluate concentrations of Cu (essential); Cd and Pb (not essential) on elasmobranchs (*Prionace glauca*, *Sphyrna lewini*, *Isurus oxyrinchus*, *Rioraja agassizii* and *Atlantoraja cyclophora*) and the influence of their consumption on human health. Samples were collected by field team and scientific observers from Centro Nacional de Pesquisa e Conservação da Biodiversidade Marinha do Sudeste e Sul (Cepsul – ICMBio), during 2017. Samples were processed, weighed, stored and frozen for chemical determinations. Muscle samples were dried at 65°C until steady weight, followed by hot acid digestion (HNO3:H2O2 - 5:1 v/v) at 120°C for 2 hours, left overnight, and finalized until completely dry. Metal determination was performed with AAS Perkin-Elmer, model 3110. All samples were processed in triplicates, with a maximun of 0.05 standard error. Among the evaluated species, *S. lewini* showed the lowest concentration for all metals, being the only species with values below the limit determined by legislation. For this species, Pb presented mean values of 0.065 ± 0.038 mg.g-1, while for *A. cyclophora* it was 1.13 ± 0.22 mg.g-1, which is 3.8 times above the legislation limit. For Cd, *S.lewini* showed mean concentration of 0.044 ± 0.0037 mg.g-1 while *A. cyclophora* showed the highest concentration for this metal, with 0.36 ± 0.19 mg.g-1. For Cu, all samples from all species evaluated showed concentrations lower than the legislation limit, with minimum of 0.072 ± 0.017 mg.g-1 in P. glauca and maximum of 0.53 ± 0.19 mg.g-1 in *A. cyclophora*. Considering the presence of Pb and Cd in values above the maximum limits defined in the legislation and in addition to the fact that these species are widely marketed, a concern is evidenced regarding the real impact on human health. Although these results are preliminary, a more comprehensive monitoring becomes essential for the validation of the quality of these organisms for human consumption.

Keywords: human consumption, trace metal, elasmobranch, muscle.

Rays of Arvoredo Marine Biological Reserve, southern of Brazil: seasonal and spatial patterns distribution

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Rays are important marine ecosystems elements, however, their population dynamics are poorly known on the Southwest Atlantic coast. The Arvoredo Marine Biological Reserve is an integral protection area in the south of Brazil which many species of rays use as a reproductive and nursery area. Inside the Arvoredo Reserve, tourism and fishing are not allowed (no-take zone), but the Southern portion of Arvoredo Island, which is not formally part of the Reserve, recreational diving is allowed. The data were obtained via an online questionnaire (https://goo.gl/h1Ji1S) answered by certified divers and scientists that was available since August 2016. The records date from March 2009 to February 2018. Six different taxons of rays were identified: *Gymnura altavela* (n=23), Dasyatidae (n=30), *Aetobatus narinari* (n=8), *Narcine brasiliensis* (n=3), *Zapteryx brevirostris* (n=2) and *Pseudobatos* sp. (n=5). Dasyatidae and *G. altavela* were significantly more sighted than the other four recorded taxons. *G. altavela* had more sightings during high tourist season (November to March). Rays are more likely to be found in sandy than rocky environments and ecotone. It is also easier to found them resting rather than swimming. During the high season, *G. altavela* and *A. narinari* occurred more frequently than Dasyatidae, while during the low season (April to October) Dasyatidae had more sightings. This study represents the first step towards the knowledge of the spatial and seasonal distribution of the rays in Arvoredo Marine Biological Reserve, in order to assist more robust researches on conservation of these animals.

Keywords: citizen science, marine protected area, marine ecology, conservation, elasmobranch.

International Sawfish Day- Collaborating for Conservation

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The first International Sawfish Day, dedicated to increasing awareness of sawfish, was held on October 17, 2017. This annual event was established through collaboration of the Sawfish Studbook and Species Survival Plans of the European and American Associations of Zoos and Aquariums, and through partnership with the Sawfish Conservation Society (SCS). More than 50 participating organizations from around the world including public aquaria, conservation agencies and research facilities held celebrations and events, shared messages and images on social media, and otherwise spread the word about these amazing animals. Social media posts and interactive events at public aquaria and zoos reached hundreds of thousands of people in the days leading up to, including, and following International Sawfish Day. Fundraising efforts by The Deep, SCS and others contributed to sawfish field programs in the Sudan. In addition to the awareness generated for sawfish this program helped to strengthen the collaborative relationships between the public aquarium community and research and field conservation organizations. Plans have already begun for next year's event and this momentum will be carried forth in future years solidifying efforts to strengthen both in situ and ex situ conservation and research efforts, with the intent that along with increased awareness about sawfish, these actions will generate additional funding in the future for important sawfish conservation and research projects.

Can the status of pelagic shark populations be determined using simple fishery indicators?

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Calls to develop alternative methods of assessing the population status of pelagic shark populations have increased substantially in recent years. An interim solution has been the development of more subjective evaluation of data series (indicator-based analysis) rather than predictions from complex stock assessment models. This study determines the probability with which analysts can correctly assign the population status (i.e. whether it has been overfished) and the fishing pressure (i.e. whether overfishing is occurring) based on these fishery indicator trends alone. We simulate a variety of large pelagic shark populations under different exploitation scenarios using life history parameters, and measurable fishery indicators information (catch-per-unit of effort - CPUE; and average length - AL). Our simulation results showed that the reliability of fishery indicators for establishing population status is strongly dependent upon the length of the time series analyzed and likely unreliable for when the available data series are temporally short. These caveats are critical to the proper evaluation of population trajectories that underlie the most important conservation decisions being made for sharks today.

Keywords: simulation, indicator-based analysis, population status, reliability.

JABBA: a new web-based tool developed to assess the population status of pelagic sharks

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This study presents a new, open-source modeling software entitled 'Just Another Bayesian Biomass Assessment' (JABBA). JABBA can be used for biomass dynamic stock assessment applications for sharks and rays, and has emerged from the development of a Bayesian State-Space Surplus Production Model framework, already applied in stock assessments of pelagic sharks around the world. JABBA presents a stable, flexible framework for biomass dynamic modeling, runs quickly and generates reproducible stock status estimates and diagnostic tools. Specific emphasis has been placed on allowing the user to specify alternative scenarios of varied model complexity, achieving high stability and rapid convergence rates. Default JABBA features include: 1) an integrated state-space tool for aver-aging and automatically fitting multiple abundance (i.e. CPUE) time series; 2) data-weighting through estimation of additional observation variance for individual or grouped CPUE; 3) selection of Fox, Schaefer, or Pella-Tomlinson production functions; 4) options to fix or estimate process and observation variance components; 5) model diagnostic tools; 6) future projections for alternative catch regimes; and 7) a suite of inbuilt graphics illustrating model fit diagnostics and stock status results. As a case study, JABBA is applied to the ICCAT 2017 assessment input data for Atlantic shortfin mako shark. We envision that JABBA will become a widely used, open-source stock assessment tool for sharks and rays, readily improved and modified by the global scientific community.

Keywords: JABBA, stock assessment, software, pelagic sharks.

What lies beneath? Estimating historical elasmobranch catch composition from low resolution data

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Detailed catch data are requisite to effective fisheries management. The taxonomic resolution of catch data is highest for targeted and high value species while relatively low value bycatch is rarely identified to species. Sharks and rays (subclass Elasmobranchii) have suffered from a catch data deficiency problem that has impeded study of their exploitation patterns and threat statuses. This research sought to elucidate historical elasmobranch catches for the Mediterranean and Black Seas, where over half the shark and ray species are threatened with extinction but data deficiency and ambiguity consistently limit conservation action. Using reconstructed catch data from the Sea Around Us database, we modelled the correlates of species-specific catch records and used the relationships to predict the species composition of currently aggregated higher taxonomic categories of catch (e.g., catches at the family level such as "Triakidae"). This analysis newly disaggregated a half million tonnes of shark and ray catches to species from higher taxonomic ranks while revealing catch time series of 34 species across 25 exclusive economic zone, 8 gear types, and 65 years. The catch data presented here have the finest taxonomic resolution of elasmobranch fisheries so far for the Mediterranean and Blacks Seas. However, these catches should not be considered a complete report of elasmobranch exploitation in the region, due to limited species-specific model input data and constraints within the disaggregation algorithm. Ambiguous catch statistics represent a lost opportunity for an otherwise critical source of abundance time series, particularly in areas and for species lacking fisheries-independent surveys.

Keywords: data deficiency, fisheries, Mediterranean and Black Seas.

Estimates of the tourist carrying capacity of whale sharks *(Rhincodon typus)* in the Bay of La Paz, B.C.S. Mexico

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At the Bay of La Paz, Mexico a high number of juvenile whale sharks (*Rhincodon typus*) aggregate to feed predictably and for long periods of time. Thanks to this, tourism activities with the species have been carried out for 30 years at the region, where there is a management plan for the swimming activity with them since 2006. However, the analysis of fresh injuries carried out from 2009 to 2016 shows that each year between 35% and 62% of sharks are hurt by boats. This problem, added to an increase in demand for tourist activities, has generated the need to take management measures that comply with the precautionary principle and reduce the pressure on the species, but maintaining the tourist satisfaction level. Therefore, a numerical model was implemented for the calculation of Tourist Carrying Capacity (TCC) that takes into account the current criteria on the species and tourist activity in the area. The correction factors taken into account included: the time it takes to carry out the activity, the number of sharks in the area, the average number of windy days that prevent the activity, and the management capacity in the area, which includes patrolling and the index of injured sharks. 73 trips were made between 2015 and 2016, in which 116 boats were identified carrying out the tourism activity with the shark. The purpose of the trips was to verify if tourists' providers were authorized (57%) or not (43%) to carry out the activity, as well as to check if they complied the management plan rules. For this study the abundance was defined through the average number of photo-identified sharks per month using historical data from 2007 to 2016 and the calculation of TCC was carried out monthly because shark numbers vary throughout the season; presenting a high peak in December with a range from 8 to 53 photo-identified sharks and an average of 31 sharks. Data shows a range from 18 to 31 boats at the same time; because of this, it's necessary that the monitoring and CCT go hand in hand, monthly. A reduction of the tourist activity was suggested from October to April, which are the months that present a greater abundance of individuals. Throughout this work it will be discussed how in management it's necessary to take into account both the sharks seasonality and abundance, as well as the conservation challenges that this entails.

Keywords: Whale shark, management, conservation.

Effect of Deepwater Horizon Crude Oil on Electroreception of *Hypanus sabinus*

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Elasmobranchs are renowned for their extremely sensitive electrosensory system, which allows them to detect electric fields of <5nV cm-1 in seawater. Their electrosensory system is used for prey detection, mate detection, predator detection and, possibly, for navigation. The objective of this study was to test whether crude oil impacts the electroreceptive sensitivity of elasmobranch fishes. Electrosensory sensitivity was quantified from six Atlantic stingrays, Hypanus sabinus, before and after exposure to a concentration of oil that mimicked empirically measured concentrations along the coast following the Deepwater Horizon spill. Orientation distance (cm), and angle with respect to a prey-simulating electric field were used to derive the electric field intensity that elicited a response. Oil exposed stingrays continued to exhibit feeding behavior, but a repeated measures ANOVA revealed that they initiated orientations to prey-simulating electric fields from a significantly closer orientation distance. The mean orientation distance after oil exposure was 5.29 ± 1.00 cm compared to a pre-exposure orientation distance of 7.16 ± 1.63 cm. Stingrays thus required a mean electric field intensity of 0.596 ± 0.506 µV cm-1 to initiate a response after oil exposure, compared to a mean of only 0.127 ± 0.063 µV cm-1 in prestine water. Oil exposed stingrays thus required a stimulus approximately 4.7 times greater than controls to elicit a response. As a result, stingrays impacted by an oil spill will experience reduced electrosensory sensitivity, which would detrimentally impact fitness. This study is the first to quantify the effects of crude oil on electrosensory sensitivity of marine predators.

Keywords: electroreception, sensory, stingray, crude oil, Deepwater Horizon.

Understanding the impacts of longline fisheries on marine megafauna in a UNESCO World Heritage site, the Galapagos Marine Reserve

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Commercial fishery was banned in the Galapagos when it became a marine reserve in 1998. Since then, artisanal fishery is allowed although with inefficient management and several target species have had severe depletions. In an attempt to relocate the intensive fishery on coastal-demersal species, four longline fishery 'pilot' projects targeting pelagic species have been allowed since 1997. Such projects resulted in high bycatch of marine megafauna (50-77%), yet they keep occurring within the Galapagos Marine Reserve (GMR) without studies addressing their impact on key protected species. In order to understand the dynamics of the longline fishery of the Galapagos and its impact on the megafauna, we analyzed the data of the pilot project of 2012-2013 to describe the species composition, quantify the catch and bycatch and identify variables affecting the composition and quantity of bycatch. Twelve vessels released 2-19 sets of longline with 60-200 hooks per trip, with 115 sets and a total of 42,007 hooks, in 312 days of fishery. A total of 4893 animals from 29 identified species were caught. According to the official definitions arbitrarily decided and modified throughout the pilot project, 91% were considered targeted species and 9% that only included species of conservation concern were considered as bycatch. From the target species, *Thunnus albacares* was the most commonly caught (79%) followed by *Lepidocybium flavobrunneum* (15%). Of the 9% bycatch, 94% belonged to 13 elasmobrach species that included iconic animals for the GMR such as *Sphyrna lewini*, *Carcharhinus galapagensis*, *Mobula birostris*, and *Carcharhinus limbatus*. Other important species caught as bycatch were 3% to *Chelonia mydas*, and 2% to *Arctocephalus galapagoensis*. We used generalized linear mixed models (GLMMs) to investigate the effect of various predictor variables on bycatch rate (bioregion, month, bait, and distance to the isobaths of 1000 m and 500 m). Model selection suggested the best model with month as only covariate (predictor). However, pairwise comparison of each month showed no significant difference. No recommendations can be given at this point for reducing bycatch of endangered species in the GMR. In an archipelago whose main economy relies on wildlife marine tourism, the implementation of extracting activities that impact key megafuna such as longline fishery should not be permitted to ensure this iconic marine reserve and UNESCO world heritage site stays as pristine as it is known to be.

Key-words: Bycatch, Galapagos islands, artisanal fishery, sharks, mantas.

Structure of the parasitic community of cestodes from *Potamotrygon* in upper Paraná basin.

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The Potamotrygonidae family has a diverse parasitic fauna originated from marine and freshwater elasmobranchs. In the present study we describe the structure of the community of parasites belonging to the class Cestoda and its parasitic parameters in two species of the genus *Potamotrygon* from the upper Paraná basin. The hosts were collected in the municipality of Ilha Solteira, SP (*Potamotrygon amandae*, n = 38) and Castilho, SP (*P. amandae*, n = 7 and *P. falkneri* n = 33) between 2015 and 2017. After capture, specimens were anesthetized and then euthanized with saturated benzocaine solution (SIS-BIO 50019-3). The spiral valves were longitudinally opened and fixed in 10% formaldehyde at 60°C, then transferred to 70% ethanol. The parasites were stained with Delafield Hematoxylin, diaphanized in Methyl Salicylate and mounted with Canada Balsam. To evaluate the influence of host sex on parasite abundance, the non-parametric Mann-Whitney U test was used. Four species of cestode were observed (*Acanthobothrium quinonesi*, *Potamotrygonocestus* sp. nov., *Rhinebothrium paratrygoni* and *Rhinebothroides glandularis*). Seven parasitized hosts were observed in Ilha Solteira and 29 in Castilho, with parasite amplitude of 0-53. There was no difference in number of males and females parasitized, however, females showed higher rates of abundance in all species of parasites and only for *Potamotrygonocestus* sp. nov. the influence of sex was statistically significant (p = 0.03). *Potamotrygon falkneri* presented the highest parasite numbers in all parasite taxa: *A. quinonesi* (prevalence of 51%, abundance 1.36 ± 0.05, intensity 2.64 ± 0.10); *R. paratrygon* (prevalence of 75%, abundance 7.30 ± 0.31, intensity 9.64 ± 0.41); *Potamotrygonocestus* sp. nov. (prevalence of 42%, abundance 0.54 ± 0.02, intensity 1.28 ± 0.05) and *R. glandularis* (prevalence of 24%, abundance 0.36 ± 0.02, intensity 1.50 ± 0.09), *Acanthobothrium quinonesi* and *R. paratrygoni* they were not found in Ilha Solteira. In this way, it can be inferred that the parasite communities have different structures in the two evaluated sites. About of the incipient state of the information on the ecology of parasites of the potamotrygonids from the upper Paraná drainage, our data show the except for *Potamotrygonocestus*, in which the registered taxon corresponds to a new species, the other cestodes diagnosed in this study were previously registered or described in potamotrygonids of other South American drainages (e.g. Amazon and Paraguay basin).This study demonstrates and corroborates that the dispersion of these parasites accompanied the recent colonization of the genus *Potamotrygon* in upper Paraná basin.

Keywords: Freshwater Stingray, helminth, ecology, Potamotrygonidae, adaptive dispersion.

Chromatic variation in *Potamotrygon amandae* pups: a true fruit salad of colors in freshwater stingrays from upper Paraná basin

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The chromatic variation in stingrays of the genus *Potamotrygon* is clearly observed in several species. Historically, evidenced by taxonomic works, the different phenotypes, in the majority, were investigated in adults semaphoronts, being little approached in other observation planes. In this study, we aimed to quantify and describe a chromatic variation in 31 pups of *Potamotrygon amandae*, collected during a breeding season from 2017-2018, in the Upper Paraná River. Five dorsal disc staining patterns were diagnosed: (i) ocellate: conspicuous ocelli predominantly bicolored with a yellowish pigmentation center surrounded by a dark ring, with random distribution; (ii) reticulate: lines and stains that connect, creating polygonal forms, similar of a net, dark colored and distributed mainly in the central region of the disk; (iii) vermiculate: elongated vermiform forms of varied size, dark or yellowish, non-uniform coloring, eventually forming circles; (iv) diffuse: unconscious vermiculation, reticles and ocelli, usually constituted by overlapping of the three patterns, with a grayish-brown background; (v) smooth color: ocelli, vermiculation and reticles absent, background with pattern predominant ranging from dark brown to light brown. In all pups, the final third of the tail is black, with light spots diffuse or absent. In the middle-anterior portion of the tails it was possible to delimit 3 different coloration patterns: (i) reticulate: lines and stains that connect creating polygonal forms similar of a net, dark color, more defined at the base of the tail, fragmenting posteriorly; (ii) vermiculated: vermiform stripes of varied size, dark color, lateral and dorsal bands that repeat with more uniform pattern in the base of the tail, and; (iii) smooth color: base of the tail without apparent forms, ocelli, vermiculation and reticules inconspicuous or absent along the posterior portion of the tail. In the discs diffuse pattern was the most frequent (41.9%). Other patterns had less than 16% of frequency. In the tails the vermiculated pattern was observed in 51.6% of the pups, followed by the reticulate with 45.2%. The smooth color pattern was observed in only pup. As interactions between the different chromatic systems observed in discs and tails resulted in 11 color combinations. The diffuse-vermiculated combination was, in general, the most frequent (22.6%), also the most observed in females (33.3%). By sequence, a diffuse-reticulated combination was observed in 25% of males and represented 19.4% of the total. The patterns dorsal/tail smooth color-smooth color, vermiculated-vermiculate and vermiculated-reticulate patterns were recorded in one individual for each pattern.

Keywords: Potamotrygonidae, Potamotrygoninae, neonates, newborns, color variation.

Trophic ecology of a migratory benthic shark using stable isotope analysis

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Many shark species undertake large-scale migrations and can have an impact on the ecosystems they frequent, however migration in benthic sharks is largely understudied. In this study, we applied stable isotope analysis to investigate spatial and temporal feeding habits of a migratory benthic shark, *Heterodontus portusjacksoni*, in eastern Australia. Port Jackson sharks were used as a model species as they migrate annually in large numbers and their impact on resource availability in coastal ecosystems could be substantial. Samples were collected over two years from wild sharks throughout the four-month breeding season (July-October) and analysed for δ13C and δ15N. Multiple tissue types (whole blood, plasma and fin tissue) were used to gain a snapshot of movement and feeding habits over different time scales. Isotopic ratio δ15N of whole blood indicated that three NSW shark populations utilised similar food sources (Jervis Bay 12.89‰, Sydney 13.38‰ and Port Stephens 13.08‰), whilst the Melbourne population appeared to feed at a higher trophic level (δ15N=14.96‰). There was also evidence of a potential diet shift during migration as both δ13C and δ15N of Jervis Bay sharks increased over the breeding season when sharks were resident. Additionally, the δ13C values of some individuals were significantly different to the rest, and may indicate a tendancy to feed offshore. These data indicate that benthic sharks may feed opportunistically to take advantage of locally abundant prey items.

Keywords: δ13C, δ15N, diet, spatial ecology, migration.

Assessing the population status of the bonnethead shark (*Sphyrna tiburo*, Linnaeus, 1758) along the coast of Campeche, Mexico, using a data-poor method.

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In the southeastern portion of the Gulf of Mexico along the coast of Campeche, the bonnethead shark (*Sphyrna tiburo*), locally known as cazón pech, has been captured since the 1950s by artisanal fisheries and remains an important commercial species in the region. Despite the historical fishing importance of the bonnethead shark, no population assessment has ever been carried out. In this study, we used a data-poor stock assessment approach to evaluate the population status of the bonnethead shark in two locations: Campeche and Champotón. The evaluation was based on simple indicators such as the size structure of catches, the ontogenetic stages present, the sex ratio, and the estimated catch per unit effort (CPUE). Total mortality (Z) was calculated using a modified catch curve approach and natural mortality (M) was estimated through empirical models. Fishing mortality (F) and the annual exploitation rate (U) were also estimated. We found that more than 80% of the recorded catch was composed of juvenile bonnethead sharks (mean, 628 mm TL) for both sexes. The relative CPUE abundance index was one individual caught per fishing day for both locations. In Campeche, F was estimated to be 0.80, while in Champotón, F was 0.34. The annual exploitation rate in Campeche (U=0.45) was almost double that of Champotón (U=0.23). All estimated values suggest that the bonnethead shark has been heavily fished, particularly in Campeche, which could imply that overfishing is taking place. We recommend reducing the fishing effort, or at least maintaining it at current levels, while more robust methods are used to assess the population of the bonnethead shark.

Keywords: hammerhead shark, artisanal fisheries, fishing mortality, CPUE, bonnethead shark.

Update on the sawfish *Pristis pristis* landings in the North Coast of Brazil: are they still there?

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This study provides information on the landings of the sawfish *Pristis pristis* (Pristidae) in the North Cost of Brazil. Sawfish landings from the Ver-O-Peso Fish Market in the city of Belém, State of Pará, were registered between January 1997 and February 2016. Anecdotal reports on landings were also obtained through interviews carried out mainly between 1997 and 2007. The number of specimens landed and approximate total weight were obtained from the fishermen, the market middlemen and direct observation. Data on specimen sex was available in approximately 50% of the samples. Three main fishing areas off the North Coast of Brazil were identified and sawfish were always considered a bycatch of other targeted species. Male and female specimens were observed, including pregnant females, neonates, juveniles, sub-adults and adults. The results indicate that landings are seasonal, take place on a regular basis but not on a daily basis and vary according to the areas used by the fishing fleets. Historically the maximum sawfish weight landed in a single day corresponded to five tons, considering that this sample was composed only of adult individuals, and the maximum number of sawfish landed on a single day reached 25. Since 1997, information on number of specimens landed and weight have indicated a continuous decline of over 85%. The landings data from the first ten years of this study also indicated that even after Federal and State protection measures were adopted, sawfish and sawfish parts were still commercialized in this fish market due to enforcement challenges. Apparently, the CITES listing decreased the trade of rostra and rostral teeth. Nowadays, protection measures and enforcement are more evident. Nevertheless, adequate conservation and protection of *Pristis pristis* in the North Coast of Brazil are still needed for this critically endangered species.

Keywords: Pristidae, fisheries, market, critically endangered, conservation.

Elasmobranch communities on Panama's Caribbean coast: fisheries-independent monitoring in the Guna Yala and Bocas del Toro archipelagos.

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Quantitative fisheries-independent data on elasmobranch populations in the Republic of Panama are currently lacking, notably for reef-associated sites along the country's Caribbean coast. Data on species diversity, population demographics, and habitat use are needed to inform national and regional management plans following the revision of the National Plan of Action for Sharks as well as assess the effectiveness of multiple Marine Protected Areas in protecting large mobile species. Here we present results from standardized fisheries-independent monitoring conducted at 90 stations in the Guna Yala and Bocas del Toro archipelagos on Panama's Caribbean coast using Baited Remote Underwater Videos (BRUVs), underwater visual census, and scientific longline over 1 and 3 years, respectively. Results reveal a relatively low diversity, abundance and density of meso- and high-trophic level predators. Monitoring highlighted 5 shark and 4 ray species around the island groups, including species of conservation concern such as scalloped (*Sphyrna lewini*) and great (*Sphryna mokarran*) hammerheads. Nurse sharks (*Ginglymostoma cirratum*) and southern stingrays (*Hypanus americanus*) were the species most commonly recorded. Results highlight the need to reduce the use of unsustainable fishing gear used prolifically in the sites to help reverse declines and reestablish populations of sharks and rays along the Caribbean coast of Panama.

Keywords: conservation, management, endangered species, Central America.

I'm not dead yet: a historical and contemporary overview of sawfish distribution and persistence in Panama

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Sawfish historically ranged along both the Caribbean and Pacific coasts of Panama, though detailed information on their distribution as well as recent information on their status throughout the country is lacking. We conducted interviews with traditional fishers in 11 provinces and indigenous comarcas along both coasts of Panama to better understand historical populations of sawfish, the effects of fishing on sawfish in these areas, perceived changes in populations over time, and to identify potential extant populations and critical habitats. Over 200 surveys were conducted with individuals in 60 communities. Measurements were also taken on 11 dried and 1 fresh largetooth sawfish (*Pristis pristis*) rostra from Pacific coastal communities and 1 smalltooth sawfish (*Pristis pectinata*) rostra from the Caribbean coast. Incidental capture in gillnets was the most common type of encounter reported, and fishers highlighted nets as the most probable reason for declines in sawfish numbers and the most significant threat to any extant populations. Although 57% of fishers noted at least 15 years since their last sighting of a sawfish, 18 individuals noted captures within the last year, with multiple confirmed captures occurring in 2 locations on the Pacific coast of Panama within the previous 6 months. Straight rostral length of *P. pristis* rostra ranged from 20.0 – 73.0 cm. Results suggest extant populations of *P. pristis* on the Pacific coast of Panama and highlight the need for national protection for sawfish in Panama as well as the need for further monitoring and work with local fishing communities to reduce mortality and create incentives for releasing animals incidentally captured.

Keywords: conservation, endangered species, Central America, *Pristis pristis*, *P. pectinata*, CITES.

Shark fisheries in Argentina revisited: 20 years later.

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Since the publication of Shark Fisheries in Argentina (SFA) in 1998, several changes at a global, regional and local level, have impacted on the fishing activity of Argentina, and in particular on those fisheries that extract cartilaginous fish. Twenty years later I take "sharks" in the sense that FAO has given to them for the action plans, involving all the cartilaginous fishes: sharks, rays and chimaeras. Through the data provided by the fishing authority of Argentina, it has been possible to analyse the processes of changes in the participation of the fleets that operate on the resource of cartilaginous fishes, and for some species it has been possible to have an indirect rude indicator of the changes in their abundance. The total number per year of fishing vessels by fleet stratum and fishing trips by fleet stratum was obtained (standardization was not possible due to the great heterogeneity of the data) and the effort unit was calculated as number of fishing trip per fishing vessels by stratum of fleet. Finally, for each chondrichthyan species or group of species, the BPUE as total landing biomass per unit of effort per fleet stratum by year was calculated. The sustained increase in the participation of the coastal fleet in landings was maintained, the ice trawlers fleet gained importance at the beginning of the decade 2000, while the freezer fleet progressively decreased its share in landings, intensified by the departure of longline vessels directed specifically to pelagic stingray. In the same year of the publication of SFA there was the extinction of the last fishery directed to a shark in the country, as a result of a macroeconomic situation that, combined with the abrupt drop in the catch yields of *Galeorhinus galeus* made this fishery unfeasible. Since then, other species have been gaining predominance in the landings of cartilaginous fish, changing the composition of them drastically. The fishing activity of the fleet directed to the so-called variado costero (vg multispecific fishing, coastal and ice trawlers) maintains a strong fishing pressure on other species of cartilaginous fish, such as the unidentified batoids, the angel sharks, and the gatuzo, *Mustelus schmitti* that already shows clear signs of overfishing.

Keywords: chondrichthyan landings; South West Atlantic; fleets effort distribution; biomass per unit effort.

Chondrichthyans as biomonitor of Persistent Organic Pollutants in a nursery area off Argentina

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Chondrichthyans are highly vulnerable to human impact, resulting in increased risk to coastal species by its proximity to the terrestrial environment. Coastal marine areas can function as sinks for diverse anthropogenic pollutants, such as Persistent Organic Pollutants (POPs), which include organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs). Although these substances are banned in Argentina, they are highly persistent and lipophilic. Therefore, once released into the environment, POPs are bioconcentrated and biomagnified in the food web with the highest POPs levels in top predators. Fishes have been extensively used for monitoring studies because they concentrate pollutants in their tissues directly from the water and also through diet. In this sense, chondrichthyans are able to accumulate significant concentrations of POPs due to their relative longevity, moderate to large size, lipid-rich livers and high trophic position. An important nursery area for chondrichthyan species is located in coastal waters of Buenos Aires Province between 39º and 41º S (<50 m depth), with an intensive agriculture production and important commercial harbors and industries. Therefore, levels and distribution of POPs were analyzed in muscle samples of cockfish *Callorhinchus callorynchus* (Holocephali: Callorhinchidae) and the Southern Eagle Ray *Myliobatis goodei* (Elasmobranchii: Myliobatidae), species of recreational and commercial interest on the Argentinean Continental Shelf. Concentrations were determined by GC-ECD and reported as ng/g wet weight. POPs levels in muscle of *M. goodei* (0.09-87.54) were notably higher than *C. callorynchus* (0.20-5.48). The ratio PCBs:OCPs was close to 1 in M. goodei, whereas PCBs predominated in *C. callorynchus*. Particulary, OCPs showed the following tendency DDTs metabolites>>endosulfans in *C. callorynchus*, indicating the historical use or a relative fresh input of DDT as impurity. However, in *M. goodei* the pattern was endosulfans>>DDTs, showing a recent use of endosulfans. The most abundant PCBs were tetra- and hexa- congeners, which could have stemmed from historical usage of Aroclor 1254 and 1260. Finally, the embryos of *M. goodei*, presented the same POPs pattern and similar values that pregnant females, indicating that maternal offloading may represent another important pathway of contaminant accumulation in viviparous species. These results suggest that chondrichthyans bioaccumulate high levels of POPs since early stages of development. In this way, continuous monitoring of the accumulation of POPs in chondrichthyans is necessary for adequate management and conservation of existing fisheries and aquatic resources.

Keywords: anthropogenic pollution, Holocephali, Elasmobranchii, coastal waters, maternal offloading.

Spatial ecology and conservation of neonate and juvenile blacktip reef shark (*Carcharhinus limbatus*) in San Cristobal Island – Galapagos Marine Reserve

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The Galapagos Marine Reserve (GMR) protects some of the last remaining large aggregations of sharks in the world. Although it is common to find large schools of *Carcarhinus limbatus* within the Marine Reserve, very little is known about the juvenile stage of this species. 75% of the coastline of the Galapagos is exposed to a rocky shore that is why mangrove habitats are uncommon. These are key areas for the development of juvenile blacktip sharks and other endangered shark species, such as the scalloped hammerhead shark (*Sphyrna lewini*). Although industrial fishing is prohibited in the Galapagos and sharks are protected within the Marine Reserve, 77% of the coastline - including shark nursery areas - are open to artisanal fishing, and neonates and juvenile mortality from by-catch could be high. In this study we proposed to evaluate the abundance of *C. limbatus* in four nursery areas within the San Cristobal Island - GMR, in addition to evaluate the connectivity between these zones, the residence and site fidelity, using acoustic telemetry and a receiver array. 380 individuals were captured in mangrove bays between 2016 and 2017, recording morphometric measurements. Mean total lengths of 72.96 cm for 2016 and 69.07 cm for 2017 suggest that individuals were mostly juveniles of the year. In relation to abundance, Puerto Grande was the nursery area with the largest number of individuals: a total of 161 individuals in the two sampling seasons. Diel movement patterns, connectivity between areas, residence and site fidelity, are being analyzed. We hypothesize that connectivity between mangrove bays will exist as long but only where distance between bays is short (<10 km). In addition, according to literature, it has been found that juveniles of *C. limbatus* make exploratory movements in other mangrove bays but always return to their nursery area, believing that this information will be corroborated in our research. We hope that this study will be the beginning of a long-term monitoring program to evaluate the effectiveness of the new zoning scheme of the Marine Reserve, and could also form the basis for shark nursery protection archipelago-wide.

Keywords: blacktip shark, nursery ground, acoustic telemetry, Galapagos Island.

Quantified analysis of the efficacy of morphometric measurements in discrimination of Chimaeroids species

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The Chimaeriformes (Chondrichthyes: Holocephali) are a small group of cartilaginous fishes that mostly reside in deep-sea benthic habitats along continental shelves and seamounts. The order comprises three families, Callorhinchidae Garman, 1901 (plow-nose chimaeras), Rhinochimaeridae Garman, 1901 (long-nose chimaeras), and Chimaeridae Bonaparte, 1831 (short-nose chimaeras), with the latter family being the most species-rich with two genera and 42 described species. The family Chimaeridae is among one of the most poorly known groups of cartilaginous fishes, with limited taxonomic resolution. Historically understudied, the family has benefited from a recent resurgence of taxonomic effort, with 23 species described since 2002. However, despite the rate of new species descriptions, taxonomic confusion persists due to inconsistent method of morphometric measurements and lack of information regarding reliability of important discriminating characters. Variation in defining morphometric measurements is further complicated by the potential of ontogenetic variation and sexual dimorphism. Little has been done to evaluate the efficacy of characters used to discriminate taxa. In this study 91 measurements were taken from 57 specimens of *Chimaera willwatchi*. Specimens ranged from 118 mm body length (BDL) neonates to 645 mm BDL adults. Ordination analysis was run in PRIMER to cluster related morphometric features of the holotype, paratypes (both large and small size classes), nontypes, and comparative material (comprised of 98 specimens, 10 species, two genera, and 29 parameters) to test for significant differences between species and their congeners. Non-metric multidimensional scaling (nMDS) scores were plotted to illustrate morphological dissimilarity between the chimaeroid species of this study. SIMPER pairwise comparisons of morphometric measurements were used to quantify the top five traits defining species from each other. Additionally, the overall 15 most defining characters were calculated for diagnostic purposes, with comments on color variation, ontogenetic shift, and sexual dimorphism. The overall goal of this study is to find the best characters to quantitatively discriminate between species of this family in order to aid in identification of regional chimaeroids. As the foundation upon which biological sciences rest, accurate and universal taxonomy is essential to achieve effective and sustainable ecosystem-based management.

Keywords: morphometric method, identification, ontogenetic shift, sexual dimorphism, color variation.

Mitigation against shark attack: a changing of the guard?

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Shark attack is a global phenomenon, but it has had a major impact on beach usage and tourism in a number of hotspots. They include the east coasts of Australia and South Africa and more recently Brazil, Western Australia and the island of Reunion (southwest Indian Ocean). The traditional approach, as evident in New South Wales and Queensland (Australia) and Natal (South Africa), is the permanent deployment of shark fishing gear off popular recreational beaches. The objective is to reduce the chances of a dangerous shark encountering a bather or surfer. These three programmes were all introduced over 50 years ago, at a time when there was little concern for the impact on the species caught and the nearshore marine ecosystem as a whole. To their credit, all three programmes have implemented significant changes to address these concerns but the bycatch of a range of relatively harmless sharks, rays, turtles and marine mammals still continues. More recent outbreaks of shark attack have elicited far more enlightened responses. In 2004 the Brazilian city of Recife implemented a research programme in which fishing for large sharks using baited lines resulted in the successful translocation of many tiger and bull sharks well away from the swimming beaches. In 2004 a highly successful Shark Spotter programme to detect approaching white sharks was introduced at some Cape Town (South Africa) beaches. In 2014 Western Australia huge public opposition put a stop to drumline deployment and the killing of white and tiger sharks, with the result that other interventions were explored. In Reunion SMART (Shark Management Alert in Real-Time) drumlines were developed in 2014 to reduce unnecessary mortalities. In all the locations mentioned above it is not surprising that huge emphasis has been placed on shark research, in particular the deployment of acoustic receivers to monitor the movement of tagged sharks, in some cases in real time. The concept of an electrical shark cable continues to show promise, but at this stage, is no more than that. The development of personal shark repellents has resulted in several on the market, using electrical or magnetic fields or olfactory cues. Huge potential exists, but the challenge remains that of stopping a highly determined white, tiger or bull shark. Advancements in technology and growing public empathy towards sharks have driven the most recent responses to shark attack and this trend is likely to continue.

Keywords: shark nets, drumlines, detection, shark fishing, repellents.

Individual shark profiling: an innovative and environmentally responsible approach for managing fatal attacks on humans

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Most fatal shark attacks on humans are still followed by blind fishing campaigns that are almost always ineffective and have a heavy ecological cost. The fishing strategy assumes that bite risk is directly correlated with shark density, an assumption that has yet to be fully demonstrated. Based on existing evidence, we present the alternative hypothesis that attacks are more likely to be caused by behavioral variability among individual sharks than on shark density. Throughout their ontogenic development, large species of sharks opportunistically establish a diet that is rarely, if ever, inclusive of humans as a food source. However, some bold animals may stochastically and rarely prey on humans. This implies that the risk of a shark attack in a given area would relate to the presence of a limited number of high-risk individuals, while the probability for all other sharks to bite humans would be almost non-existent. In order to better understand and manage shark bite risk, we suggest the development of a profile for individual sharks through a detailed forensic analysis after a fatal attack. Such a process could be combined with underwater behavioral studies conducted through experimental shark feeding in order to aggregate such elusive animals, and then identify and remove 'problem individuals'. The acurate assessment of the size of the animals through both i) underwater photogrammetry on aggregated animals and ii) thorough forensic analysis of the wounds on humans, would be paramount for profiling these problem individuals. The general purpose would be to implement behavioral studies to solve a behavioral issue, which has not been the case thus far. As the feasibility of managing feeding sites may indeed seem difficult in vast places such as South Africa and Australia, or in the presence of highly migratory species such as the white shark *Carcharodon carcharias*, it might be especially worthwhile for more confined places such as La Reunion island, Brazil or for some Hawaiian islands, and where more sedentary species such as bull shark *Carcharhinus leucas* or tiger sharks *Galeocerdo cuvier*, reside. Focusing management efforts on individual animals not only has the potential to dramatically reduce the incidence of shark attacks, but stands to improve the reputation of sharks globally, demonstrating that the problem rests with individuals and not with sharks in general.

Keywords: shark attack management, shark individualities, problem individuals, behavioural hypothesis, culling campaigns.

Contrasting diel patterns in swimming behavior of a vertically migrating deepwater shark

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Advances in biologging technologies have significantly improved our understanding of the spatial ecology of marine animals in relation to their dynamic environment. With the recent advent of oxygen-sensing tags, the relative importance of temperature and dissolved oxygen on the vertical distribution and behavior of fishes may be better assessed. We used a combination of a novel temperature-depth-recorder capable of measuring and logging dissolved oxygen data and a tri-axial accelerometer to investigate the fine-scale swimming behavior (tail beat frequency, overall dynamic body acceleration [ODBA]) of a vertically migrating deepwater shark, the bluntnose sixgill (*Hexanchus griseus*). This is the first study to combine this suite of biologging technologies and revealed distinct changes in behavior across mesopelagic environments occupied during diel vertical migrations. Overall dynamic body movements were greater during shallower (200-350 m), nighttime distributions at warmer temperatures (10-13°C) and higher dissolved oxygen saturations (70-80%) compared to deeper (500-700 m), daytime distributions in cold (5-6°C), low oxygenated (15-25%) waters. However, ODBA declined when water temperatures exceeded 13°C. Acquiring contemporaneous in situ measurements of dissolved oxygen alongside temperature, depth, and accelerometry data greatly enhances our ability to identify how oceanographic conditions drive patterns in the distribution and behavior of marine animals.

Keywords: biologging, accelerometer, dissolved oxygen, ODBA, bluntnose sixgill shark.

Olfactory enrichment effects on the reproduction behavior of nurse sharks

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Nurse shark, *Ginglymostoma cirratum*, is one of the most exhibited sharks in Aquariums in the world, however, the reproductive failure rate of this species continues high. Since there probably is an olfactory mediation for its reproduction and environmental enrichments have a potential positive effect on the reproduction of captive animals, the present study aimed to evaluate whether the use of olfactory enrichment would generate effects in the exhibition of reproductive behaviors of nurse sharks, as well as if this effect would be differential according to sex. The study was divided in three phases (control – without enrichment, short-term enrichment – recently applied, long-term enrichment – after being incorporated into the husbandry routine) and was performed in two institutions with distinct husbandry. The enrichment used was commercial basil (*Ocimum basilicum*), which was initially prepared as an ice block and, for the long-term phase, presented as an extract. The behavioral observations were performed through focal sampling with instantaneous recording, totaling 120 hours of observation per animal, divided into two moments (active and inactive). Results show greater activity related to nocturnal period and feeding sessions; greater frequency of occurrence of reproductive behaviors in the inactive period, with males and during the long-term enriched phase. It is important to note that the enrichment effects are differentiated for the sexes and therefore, close monitoring and scheduling are essential to avoid over-stimulation or habituation to the enrichment. Nevertheless, the fact that the greater frequency of reproductive behavior occurred during the inactive period facilitates this monitoring, since it refers to the operating hours of zoological institutions (daytime). These results highlight the importance of having a management that constantly stimulates the senses of elasmobranchs, especially in institutions that aims to carry out breeding programs.

Keywords: captivity, elasmobranchs, environmental enrichment, olfactory mediation, shark.

Seasonal presence, relative abundance, and migratory movements of juvenile sandbar sharks, *Carcharhinus plumbeus*, in Winyah Bay, South Carolina.

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Winyah Bay, the fourth largest U.S. estuary by discharge rate, is a nursery for juvenile sandbar sharks (*Carcharhinus plumbeus*), the numerically dominant shark in the system. From May – September 2016 and 2017, we set a total of 303 bottom longlines in middle and lower bay and deployed eleven VEMCO (V16-4H) acoustic transmitters on juvenile sandbar sharks to analyze seasonal occurrence, CPUE, and residency in Winyah Bay. Opportunistic data were also collected on migratory movements. Juveniles were caught every month surveyed and abundance didn't significantly differ by month or year (p> 0.05). Catch was dominated by individuals of 81 – 100 cm PCL. Mean size did not vary by month or year (p>0.05), indicating no ontogenetic shift in individuals utilizing the bay. Four times as many juveniles were caught during high tides than low tides for surveys in 2016, showing a significant influence of tide on catch abundance (p>0.05). Catch abundance was also not influenced by temperature, salinity, dissolved oxygen, depth, or turbidity (p>0.05), suggesting juveniles utilized a range of habitats within the bay. Juveniles were detected in Winyah Bay from April to November for up to 186 days (mean ± SE = 72.0 ± 19.7 days), though variations in inter-annual temperatures resulted in differences between 2016 and 2017. Detection frequency and presence differed by area and tide, with 98% of detections in the lower bay and adjacent coastal waters, 2% in middle bay, and none in upper bay. Within the lower bay, sharks exhibited longer and significantly more frequent visits on the west side (p<0.001). After leaving the bay in late fall, six juvenile sandbar sharks were tracked moving southward (to as far Cape Canaveral, FL). Three of the five sharks tracked south in fall 2016 returned to Winyah Bay in spring 2017. Consistency in southerly emigration routes in both years differs from over-wintering data collected for juvenile sandbar sharks captured in the Chesapeake and Delaware Bays (Grubbs et al. 2007, McCandless et al. 2007, Bangley 2016). These new data support the notion of Winyah Bay as an important secondary nursery area that is used annually by juvenile sandbar sharks from spring until early fall, which was historically difficult to substantiate given low tag-recapture rates in this system, particularly across study years.

Keywords: sandbar shark, estuary, longlines, acoustic telemetry, migration.

The importance of a closure area established for chondrichthyans in the Southwestern Atlantic Ocean

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In the Southwestern Atlantic Shelf, south of 34°S, 106 chondrichthyans species have been reported, of which 2 are holocephalans, 55 are sharks, and 49 are batoids. Occurrence, distribution patterns and the ecology of these species are related to the zoogeographic scheme proposed for the region. Reproductive biology studies and ecology of chondrichthyans have been increased notably the last 15 years. This increase helped to understand the importance of historical closure areas designed for main commercial species, and to design new marine closure areas. In this sense, from 2007 there is a coastal seasonal closure area specifically designed for the conservation of elasmobranchs, based on lineament of precautionary management because it was one of the highest landings areas of sharks and skates. Federal jurisdictions of Argentina and cooperative agreement by Argentina and Uruguay are involved in the management of this area. Using bottom trawl research cruises and monitoring gillnet artisanal fishery, here we present new information about the importance of this area regarding biological cycles of sharks and batoids. Birth and mating of the narrownose smooth hound *Mustelus schmitti* take place in this area during spring months. Likewise, the repeatedly encountered of young of the year and small juveniles observed across years suggest that this area could be considered as a nursery areas for the broadnose sevengill shark *Notorynchus cepedianus*. Coastal aggregations of mature females of the spiny dogfish Squalus acanthias during early spring was associated with foraging process instead reproductive events. This area is also important for batoids due to endemic rays and juveniles skates captures. The present data update support the importance of this management measure to preserve a critical coastal habitat for chondrichthyans in the Southwestern Atlantic Ocean.

Keywords: elasmobranchs, ecology, fisheries, management measure.

Molecular and morphometric evaluation of the bonnethead shark *Sphyrna tiburo* (Carcharhiniformes: Sphyrnidae)

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The origin of the Isthmus of Panama has caused the separation of marine populations, generating a barrier to the genetic flow between the species located in the Caribbean and Pacific. *Sphyrna tiburo* is among the several species that have been separated by this geological event; currently the species is divided into two sub-species: *Sphyrna tiburo tiburo* (Caribbean) and *Sphyrna tiburo vespertina* (Pacific). The nature and time span of this barrier suggests that there should be genetic distances and sufficient morphological differences to consider them as different species. In order to tackle this doubt, tissue samples and ventral view photographys were taken from individuals along the Caribbean and Colombian Pacific. A molecular analysis on the mitochondrial control region and geometric morphometric analyses on the cephalofoil were performed. In addition, the difference in the density of Lorenzini's ampules was examined, based on the contrasting conditions of turbidity that occur in both environments. Our results indicate that differences exist at the genetic and morphological levels. In the first case, monophyletic groups were obtained for both populations with genetic distances of 1.8%. Regarding the cephalophoil morphology, consensus shape of each sub-species turned to be significantly different. Finally, ampules density was different in three of the four zones compared. Our results suggest that the sub-species of *S. tiburo* studied, have enough morphological and genetic differences to raise the species level.

Keywords: Mitochondrial DNA, ampullae of Lorenzini, cephalofoil, divergence, Isthmus of Panama, sub-species.

New data on abundance of lemon-shark, *Negaprion brevirostris* (Poey, 1868), at MPA Rocas Atoll, Brazil

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Due to the importance of MPAs (Marine Protected Areas) for helping shark species and the poor knowledge about the current situation about the lemon shark (*Negaprion brevirostris*) at Rocas Atoll, the present study re-evaluated the abundance estimation and the movement patterns of this species at the nursery area Lama Bay, in different seasons and tides. The non-invasive and non-lethal technique of visual census from fixed points in emerged areas was adopted in two field trips (austral summer and winter) in 2015. The sightings were done according to tidal time and light period. Mean abundance of 29 individuals in the austral summer (35 maximum) and 31 in the austral winter (41 maximum) were registered, from daily observations. Combined with literature, our data show that the abundance mean of lemon shark in that specific area is declining substantially over 18 years. However, the population probably are being recovering, by the last years collected, knowing that there is a temporal lag in the data. Moreover the movement pattern of the species, concerning fidelity to their birthplace, was confirmed. These results recommend a continuous monitoring of lemon-sharks over the time, enabling better understand variation in the number of individuals. In addition, the species studies will provide knowledge that will aid their preservation.

Keywords: visual census, lemon shark.

Using BRUV to assess the elasmobranch community off Pernambuco, Brazil

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In the 90's, Recife became well known by the high incidence of shark attacks, which were concentrated along a 20-km stretch of beaches, mainly Piedade and Boa Viagem. Aiming at mitigating that problem, the government of Pernambuco invested in a monitoring program that was, however, discontinued in 2014, due to budgetary issues. In this project, the use of BRUVs (baited remote underwater video) was tested for the first time to investigate the diversity, abundance, sexual proportion and spatial distribution of elasmobranchs off Pernambuco, in collaboration with Global Fin Print program. Eleven field trips were conducted between 15 and 27 of November 2017, comprising 90 sites. Brazilian sardine (around 1 kg) was used as bait. Each site comprehended one and a half hour of video, totalizing 135 hours. The sites were randomly distributed along the coast of Pernambuco, covering an area of approximately 30 km, including south of Olinda (Milagres beach), Recife (Pina and Boa Viagem beaches) and Jaboatão dos Guararapes (Piedade and Candeias beaches), in depths from 8.0 to 28.6 m, and at distances from shore ranging from 1.3 to 5.7 nautical miles. The videos showed the presence of stingrays in 19 sites, with no clear pattern of distribution along the coast. Only one shark, a nurse shark, was seen in one of the sites. In addition, 7 specimens of stingray were sexed, 5 females and 2 males. The sex of the nurse shark could not be identified. These results, although preliminary, do confirm the low abundance of sharks in the proximity of the beaches where most of the attacks have been recorded, previously found by the State-run monitoring program. They also show the BRUVs can be a useful alternative for monitoring the elasmobranch community off Pernambuco.

Keywords: Recife, BRUV, shark attack.

From the Indo-Australian Archipelago to the world: applying genomic data to reconstruct the demographic history and range expansion trajectory of blacktip reef sharks (*Carcharhinus melanopterus*)

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Carcharhinus melanopterus is one of the most abundant and widespread reef-associated sharks in the Indian and Pacific Oceans. Recent work has suggested that French Polynesian populations of *C. melanopterus* have been impacted by human activity. In an effort to better understand the population genetic patterns induced by human impacts and place them in a broader context, we undertook a comprehensive population genomic study that aimed to characterize the historical demography, colonization history and conservation status of *C. melanopterus* throughout its range. We sampled 145 individuals from 13 populations and deep-sequenced ~1,000 genomic regions using a recently developed target gene capture approach. We show that the demography of the species is best described by metapopulation models and that models that do not accommodate structured populations can lead to misleading inferences about the conservation status of sub-populations. The data collected allowed us to reject an equilibrium metapopulation model and suggested, instead, that a relatively recent range expansion had occurred in this species. Spatial genetic modelling identified two colonization waves originating in the Indo-Australian Archipelago that lead to the modern range distribution for the species: an eastward moving wave moving through the Pacific and a westward one moving though the Indian Ocean. The study highlights insights that can be gained about evolutionary demography by coupling population genetic metapopulation models with spatial modelling and underscores the need for cautious interpretation of population genetic data when advancing conservation priorities.

Keywords: genomics, blacktip reef shark, demography, range expansion, evolution.

Condition analyses of sharks in a multispecific coastal nursery area: differences between biennial and annual reproductive cycles

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Analyzing the condition of an animal is important to evaluate the accumulation of energy for future use in vital processes. Studies on sharks; condition have received limited attention in the literature, especially in nursery areas. The aim of the present study was to analyze the condition metrics (hepatosomatic index - IHS and condition factor) of five shark species (*Carcharhinus brevipinna, C. limbatus, Sphyrna lewini, Rhizoprionodon porosus* and *R. lalandii*) during co-occurrence period in a coastal nursery area. Specimens were obtained weekly from artisanal fisheries operating along the southeastern Brazil, between August 1996 and July 2003. The analyses were performed during the spring-summer period, the seasons with the greatest species overlap. The sample was represented by 6905 specimens, including neonates of *C. brevipinna* (458) and *C. limbatus* (130), neonates and young-of-the- year (YOY) of *S. lewini* (1819) and *R. porosus* (1801) and YOY and juveniles of *R. lalandii* (2697). High values of condition (IHS average from 7.6 to 9.4) were obtained for *Carcharhinus* species, while *S. lewini, R. porosus* and *R. lalandii* presented a lower condition level (IHS average from 4.4 to 5). Although *S. lewini* reaches large sizes when adult, its condition values resembled the small shark species. The *S. lewini* maternal tradeoff between having energy for an annual reproductive cycle and providing energetic support to each near-term pup may have influenced the results obtained in the present study, especially considering the high fecundity of the species. Therefore, it was observed that the highest condition occurred for the species with biennial cycle, whereas a lower level was recorded in the species with annual cycle.

Keywords: multispecies, fulton, life cycle, hepatosomatic index, condition factor.

Environmental modelling of the occurrence of the oceanic whitetip shark *Carcharhinus longimanus* in the Eastern Pacific Ocean

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The oceanic whitetip shark (OWT), *Carcharhinus longimanus* was one of the more common tropical pelagic species taken as incidental catch primarily in tuna and swordfish fisheries. Fishing pressure has caused massive declines in its abundance in a very short time period, to the extent of being listed in the IUCN Red List as globally "Vulnerable". In this study we analysed a 20 year database of OWT incidental catch reported by scientific observers of the IATTC aboard of tuna purse-seine ships. We used presence/absence logistic Generalized Additive Models to assess the effect that sea surface temperature (SST), chlorophyll-a (Chl-a) and the sea level anomalies (SLA) had on OWT and to depict zones of high OWT occurrence in the Eastern Pacific Ocean (EPO). The final occurrence model of OWT explained 20.5 % of the total deviance. The predictive variables that accounted for most of the deviance were the longitude (4.6% of deviance explained) and the set type (4.3%).

The environmental variable that accounted for most of the explained deviance was the SST (2.19%), followed by the Chl-a (1.98 %) and with very little effect the SLA (0.3 %). The occurrence probability of OWT increases when the SST values are 25-28°C, low Chl-a values 0.07- 0.15 mg/m3 and positive SLA values 0-0.1 m. On the other hand the number of purse-seine sets accounted only for a small fraction of the explained deviance, so it was discarded from the final model. This is a clear evidence of the low abundance of OWT in the EPO. The predictive evaluation of the model was good with a percentage of the area under the curve (AUC) = 0.87. The model predicted some zones of high probability of OWT occurrence ("hotspots"): particularly, one of them remains active throughout the year which highlights it as a very important zone for OWT conservation, so we recommended that special attention needs to be addressed to such area.

Keywords: incidental sharks catch, tuna purse seine, habitat suitability models, satellite oceanography.

Population structure of the Brazilian large-eyed stingray *Hypanus marianae* Gomes, Rosa & Gadig, 2000 (Myliobatiformes, Dasyatidae) in the Tropical Southwestern Atlantic

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In general, elasmobranchs are K strategists and their dispersion is mainly a result of the movement of adults. However, other specific features such as preference for habitat and spatial fidelity, may interfere with gene flow and population connectivity, in addition to the actual mobility. *Hypanus marianae* stingray is endemic of northeastern Brazil, the small-medium size and inhabits coastal areas associated with reefs. Through a phylogeographic approach, we evaluate the population structure, genetic diversity and gene flow of the *H. marianae* using mitochondrial DNA sequences (CYTB) and nuclear (RAG1). We sampled 109 individuals in six locations along the geographical distribution of species. The results show that most haplotypes are unique to particular localities and the analysis of the peer-to-peer fixation index FST was significant in most comparisons (60%). All results highlighted the SAL location. Incorporating geographic information to multilocus molecular analysis we identified two genetically different groups (BITUPITÁ+CAIÇARA DO NORTE+MARACAJAÚ+PONTA DE PEDRAS+ABROLHOS/SALVADOR) value of FST 0.68594 (p <0.0001) between them. *Hypanus marianae* presented an unusual population structure for elasmobranchs, with strong genetic structuring between nearby locations (SAL and ABR) without an apparent gene flow barrier, while more remote locations are connected. This pattern suggests an ecological isolation IBE, not mobility or distance. Apparently, the different characteristics of watersheds influence the distribution and gene flow of this coastal species, favoring the occupation of areas further north of its geographical distribution and greater genetic diversity in these areas.

Keywords: phytogeography, Brazilian large-eyed stingray, genetic structure, mitochondrial gene, northeastern Brazil, ecological isolation.

Geographic and Latitudinal variation of endemic stingray *Hypanus marianae* Gomes, Rosa & Gadig, 2000 throughout its restricted distribution in South Atlantic

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Several factors can cause changes in body shape of fish and these variations can characterize local distinct patterns throughout its distribution. In the particular case of *Hypanus marianae* stingray, its range is relatively small compared to the overall pattern of elasmobranchs, however, even in this geographical mesoscale may vary. The species shows a close relationship with the reef formations and associated environments. In this study, we investigated the morphometric variations *H. marianae* specimens to identify possible population groups related to the three major reef areas in the northeast of Brazil (North, Northeast and East). Twenty-two metric character 137 copies were used. After preparation, the data were analyzed by of canonical variables analysis (CVA), non-parametric multivariate analysis of variance (NPMANOVA) and agglomerative hierarchical clustering analysis. The population group East had significant morphological separation along the second axis canonical. North and Northeast have distinction over the first canonical axis. The most morphologically well-defined groups were: East and North, with respectively 79% and 69% chance of belonging to the morphometric standard region. North and Northeast have a common morphological pattern, with morphometric characteristics most shared. The NPMANOVA test showed a significant overall effect (F = 10.61, p = 0.0001) and the CLUSTER analysis revealed two distinct groupings: a group uniting the North and Northeast regions, indicating greater similarity between them and other isolating the eastern region. A pattern that confirms the Bergmann rule, correlating larger body sizes with higher latitudes yet been identified. Morphological characters may indicate high degree of phenotypic plasticity in response to local environmental conditions. Beyond the specific characteristics of the reef areas along the distribution *H. marianae*, one should also consider the discontinuity of reef bodies along the Brazilian coast. The phenotypic pattern identified suggests some limitation of mobility of the species because population groups are shown true to certain locations with specific phenotypes. In this sense, from our results and marine zoogeography work, we find that the Eastern group may be really exposed to specific pressures in this region, allowing a more limited standard morphometric.

Keywords: Brazilian large-eyed stingray, morphometric variation, phenotypic expression, Bergmann's Rule.

Determining life history parameters of deepwater sharks in a compromised system: Can we detect organismal-level effects of hydrocarbon exposure from Deepwater Horizon oil?

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In order to model the population-level effects of ecological injuries such as the Deepwater Horizon (DwH) Oil Spill, scientists need species-specific life history information, particularly related to age, growth, and reproduction. The depth of the DwH spill resulted in ecological repercussions that affected groups of species for which little or no published biological information existed. Hence, the majority of life history information we have documented for deepwater sharks in the vicinity of the DwH spill is based on potentially compromised populations. In addition, the lack of baseline biological, toxicological, and physiological data, as well as the unknown magnitude of background hydrocarbon exposure has exacerbated the interpretation of results from our post-spill life history studies conducted in this region. Herein we present life history parameters for the dominant shark species inhabiting the Desoto Canyon region: gulper shark (*Centrophorus granulosus*), little gulper shark (*Centrophorus* cf. *uyato*), Cuban dogfish (*Squalus cubensis*) and Genie's dogfish (*Squalus clarkae*). Our results show a wide range in life history parameters for these deepwater sharks, challenging long-held assumptions of deepwater sharks uniformly exhibiting "extremely long-lived" or "extremely conservative" life histories. Additionally, we propose a series of simple analyses to determine whether the toxicant load of an individual results in a measurably negative effect on life history parameters such as fecundity, embryonic sex ratio, mean embryo size, size-at-maturity, and size-at-age. Finally, we suggest future research initiatives that would further clarify the organismal effects of hydrocarbon exposure resulting from the Deepwater Horizon Oil Spill.

Keywords: age, growth, reproduction, *Squalus*, *Centrophorus*.

Ageing chondrichthyan fishes using dorsal finspines: Utility or futility?

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Chimaeras (Holocephali) and dogfishes (Elasmobranchii: Squaliformes) are commonly caught as bycatch or targeted in several fisheries worldwide for meat and valuable squalene. Age and growth data are lacking for most squaliform species, in part because traditional aging methods rely on vertebral centra which are not suitably calcified to record growth in these species. All holocephalans and most squaliform species possess dorsal fin spines that have been shown to record both internal growth bands, visible in a transverse section, and external growth bands, visible on the spine base or enamel cap (present in select species). In ongoing collections of deepwater shark finspines, we have accumulated samples from 2 holocephalan species and more than 20 squaliform species. We suggest optimal methods for cleaning and preparing samples in order to improve readability. This information will be useful to scientists involved in age and growth studies of any phalacanthous chondrichthyan.

Keywords: age, growth, shark, Squaliformes.

Historical survey of shark attacks in Pernambuco coast

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Shark attacks are incidents that occur in many countries of the world, including Brazil. This kind of human-shark interaction is not recent, with incidents being reported since mid-sixteenth century, as recorded in the International Shark Attack File (ISAF). In Pernambuco State, northeast Brazil, there were several shark incidents since the early 1990's. However, there are no official records of incidents prior to this period in the area. In this survey, data on possible shark incidents since mid-nineteenth century until the 90's were investigated, with a focus on the neighboring cities of Olinda, Recife and Jaboatão dos Guararapes. The analysis was based initially on data available at the International Shark Attack File. Then, an ample search was done in social history books and records of Pernambuco chronicles, seeking information that could evidence the existence of ancient shark attacks in the state. Data from old newspapers were also mined, looking for information about this kind of incident. Records of ten shark attacks were found, as well as many reports about the presence of sharks in Pernambuco waters. The first record of human-shark interaction was from a local newspaper in 1874, in fact a rush, since no injuries were described. The first confirmed attack reported occurred in Olinda, provoking the death of a young man in 1915, becoming the oldest shark attack ever recorded in Brazil. Besides, the fear of sharks by the locals is documented in diverse sources. One of the first testimonies dates from 1840, written in a personal diary of a French visitor who was advised not to bath in Recife waters. The data gathered, although scanty, do indicate that shark sights and other types of interactions, including fatal attacks, were not uncommon in Pernambuco before the nineties and probably were not well documented due to the much less capacity of the media. They are relevant to the understanding of how this ecological and socioeconomic problem evolved over time, by clearly showing, for instance, that shark attacks are not a problem that emerged only in the 1990s, although they did become much more frequent after that time. They also reinforce the need to invest in educational outreach to raise the awareness of the local population on the risk of this kind of incident and to inform the beach-goers on the precautionary measures needed to avoid it.

Keywords: shark incident, coastal history, beach recreation, injuries, unprovoked attacks.

How old can be a modern shark nursery area?

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Sharks use nursery areas since remote times; in the fossil record nurseries have been documented from 320 million years ago. But how old can be modern shark nursery areas? How important is this aspect for establishing conservation priorities for the nursery areas? To answer these questions, we studied the biogeographic relationships of fossil and modern shark nursery areas in Venezuela, using a cladistic analysis and additionally comparison with models of geological evolution from fossil and modern shark nurseries in the Caribbean and Venezuelan coast. Recent paleontological surveys allowed us to collect hundreds of fossil sharks teeth and to identify fossil nursery areas present in the following formations: Castillo (≈18 Ma), Cantaure (≈15 Ma) Capadare (≈7Ma), Caujarao (≈4 -2.5 Ma), all located in the northwestern of Venezuela. Also, data from modern nurseries situated in the Gulf of Venezuela and the Los Roques Archipelago were analyzed. For the analysis of cladistic biogeography, first binomial matrices of area by taxon were established for each group and region under study, based on novel information generated in this study, as well as additional data present in specialized literature on Caribbean shark nursery areas (fossil and modern). These matrices contain the valid taxa and their corresponding geographic locations. Subsequently, a BPA was performed, obtaining a general cladogram of areas in order to establish the biogeographic relationships between the study areas. Finally, once the biogeographic relationships between the study areas were obtained, the results were compared with three spatial models of evolution of the Caribbean plate and two geological models of evolution of the Venezuelan coast. Our results indicate that there is a high level of correlation between taxa present in all nursery areas, with a marked vicarious event about 3.7 million years ago, which could be related to the closing event of the Panama Isthmus. The models of geological evolution of the Caribbean and the Venezuelan coast over the last 25 Myr supports the idea that the northwestern Venezuela (i.e. Gulf of Venezuela), has been used as a nursery area by five genera of sharks (*Carcharhinus, Rhizoprionodon, Gynglimostoma* and *Galeocerdo*) for at least 18 Ma.

Keywords: shark nursery areas, historical biogeography, Caribbean.

Ionic characterization of the ampullae of Lorenzini jelly in marine elasmobranchs

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The study of the Ampullae of Lorenzini is one of the most classic branches of elasmobranch research, with emphasis on the morphology, function, distribution, anatomy and histology of these structures that characterize the electroperception system in the group. However, qualitative and quantitative aspects of the conductive jelly present in the ampullae channels are still poorly understood and little is known about the components responsible for conducting the electrical signal detected from the environment to the sensory cells of the ampullae itself. The present study aimed to characterize the ionic composition of the jelly in *Zapteryx brevirostris*, *Rhizoprionodon lalandii*, *Sphyrna zygaena* and *Sphyrna lewini*. The samples were obtained from animals caught by artisanal fisheries held in Matinhos, Paraná coast. The jelly was obtained by compressing the opening pores of the ampullae located on the animals' heads. After extraction, the material was fluidized with the aid of an ultrasonic sonicator. Chloride, sodium, magnesium, potassium and phosphorus were measured using commercial kits and flame photometer. The concentrations of the ions varied among the species and were therefore species-specific, but all showed the same tendency, with chloride and sodium concentrations being highest, followed by magnesium, potassium and phosphorus. The analysis indicates that in fact chloride, sodium and potassium have a high degree of signal-conduction/amplification in the jelly, and that they are kept in a concentration below their respective levels in sea water. Differences between the pelagic sharks and the benthic guitarfish were observed, being possible that the concentration of the jelly is evolutionarily shaped by the life habits of the animal in question.

Keywords: electroperception, ampullae jelly, sharks, batoids.

Genetic analyses in the stingrays *Potamotrygon motoro* and *P. falkneri* (Chondrichthyes, Potamotrygonidae): invasion or population admixtures along the upper Paraná River basin?

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The stingrays *Potamotrygon motoro* and *P. falkneri* occur in Lower Paraná and Paraguay rivers and have invaded recently the upper course of Paraná River (Southeastern Brazil). In the current study we performed a genetic analysis of *P. motoro* and *P. falkneri* populations, two important elasmobranch fishes occurring in the Paraná River basin, using microsatellites to provide insight into connectivity, genetic diversity, and to increase understanding on the invasion or admixture process involving these stingray species along the Paraná River. Two hundred and fifty-six samples of freshwater stingrays were collected in the period of 2010-2016 in the Paraná River basin. The specimens of *P. motoro* (152 animals) and *P. falkneri* (104 animals) were collected along the Paraná River. *P. motoro* populations analyzed under the admixture model and K=1 to 6 populations result to one cluster K=1 (mean LnP(K) -2070.200000), indicating that P. motoro presents a single genetic stock. Pairwise multi-locus FST analysis showed small but highly significant values in comparisons (FST from 0.000 to 0.101). The global AMOVA test that included all samples resulted in a small and unsignificant value for FST = 0.038 and significant value RST 0.169. P. falkneri conducted under the admixture model and K = 1–4 populations showed one cluster K=1 (mean LnP(K) -1732.740000). The analyses of the FST and RST indicating the existence of a moderate population differentiation condition, with a global indices FST of 0.094 and RST of 0,391. The analysis for detecting genetic differentiation (pair-wise FST) indicated in *P. falkneri* a statistically significant divergence (P ≤ 0.05) was most often observed for Ilha Solteira (IS). This indicates the presence of a certain level of divergence in populations, but no population was completely isolated from the others. In the RST analysis, a relatively same number of population pairs showed significant divergence (4 from FST and 4 from RST). One hypothesis could be that these stingrays would not have been totally extint in the Alto Paraná basin after European colonization, but the over capture only reduced the population size of the both species. This fact would make it difficult to detect and capture the species and perhaps the genetic stock currently existing and analyzed in this location would be part of the old one that lived in the Alto Paraná River basin prior to the flooding of the Itaipu hydroelectric dam.

Keywords: mitochondrial DNA, SNPs, Itaipu hydroelectric dam.

Artisanal shark fisheries of Bahía San Blás MPA (Argentina): the last oral records

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Bahía San Blás (BSB), Northern Patagonia (Argentina), is an important shark breeding and nursery ground in the Southwest Atlantic, including endemic species such as the narrownose smouthhound *Mustelus schmitti*. It was declared in 2001 as a MPA with multiple uses including small scale fisheries activities. The aim of the study was to interview the last artisanal shark fishers of BSB MPA to describe their fishing activity and increase management knowledge of targeted species. During November 2017 three fishermen of BSB were interviewed in person and individually to register: target species, fishing, capture and trade information, including temporal and spatial data. At the same time we used maps in each interview to identify fishing areas, number of gillnets deployed per species and parturition sites. The artisanal fleet was of 5 boats with crew members varying between 3 and 8 people per boat. Three species were targeted by gillnets, *M. schmitti*, the tope shark *Galeorhinus galeus* and the copper shark *Carcharhinus brachyurus* while the hidden angelshark *Squatina guggenheim* was captured as bycatch. Fishing season period used to be between 30 and 45 days per species as following: *M. schmitti* (Oct-Nov), *G. galeus* (Nov-Dec) and *C. brachyurus* (Dec-Jan-Feb). All fishers used bottom gillnets (Height: 1.3m, Length: 50m) made by hand and with nylon or polyester materials with different mesh sizes: *M. schmitti* (10.5-12 cm), *G. galeus* (18-20 cm) and *C. brachyurus* (34-35 cm) and operated by hand. The number of nets deployed per day varied between 3 (*G. galeus* and *C. brachyurus*) and 20 (*M. schmitti*). Bottom gillnets were deployed against current at different depths: 3-4 m for *M. schmitti* and *G. galeus* and > 5m for *C. brachyurus*. Catch was sold to fish traders with cold chambers settled in Mar del Plata and Bahía Blanca. *Mustelus schmitti* were sold fresh while *G. galeus* and *C. brachyurus* dried and salty. The maximum harvest per season of *M. schmitti* was 78 tonnes while for *G. galeus* was 3.8 tonnes (estimated individuals N=422) of dried products while a "good fishing day" were 2.1 tonnes for *M. schmitti* and 250 and 12 individuals for *G. galeus* and *C. brachyurus* respectively. No capture trend was recorded for any of the targeted species. Spatial analysis showed overlapping between areas used by each fishermen, assuming no exclusive zones. A sustainability assessment, including ecological, community and socioeconomic components, is recommended before reopen this activity targeting threatened species.

Keywords: Patagonia, bottom gillnets, small scale fisheries, *Mustelus schmitti*, *Galeorhinus galeus*, *Carcharhinus brachyurus*, *Squatina guggenheim*.

Suitable habitat for neonates and young juveniles of the bronze whaler *Carcharhinus brachyurus* in Northern Argentinean sea and identification of potential nursery areas.

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Nursery areas are essential habitats for the development of species and a key spatial tool for the protection of early life stages of sharks. The bronze whaler (*Carcharhinus brachyurus*) has been classified as Near Threatened globally by the IUCN and its coastal nursery areas threatened by urban development and pollution worldwide. It is considered a low productive species with an average of 15 pups per litter for the Southwest Atlantic population. In Argentina it was captured by the last shark gillnet fishery during the 90`s and as a large coastal species is one of the main targets of the recreational fishery. The main objective of this study was to describe the habitat preferences of the neonates and juveniles of the bronze whaler shark and identify potential nursery areas for its conservation through the modeling approach of maximum entropy. Bronze whaler data obtained for this study included 34 records from spring and summer between 2013 and 2018. The MaxEnt model performed better than random and produced an area under the curve (AUC) score of 0.977. Distance to the coast, minimum of chlorophyll-a, slope and sea surface temperature range were the variables most strongly related to *C. brachyurus* sightings. The model predicted that the most suitable habitat was located at south of Buenos Aires Province (39°-41° S) and close to the coast (<12 nm), overlapping with provincial jurisdictional waters. This findings help to clarify what are the main environmental factors that drive the habitat preferences of early life stages of bronze whalers in Argentina and improve the identification of potential nursery areas for its protection.

Keywords: coastal sharks, maxent model, Buenos Aires waters, species distribution.

Records of whale sharks (*Rhincodon typus* Smith, 1828) (Orectolobiformes, Rhincodontidae) between 1984 and 2017 on the east coast of Rio de Janeiro State, and their possible relation with local upwelling

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The whale shark (*Rhincodon typus* Smith, 1828) is the largest specie among the elasmobranchs and the largest of the chondrichthyes. It can reach 20 meters of total length (TL) and weigh approximately 36 tonnes, although most specimens have an average of 10-12 meters (TL). It is a cosmopolitan specie, usually found in tropical and neotropical waters, inhabiting the pelagic zone in both onshore and offshore waters, generally in the superficial layers of the water column, especially in regions with high primary productivity. The coast of Cabo Frio and Arraial do Cabo, located on the east coast of Rio de Janeiro State, has two important characteristics: a unique oceanic projection in relation to the coastline, which makes it one of the most advanced points towards the sea on the Brazilian coast, and the presence of upwelling (the rise of deep cold waters rich in nutrients, coming from South Atlantic Central Water). This facts influences the life of local organisms and probably the behavior of many seasonal species, such as fishes, birds, and marine mammals that, every year, frequent the waters of the region. Between 1984 and 2017, 10 occurrences of whale sharks were recorded on the east coast of Rio de Janeiro State, specifically on the coast of Cabo Frio and Arraial do Cabo. Half of these records were of stranded specimens, while the other half were of individuals moving near the coast, both near the surface and along the water column. All stranded specimens were females, with total lengths ranging from 9.86 to 10.2 meters. It was not possible to determine the sex of the individuals observed near the coast, it was only possible to estimate their total length, which varied from 4 to 10 meters. Whale sharks are filtering fishes that feed off of planktonic and nektonic organisms by suction. The occurrence of the species in the waters of the east coast of Rio de Janeiro State may be related to the upwelling, intensified by the wind action and the prominence of the coast, which provides a high primary productivity and consequently the increase of the local planktonic biomass.

Keywords: largest, elasmobranchs, Cabo Frio and Arraial do Cabo, behavior, occurrences.

Temporal resource partitioning between two sympatric reef shark species within the British Indian Ocean Territory

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There is still a great deal to understand about the role of reef sharks in coastal ecosystems. We used stable isotope analyses of multiple tissues to determine the extent of dietary resource partitioning by two sympatric reef sharks, the grey reef shark (*Carcharhinus amblyrhynchos*) and the silvertip shark (*Carcharhinus albimarginatus*), within the British Indian Ocean Territory marine reserve. We report evidence of ontogenic shifts in resource use by grey reef sharks, that anthropogenic nutrients are not fu-

eling local food webs, and clear resource partitioning between the species. Furthermore, we find that the extent of resource partitioning varies temporally and attribute this to an influx in pelagic prey items from outside the reserve during austral autumn and winter. Therefore, our findings suggest that fisheries outside of the British Indian Ocean Territory marine reserve could still impact sharks utilising seasonal pelagic prey, even if they do not leave the reserve boundary themselves.

Keywords: British Indian Ocean Territory, resource partitioning, shark, stable isotope analysis, sulphur (δ^{34}S).

Habitat use of young-of-the-year white sharks (*Carcharodon carcharias*) in three dimensions

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Young-of-the-year (YOY) and juvenile white sharks (*Carcharodon carcharias*) have been poorly studied compared to older age classes in the northwest Atlantic Ocean. The New York Bight is a summer nursery area that has recently emerged as a new site for field research. To gain insights into movement and habitat use patterns in this area, we deployed acoustic and satellite-linked Smart Position or Temperature transmitting (SPOT) tags on 20 white sharks (119-158 cm fork length), including six individuals additionally fitted with high-rate pop-up satellite archival tags (PSATs). Horizontal movements were generally parallel to Long Island's southern shoreline over bottom depths of less than 40 m, and across sea surface temperatures of 16-25 °C. Data from the PSATs revealed vertical oscillations between the surface and bottom, as deep as 200 m and temperatures as low as 6 °C, but the sharks spent the majority of their time swimming at depths of 10 m (± 9 m), and in water temperatures of 19.5 °C (± 2 °C). Thermal preferences and prey availability are likely primary influences on both horizontal and vertical habitat use within this nursery area, however additional research is needed to better quantify feeding habits and explore the potential influence of other environmental factors. These results will help to better assess exposure of YOY white sharks to recreational and commercial fishing activity, offshore energy development, and coastal habitat degradation in the New York Bight.

Keywords: nursey habitat, movement, satellite telemetry, acoustic telemetry.

Life history of scalloped hammerhead sharks, *Sphyrna lewini*, from Papua New Guinea

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The National Fisheries Authority (NFA) of Papua New Guinea (PNG) has identified the need for better information on key exploited species to inform fisheries management. One particular species of interest, is the scalloped hammerhead, *Sphyrna lewini*. Annual catch of *S. lewini* has been reported to be declining considerably. However due to the paucity of the data from PNG, the cause of the decline is unknown and regional biological information is required. One hundred and twenty three samples (102 - 292 cm total length; TL) were collected from commercial longline vessels targeting sharks in the Bismark and Solomon Seas, and 6 neonate samples (50 - 61 TL cm) were collected from the PNG inshore prawn trawl fishery. Vertebrae were process using standard protocols. Annual band formation was assumed, and bands counted by two independent readers. Back calculation was employed to account for the low number of samples from juveniles. A multi-model approach, incorporating the von Bertalanffy, logistic and Gompertz growth functions, with a small sample size bias correction, was used to estimate growth parameters. Length- and age-at-maturity estimates were produced using a logistic regression model. Understanding the local life history of shark populations is vital for region specific management, and this life history information will be crucial for the on going management and conservation of this species in PNG.

Keywords: growth, maturity, fisheries, back calculation, Akaike's information criterion (AIC).

Age, growth and maturity of oceanic whitetip shark (*Carcharhinus longimanus*) from Papua New Guinea

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Oceanic whitetip sharks *Carcharhinus longimanus* in the Western Central Pacific Ocean have been overfished and requires improved assessment and management to enable planning of recovery actions. Samples from 103 individuals, 70 males (76.0 – 240 cm TL) and 33 females (128 – 235 cm TL) were used to estimate age, growth and maturity parameters from sharks retained by longline fisheries in Papua New Guinea. Back calculation was used due to low number of juveniles and a multi-model framework with AICC estimated growth parameters. The von Bertalanffy growth model provided the best fitting growth model for both sexes. Parameter estimates for males were $L\infty$ = 315.6 cm TL, k = 0.059 yr-1, L0 = 75.1 cm TL, and $L\infty$ = 316.7 cm TL, k = 0.057 yr-1, L0 = 74.7 cm TL for females. Maximum age was estimated to be 18 years for males and 17 years for females, with a calculated longevity of 24.6 years and 24.9 years, respectively. Males matured at 10.0 years and 193 cm TL, while females matured at 15.8 years and 224 cm TL. *Carcharhinus longimanus* is a slow growing, late maturity species, with regional variation in life history parameters, highlighting increased vulnerability to fishing pressure in this region.

Keywords: life history, vertebral analysis, pelagic fisheries.

Regulating shark and ray mortality through effective policy

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Shark and ray populations across the world are under threat, primarily due to fishing pressure resulting from global demand for shark fins and mobulid gill plates, and more recently, domestic and regional consumption of meat. However, most countries lack effective management measures to regulate their fisheries or trade in order to curb further population declines, aid species recovery, or shift toward sustainable fisheries that also secure fisher livelihoods. Increasingly, international conventions such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species (CMS) are playing a role to manage these species, however, one major obstacle hindering progress, and sometimes resulting in the failure to implement actions, is the lack of sufficient data. Sri Lanka, although being among the top 15 elasmobranch fishing nations, played a leading role in listing sharks in 2016 at CITES and 2017 at CMS. They have also recently demonstrated that a positive Non-Detriment Finding (NDF) with conditions can be developed to facilitate sustainable trade of CITES sharks, even in data-poor situations. Central to this NDF was a recommendation for additional species-specific data to be collected. Therefore, we have established a research project to routinely collect data from four major landing sites across Sri Lanka. Since August 2017, we have conducted 135 surveys and identified a total of 48 species (23 sharks and 25 rays) from 1,947 recorded specimens. In addition to fulfilling requirements under the NDF, this data improves our understanding of national species diversity, helps track changes over time, and updates regional distribution maps. While progress is being made, such data collection must be expanded across the region, particularly given the regional ranges of many shark and ray species. Furthermore, additional fisheries management initiatives are necessary, such as regional NDFs that take into account shared stocks, survival post-release to implement catch quotas, and bycatch mitigation. Ultimately, for conservation policies to be effective they must be up-to-date, realistic, practical and enforceable, and of course be implemented. Focus on sustainable management of species such as via CITES regulated trade should be prioritised over drastic, reactive last-minute measures such as total prohibition.

Movement and habitat use of spotted eagle rays, *Aetobatus narinari*, throughout Florida's coastal waters.

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Spotted eagle rays (*Aetobatus narinari*), are protected in Florida waters yet harvested in neighboring areas of the Gulf and Caribbean including Mexico, Cuba, and Venezuela. Despite a hypothesized capacity to undertake large-scale migrations, the movement ecology of spotted eagle rays remains largely understudied. This data gap limits our ability to assess population connectivity and the potential impact of these conflicting management approaches. The objective of our study is to examine habitat use and multi-scale movement patterns in two major lagoon systems of Florida (Sarasota Bay Complex and the Indian River Lagoon). To study these movements, we are utilizing multiple acoustic biotelemetry methods, including active tracking and passive monitoring in our locations of interest. Additionally, we are taking advantage of major collaborative acoustic networks to understand large-scale movement patterns along the Florida coastline and beyond as well as utilizing several physicochemical monitoring stations to determine if movement is associated with environmental conditions. Of the fifteen individuals tagged in Sarasota in 2016, eleven were redetected within the array after a lapse in detections suggesting these animals may be seasonally resident to the area. In the Indian River Lagoon individuals are more consistently detected in the area. These contrasting movement patterns have led to hypotheses regarding the role abiotic factors may play in the movement of these species. Understanding movement patterns and how spotted eagle rays respond to varying environmental conditions is pertinent for the effective conservation of the species throughout its range.

Keywords: batoid, acoustic telemetry, distribution, ecology.

Sex-linked markers and their use for inferring sex-determination systems in sharks

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Fish have the largest variety of sex-determination systems in the animal kingdom, including genetic, environmental or the interaction of both. Within fishes, the genetic system can be XY, ZW or even an autosomal. This exceptional diversity has been observed in the few studies on chondrichthyans. Karyotype morphology has only been studied in 50 out of >1250 known chondrichthyan species. Eight species showed reliable evidence of heterogametic sex-determination in males (XY), one species was heterogametic in females (ZW), and two species were homogametic for both sexes. Other species have not yet been assessed, because karyotyping chondrichthyans can be challenging due to the high salt concentrations in their blood and the difficulty in obtaining and storing blood samples. Consequently, we used genome-wide markers to infer the sex-determination system in species from the Carcharhinidae (6), Lamnidae (1) and Triakidae (1). Most studied shark species exhibit an XY system; nevertheless, complex XY systems have been detected as well. These new insights will prove valuable in unravelling the evolution of sex-determination systems in chondrichthyans. Moreover, sex-linked markers can help sex identification of fin or tissue samples, since in silico and PCR validations showed that these markers were effective at assigning the correct sex. In conclusion, our genome-wide methodology is also applicable to a broad range of species with complex genetic sex-determination.

Keywords: SNPs, complexity reduction sequencing, genomics, biology, evolution.

Fishery dynamic of the angel shark (*Squatina guggenheim* and *Squatina occulta*) of the Southwestern Atlantic

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Squatina guggenheim and *Squatina occulta*, also known as angel sharks, are endemic species of the Southwestern Atlantic and are classified as endangered by the IUCN Red List. These animals are highly vulnerable to trawl and gill net fishery, due to their demersal habits with distribution between 10 and 350 m depth. This fact associated with their low reproductive potential, make them extremely susceptible to population depletion. This study aimed to analyze the composition and variation of fishing landings of *S. guggenheim* and *S. occulta* off São Paulo State coast, Brazil. The data used were obtained from the Fisheries Monitoring Program developed by the Instituto de Pesca, which uses census method to collect fishing information through dockside interviews in the main ports of the state. For the analysis, the fishing methods that captured the highest biomass were selected: gill net (77%) and trawl net (16%), and CPUE was calculated as the catch (kg) by fishing days (fd). In total, 7398 landings of angel sharks were recorded between 1998 and 2013, totaling 1351 t. Of these, 2915 landings were from gill net fishing, which occurred at depths from 18 to 70 m. There was a downward trend in annual CPUE, which dropped from 217 in 1998 to 4 kg.fd-1 in 2013, registering a smooth peak in 2010. For the trawl fleet, there were 3892 landings of these species from fishing operations conducted between 32 and 100 m, and the annual CPUE remained unchanged over the period analyzed, ranging from 4 to 7 kg.fd-1, with only a peak of 10 kg.fd-1 in 2003. The main fishing methods that catches angel sharks presented different trends during the period considered. Trawl fishing recorded lower catch rates and remained constant, while gill net showed more pronounced decline, matching the values obtained for trawl in the last year of the historical series.

Keywords: Elasmobranchii, CPUE, fishing, trawl net, gill net.

Characterization of the eye and liver transcriptome of the shortfin mako (*Isurus oxyrinchus*)

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The shortfin mako, *Isurus oxyrinchus* is an oceanic pelagic shark species found worldwide in tropical and subtropical waters. It is one of the most frequently shark caught by pelagic longline fisheries, and despite its commercial importance and ecological significance, the understanding of its biology at molecular level is still incipient. Therefore, we have used a deep RNA sequencing analysis of eye and liver tissue from four shortfin mako individuals, in order to uncover and characterize the genes of both organs. A total of 89,95 Gb raw reads were obtained by Illumina paired-end sequencing technology (Hiseq 4000). De novo transcriptome from eye and liver yielded a total of 506,686,525 reads and 336,210 contigs. A total of 274,218 and 310, 628 contigs were mapped for eye and liver, respectively, and 37,227 (11,04%) sequences were successfully annotated based on sequence similarities against Uni-Prot, Kyoto Encyclopedia of Genes and Genomes (KEGG), and NCBI non-redundat (NR) protein database. Of these, 31,479 (84,55%) sequences exhibited gene ontology term, which 86.068 (47,8%) were associated with biological process, 55,194 (30,6%) with molecular function, and 39,175 (21,6%) with cellular component. The most frequent terms were: cellular process, single-organism process, and metabolic process for biological process, binding, catalytic activity, and transporter activity for molecular function, and cell, organelle, and membrane for cellular component. In addition, 1,801 gene associated were found to imune system, 1,090 to growth, 520 to behavior, and 344 to reproduction. Furthermore, were found 879,838, 514,037, and 731,659 putative SNPs from de novo transcriptome, eye, and liver, respectively. Our results provide valuable sequence resources for future functional and populational studies for globally Vulnerable shortfin mako shark.

Keywords: shark, RNA-seq, gene annotation, SNPs, conservation.

Evaluation of non-lethal sampling for DNA barcode of endangered skates and rays

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In the last decades a wide variety of non-invasive methods for the collection of genetic samples from elasmobranchs was developed, with direct applications in population genetics, forensic genetics, sex determination and intra and interspecific genetic diversity of threatened species, without cause injuries or death. To test the use of genomic DNA (gDNA) for species identification of batoids using a DNA barcode approach, we obtained mucus samples from skates and rays collected with bottom trawling in Ubatuba, Southeastern Brazil, in 2012. About 1.5 ml of mucus were taken from the pectoral fin surface of *Rioraja agassizi* (n=3), *Gymnura altavela* (n=2), *Hypanus guttatus* (n=1), *Dasyatis hypostigma* (n=2) and *Mobula thurstoni* (9), which were released after being tagged and measured. Overall sequences were blasted using the default settings on FISH-BOLD. A neighbor-joining tree was constructed to resolve the relationships among the species using the Kimura two-parameter algorithm with current COI sequences and ten samples downloaded from FISH-BOLD. Robustness of nodes within the phylogenetic tree was assessed via bootstrapping using 1,000 replicates. Sequences of *Manta birostris* downloaded from the FISH-BOLD were used as external group. All samples were successfully amplified and sequenced to COI barcode. The amplicon obtained was uncontaminated and depicted 630 bp. All the specimens blasted on GenBank and FISH-BOLD yielded to 98-100% accuracy for species identification. Similarly, the phenetic tree grouped all samples into to their respective clades downloaded from FISH-BOLD, corroborating the accuracy in species identification from mucus samples. The inter and intraspecific distance were > 2% to different species and < 1% to individuals of the same species. In addition, the NJ tree for *M. thurstoni* resulted in one clade with few intraspecific variations, not revealing difference among Southwest Atlantic and Indo-Pacific (Indonesian and Malaysian) and Pacific (Mexico and Ecuador). In an overfishing and population decline scenario of elasmobranchs worldwide, the development and validation of protocols for the non-lethal sampling of rays and skates should be encouraged and be useful of DNA-based assessments for scarce, low density, wide-ranging species.

Keywords: shark-like batoids, DNA, non-invasive methods, molecular marker, conservation.

Molecular study of the species *Rhinoptera brasiliensis* (Chondrichthyes; Rhinopteridae) in the coast of Southeast and South, Brazil

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The species of stingray *Rhinoptera brasiliensis*, is inserted within the components of elasmobranchs in the family Rhinopteridae and is currently described in the IUCN red list as 'endangered'. Although this specie currently present an alarming population decline and risk of extinction, studies focusing biological and genetic aspects are still rare. In this contest, the objective of this work was to analyze the genetic structure of populations of this specie using a molecular marker cytochrome b (Cyt b) the mitochondrial DNA, in order to better understand the genetic structure of this stingray species that occurs in the coast of Santa Catarina (SC), São Paulo (SP) and Rio de Janeiro (RJ) states, thereby establish possible relations existing between different populations. Fragments of muscle tissue were removed of the animals and fixed in alcohol, were used for the extraction of total DNA and amplification of the Cyt b gene, subsequently sequenced. The programs Geneious, DNAsp, Alerquin 3.01 and Network 4.6 were used for editing and for the statistical analysis on the sequenced obtained. The population presented $F_{ST} = 0.01543$ and a consensus sequence with 438 bp was obtained 4 different haplotypes with 3 variable sites were found. The haplotypic diversity value found was 0.4842, and the haplotype 1 (H1) was the most frequent in 42 individuals, being 25 from SC, 23 from SP and 12 from RJ. These partial results show that the *R. brasiliensis* would evidence of an initial population genetic diversity. However, it is considered a necessity of extreme importance the amplification of the sampling in other localities in which there are records of occurrence of these species, as in the coast of the Colombian Caribbean, Mexican coast (Gulf of Mexico), Venezuela, Bahamas Islands and the west coast. It is considered that such a broad analysis would provide conditions for better access to the genetic diversity patterns of the species under study.

Keywords: mitochondrial DNA, Cyt b, conservation.

Double tagging clarifies post-release fate of great hammerheads (*Sphyrna mokarran*)

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Biotelemetry applications have advanced our understanding of many highly migratory species, but present a challenge for species that suffer high capture and/or post-release stress. Failing to accurately characterize post-release fate can obfuscate our understanding of animal movement patterns, and complicate the development of effective conservation and management plans. The great hammerhead (*Sphyrna mokarran*) is a long-lived, highly migratory shark listed by the International Union for the Conservation of Nature as Endangered. Accordingly, we used a combination of tags designed to report horizontal position estimates and verify post-release fate, to examine movements of great hammerheads in the northern Gulf of Mexico. Between May and September 2016, three individuals (one male, two females) were equipped with both fin-mounted Smart Position and Temperature Transmitting (SPOT) tags and survivorship Pop-off Archival Tags (sPAT) to provide information on post-release fate. Tagged sharks measured 187 (F), 203 (M) and 250 (M) cm total length. All three sharks surfaced daily, yet individuals showed variability in vertical habitat use, with maximum daily depths ranging from 5 to 98 meters. A single fin-mounted SPOT tag, attached to the smallest of the three sharks, reported position estimates over an 81-day period and moved a straight-line distance of approximately 400 km; however, the other two fin-mounted SPOT tags failed to generate position estimates. All three sPAT tags were programmed for 30 days, and all indicated post-release survival. Final positions of the sPAT tags from the two largest sharks suggested restricted horizontal movements (< 35 km over the 81-day period). Despite their demonstrated utility on other shark species that frequent the surface, fin-mounted SPOT tags may not be the best option for tracking great hammerheads. In addition, our findings illustrate the value of double-tagging animals under certain conditions; notably, over the short monitoring period of this study, one of the three sharks tagged may have been incorrectly presumed dead had only a fin-mounted SPOT tag been used.

Keywords: SPOT, sPAT, post-release mortality, movement.

Global Shark Trends

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Over the next three years the IUCN Shark Specialist Group is developing dashboard of global shark and ray indicators to track conservation outcomes at national, regional, and global scales. Specifically, we will produce a Living Planet Index summarizing trends all available population trend data and a Red List Index tracking change in extinction risk status in 1980, 2005, and 2020. To develop the Red List index, we will complete comprehensive IUCN Red List reassessments (and retrospective assessments) of the extinction risk status of all 1,250 chondrichthyans through 10 expert review workshops by end of 2020. While working toward the Living Planet Index, we summarise trends of 163 populations of 83 species, spanning 8 orders. We will use this knowledge to make the case for shark and ray conservation to the public and provide salient information to decision-makers to enable them to make appropriate conservation decisions. The team will develop a conservation priority model to combine Living Planet and Red List Indices with conservation likelihood indices and species distribution maps to identify those locations, and associated policy interventions, worthy of further conservation attention.

Advancing our understanding of long-lived species: A case study on the Greenland shark

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Long-lived species share life history traits such as slow growth, late maturity, and low fecundity. These characteristics pose complications for species management due to implications for increased vulnerability to reductions in population size and slow recovery rates. Additionally, the duration of current monitoring studies may not be sufficient to encapsulate the total range of variation in physical characteristics and behaviours that occur throughout long animal lifespans. The Greenland shark (*Somniosus microcephalus*) recently gained the world spotlight as Earth's longest-lived vertebrate, but despite recent interest and rapid scientific advancement, many questions regarding its biology, physiology, and ecology remain unanswered. This knowledge gap highlights a critical data disparity and the emphasizes the complexity of studying long-lived species in general. Here we discuss the potential for specialised ageing techniques and demographic studies to shed light on the age-class structure and distribution of Greenland shark populations. We present advances in the field of population genetics and genomics that will reveal key factors contributing to the Greenland shark's extreme longevity and infer their susceptibility to environmental change. New tagging technologies and improvements in experimental design and data analysis will allow for monitoring of Greenland shark movements using age-based approaches to examine behaviours over various spatiotemporal scales, while simultaneously collecting data on the oceanographic conditions encountered by tagged individuals, as well as species interactions. By adopting interdisciplinary approaches such as the use of stable isotope analysis and high-tech data-logging devices (ie. accelerometer and acoustic), there is the potential to answer persistent questions surrounding the feeding strategies, predatory capabilities, and trophic role of Greenland sharks. Measures of physiology, including estimation of metabolic rate, heart rate and function, oxidative stress, and blood O2 affinity, will also be key to improving our understanding of the causes and consequences of long lifespans. Finally, determining the extent and effects of fisheries interactions and gear modifications will guide the development of management policies directed toward the protection of this inherently vulnerable long-lived species. By building on past Greenland shark research, and drawing from the cutting-edge tools and techniques across this vast range of disciplines, we propose innovative approaches to direct future research on the Greenland shark and promote an increased consideration of longevity as an important factor in the study of aquatic and terrestrial predators.

Keywords: longevity, *Somniosus microcephalus*, management.

Assessing the movement patterns and environmental triggers of cownose rays along the US Atlantic coast

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The cownose ray *Rhinoptera bonasus* is an abundant batoid species that occurs along the US Atlantic coast both offshore and in coastal estuaries. Movement data of rays tagged in the Chesapeake Bay between 2014 and 2016 indicated that cownose rays overwinter offshore near Cape Canaveral, Florida and return to Chesapeake Bay during the summer. Few rays, however were detected in other estuaries along the coast and no tagged rays were detected inside the Indian River Lagoon, Florida, where cownose rays have reportedly been sighted year-round. To explore these contradictory observations, data from 9 cownose rays tagged in Maryland that were still transmitting data in 2017 were compared with data from 12 cownose rays tagged in the Indian River Lagoon, Florida. Tagged individuals were tracked between January and December 2017. Although rays tagged in the Chesapeake Bay were detected on passive acoustic receivers from New York to Florida, rays tagged inside the Indian River Lagoon were detected only by receivers inside the Indian River Lagoon with the exception of one individual that was detected off the Georgia coast. We analyzed environmental parameters including sea surface temperature, salinity, and chlorophyll a concentration at the locations of tag detections at both coast-wide and regional scales to evaluate differences between the environmental conditions experienced by both populations. Data analysis is ongoing, but we expect to see a correlation between movement data and environmental conditions that could be influencing distributions of the two populations. Our results have important implications for the management of two likely sub-populations of cownose rays using the same region.

Keywords: Cownose ray, Chesapeake Bay, tracking, migration, ecology, telemetry.

Updated list of chimaeras, sharks, rays and skates present in the Exclusive Economic Zone of Venezuela, including information from online databases

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Starting from the last annotated checklist of the living Chondrichthyes of the world, all the species that had a Northwest Atlantic distribution (NWA) were selected. This list was croos-referenced and depurated with the published articles (including books) of the Class Chondrichthyes made within the Exclusive Economic Zone of Venezuela (EEZV). Likewise, this data matrix was complemented with the information of the FAO (NWA) identification key species whose distribution where within the EEZV. To ensure the geographic distribution (refine of the matrix), Online Databases (OD) information were included (i.e. OBIS, iSpecies and IUCN) adding new species (with at least one registry within the EEZV). The taxonomic validity of each species was corroborated with the Online Catalog of Fishes from the California Academy of Sciences. From the national bibliography a total of two Classes, nine Orders, 30 Families and 96 species were recorded. With this research it was increased to 10 Orders (Rhinopristiformes), 35 Families (Rhinochimaeridae, Anacanthobatidae, Gurgesiellidae, Aetobatidae, Pentanchidae) and 117 species. When comparing OD with the data of the new matrix compiled, they matched only with: 26.36% (OBIS) 35.89% (iSpecies) and 65.81% (IUCN) respectively. All species (with the exception of *Squatina david, Centrophorus uyato* and *Tetronarce occidentalis*) have a conservation status, highlighting four species in the "Critically Endangered" state (*Pristis pristis, P. pectinata, Narcine bancroftii* and *Isogomphodon oxyrhyncus*), four cataloged as "Endangered" and 16 species as "Vulnerable". The updating of taxonomic lists has a great importance due the congruence of the scientific and biological contribution corresponding to the correct species taxon of study, especially in developing countries, which could have an impact on the adequate management of the resource. Likewise, the inclusion of this chondricthyan list in the different OD consulted are highly recommended, given that the latter are used for biogeographic studies, which decisions are made regarding conservation, management and distribution for each species. Finally, it is also recommended to verify the identification validity of the specimens deposited in national and international museums (e.g. *Breviraja spinosa, Benthobatis marcida, Gymnura altavela, Etmopterus hillianus, Cirrhigaleus asper*) since some of the OD consulted includes those species within the aquatic space of Venezuela.

Keywords: Caribbean Sea, Chondrichthyes, IUCN, species validation, taxonomy.

Preliminary study of *Mustelus schmitti's* ova morphometry using Digital Image Processing techniques

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Mustelus schmitti is distributed geographically from north of Rio de Janeiro (Brazil) to the south of Argentinian Patagonia and shows only a left ovary. This chondrichthyan fish is one of the main shark species exploited by the fisheries in Argentina. The capture levels clearly demonstrate that nowadays it is declining its number along the South Atlantic coast. The image processing algorithm for segmentation is applied is based on a clustering algorithm in YIQ (luminance, in-phase, quadrature), color space and, the objects are classified among distance operator clusters. Histological sections were photographed by a camera C7070 Olympus adapted to an Olympus BX51 light microscope. Preliminary results show more numerous and less big ova in neonate and young specimens than in mature ones which represents accurately the natural process of folliculogenesis. The aim of this study is to facilitate the researcher's work with an automatic tool to estimate the number, shape and dimensions of ova from the ovaries' microphotographs.

Keywords: *Mustelus schmitti*, ovary, digital image processing.

A multi-technique approach to reveal resource partitioning in stingrays

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Benthic rays often occur sympatrically, which could result in high competition if resources are limiting. To reduce competitive effects, individuals could hypothetically partition prey or habitat resources. Research on resource partitioning in Myliobatiformes remains limited and requires further investigation to determine if and the extent to which it occurs. St. Joseph Atoll, Seychelles, hosts an abundance of juvenile and adult stingrays, particularly feathertail rays *Pastinachus sephen*, mangrove whiptails *Urogymnus granulatus*, and porcupine rays *Urogymnus asperrimus*, providing an ideal ecosystem in which to investigate intra- and inter-specific prey and habitat partitioning in stingrays. Dietary habits of the three species were determined through stomach content and stable isotope analysis, and movement patterns were determined through passive acoustic telemetry using an array of 88 receivers in and around the atoll. Stomach contents (n=112) revealed that although all species consumed the same prey types, there were significant inter-specific differences in prey proportions consumed (ANOSIM, R = 1, p = 0.004) and indices of dietary overlap were low between species (Schoener = 0.16 and Pianka = 0.09). Conversely, isotopic analysis of muscle samples (n = 103) failed to detect this inter-specific dietary variation due to similar isotopic values of prey items. However, isotope signatures were significantly different between ontogenetic stages highlighting intra-specific dietary shifts (ANOVA, F = 36.83, DF = 7, p < 0.01 for d13 C and F = 32.12, DF = 7, p < 0.01 for d15 N) with adults occupying a higher trophic position compared to juveniles (TL = 4.6 and 3.3 respectively). Telemetry data revealed 70% of individuals (n=60) were detected for periods of at least 1 year in the atoll (maximum of 3.5 years), and for 52% of days monitored on average. Analysis of micro-habitat usage within the atoll revealed distinct preferences for the shallow sand flats compared to deeper lagoonal and fringe reef habitats. Network analysis showed movements were highly restricted in the atoll and there was high inter-individual variability in the location of home ranges. Despite this, ANOSIMs revealed habitat was not partitioned by species, sex or size class. There was, however, evidence of dispersal by larger individuals from the atoll, suggesting that this habitat is largely utilized as a nursery area. The variety of methodologies utilized enabled a more complete understanding of the ecology of this sympatric stingray community, and we advocate for multi-technique studies moving forward to close the knowledge gaps on this understudied faunal group.

First insights into the population characteristics and distribution of manta rays, *Mobula alfredi* and *M. birostris*, in French Polynesia

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Manta rays are some of the largest and most iconic elasmobranchs of the world's oceans, yet many aspects of their life history, ecology and distribution are still poorly understood. In French Polynesia both manta species, *Mobula alfredi* and *M. birostris*, are observed. Despite being an important cultural asset and generating significant economic benefits through manta watching tourism, published data providing insights to the ecology, prevalence and threats to these species in the region are scarce. Using citizen science and data gathered during two scientific expeditions, this is the first study to assess the population characteristics and distribution of manta rays in French Polynesia. The dataset from all combined sources included 1053 photo-identification sighting records (1043 for *M. alfredi* and 10 for *M. birostris*), collected from 2001 to 2017; comprised of a total of 302 individual *M. alfredi* and 10 individual *M. birostris*. While the sympatric distribution of both manta species had previously only been reported for the Marquesas Islands, we provide the first confirmation of sympatry in the Society Islands. High site fidelity of *M. alfredi* individuals to certain aggregation sites was recorded; with 35%, 86% and 48% of the locally identified population being re-sighted in Bora Bora (n = 106), Maupiti (n = 51), and Tikehau (n = 71), respectively. Moreover, eight individuals have been recorded between sites located 50 km apart on different islands showing connectivity of these populations. From these, seven individuals have been re-sighted over periods spanning >10 years. The use of citizen science datasets provided valuable, non-intrusive and cost-effective insights into the population characteristics of manta rays in the region, although sampling effort within and between sites over time was not consistent. Our findings emphasise the need for further research to allow for a comprehensive evaluation of population structure and size. These findings also aid the identification of potential threats that may face the local manta populations, especially in areas where tourism and coastal development activities occur. Such information is essential to implement effective conservation measures for these threatened species.

Keywords: site fidelity, citizen science, sympatry, spatial connectivity, eco-tourism management.

The secret life of sharks in Costa Rica: Quantifying shark distribution and abundance using baited remote underwater cameras.

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Evaluating the status of reef-associated shark populations is particularly important given the rapid rate at which some species are declining. In Eastern Tropical Pacific (ETP), the status of common shark species is poorly known despite intense fishing pressure. Moreover, the lack of knowledge, unreliable (or nonexistent) landing statistics and limited enforcement of existing fisheries regulations has hindered management and conservation efforts, threatening the future of shark populations in this region. Therefore, implementing novel methods to effectively assess shark populations in data-poor countries from the ETP is a crucial step towards their conservation. This study quantified the distribution, abundance, and habitat use patterns of sharks in Cocos Island, Pacific of Costa Rica, using baited remote underwater video systems (BRUVS). We also examined spatial and seasonal changes in the trophic structure of Cocos Island. Between December 2016 and October 2017, we deployed 121 BRUVS at depths ranging from 5–41 m (21.1 ± 8.9 m) and covering a wide range of habitats (coral and rocky reefs, sand, rhodolites, etc.). BRUVS (40% analyzed) recorded a total of 118 fishes, from which 11 species were sharks and rays. The most abundant elasmobranch species were the whitetip reef (*Triaenodon obesus*), scalloped hammerhead (*Sphyrna lewini*) and the black-spotted stingray. Large and top predators accounted for 19% of the total fish abundance. This is part of an ongoing study that has allowed: (i) generating relatively fast baseline data to detect population level changes of reef-associated predators in response to multiple threats such as fishing, habitat degradation and climate change; (ii) evaluating shark abundances in rocky pinnacles and pelagic environments; and (iii) build capacity among Park Rangers from Cocos Island to ensure the sustainability of this assessment in the long-term. Finally, this dataset will contribute to FinPrint Project, a global-scale assessment of reef shark populations.

Keywords: sharks, rays, coral reefs, conservation, Cocos Island, Eastern Tropical Pacific.

Signs of hope: distribution and current status of the Largetooth Sawfish in Costa Rica

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The largetooth sawfish (*Pristis pristis*) is one of the most endangered species of elasmobranchs and has been declared locally extinct in 27 countries. Recent sightings included in this study show the species is still present in Costa Rica; however, given the lack of recent investigations, its current distribution and population status remains unclear. This study investigated the status (geographical distribution and abundance) of the Critically Endangered Largetooth Sawfish in Costa Rica by conducting 277 interviews in costal and riverine communities in the entire country. Through the interviews we gathered 203 sawfish encounters in Costa Rican waters, these reports included information on date, location, type of encounter (capture, sighting), state and uses; other 21 side reports were also included. Most sawfish were captured by hook and line (n = 72) and gill/seine nets (n = 67). Sawfish meat was mainly marketed and rostra's main use was as trophy or decoration, rare medicinal uses are described. The areas that registered the highest number of encounters were Gulf of Nicoya (n = 63), Northern region (n = 59) and the Térraba-Sierpe National Wetlands (n = 35). We used sawfish sighting data to investigate changes in the historical and current distribution in Costa Rica. Our findings suggest there are two main hotspots, one in the Northern region (Río San Juan, border with Nicaragua) and the other in the south Pacific (Térraba-Sierpe National Wetlands). Interviews also revealed that gillnets were the main threat affecting sawfish in the central and south Pacific, whereas the use of harpoons are a larger threat in the Northern region. This study demonstrated that sawfish had a much broader distribution than previously reported in Costa Rica. Knowledge of the current distribution and threats affecting sawfish were critical to achieve legal protection of the species in Costa Rica. However, stronger education programs and law enforcement are urgently needed to ensure the species long-term survival.

Keywords: largetooth sawfish, Costa Rica, distribution, hotspots, conservation, legal protection.

Collaborating regionally to fill priority knowledge gaps to conserve neotropical freshwater stingrays

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The Neotropical freshwater stingrays Family Potamotrygonidae are the world's largest radiation of freshwater elasmobranchs, currently numbering ca. 28 species and representing ca. 50% of obligate freshwater elasmobranchs. Despite their global biodiversity importance, the conservation status of this group is poorly known: virtually all species assessed thus far for the IUCN Red List of Threatened Species are classified as Data Deficient. Efforts to evaluate the impact of exploitation, in food fisheries and for the international ornamental trade, have been impeded by the lack of data on key population parameters and dedicated field survey efforts. The Wildlife Conservation Society (WCS), a partner in the Global Sharks and Rays Initiative (GSRI), implementing a ten-year global strategy to conserve the chondrichthyan fishes, is expanding efforts to clarify the conservation status and management needs of these species WCS hosted a regional workshop held in Manaus, Brazil, in March 2018, with the objectives of 1) identifying and prioritizing key data gaps for the Potamotrygonidae; 2) building a research agenda to address these priorities and reviewing the resources needed for implementation; and 3) strengthening a regional network of experts on, working on Neotropical freshwater stingrays in the Amazon, Orinoco, Magdalena and Mar del Plata basins. The workshop also reviewed data and other needs to support the effective implementation of CITES listings and related decisions and recommendations for this group. With a network of specialists from Brazil, Peru, Colombia, Bolivia, Argentina, Ecuador and Uruguay, this initiative aims to make major steps towards the conservation and sustainable use of this globally important group of fishes.

Keywords: freshwater stingrays, Potamotrygonidae, regional collaboration, gaps of knowledge.

Getting to the bottom of it: Bathypelagic fauna of elasmobranchs in the Falkland Islands revealed from bycatch of the deep-sea bottom longline fishery

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Bathypelagic elasmobranchs can be difficult to sample and are therefore relatively poorly studied. However, commercial fisheries could present a source of crucial data on these species, and the first examination of the elasmobranch catch in the deep-sea (900 – 1,700m) of the South Atlantic was carried out in Falkland Islands waters. We use commercial catch and observer data from the Patagonian toothfish (*Dissostichus eleginoides*) longline fishery to examine the trends in species abundance and proportions, geographical distribution, and biological characteristics of deep-sea sharks and skates from 2003 to 2017. Skates as a complex of species comprise about 2% of the longline total catch (the second highest bycatch by weight at 34.3t per year) but this is dispersed across mainly three skate species, each representing on average between 0.2% and 0.5% of the annual 1,300t total catch. All three of these species, *Amblyraja georgiana*, *Bathyraja meridionalis* and *B. papilionifera* are currently listed as 'Data Deficient' in the IUCN Red List. Porbeagle (*Lamna nasus*) and sleeper (*Somniosus* sp.) sharks represent 0.1% and 0.3% of the catch, respectively. Skates are caught more frequently in shallower (<1,000m) and in the more northern area of the longline fishing zone, while porbeagle and sleeper sharks are more common in the southern area. Porbeagle sharks caught in Falkland Islands waters are primarily large (>180cm TL) and mature, in contrast to more subtropical fisheries of the Atlantic that also catch small juveniles. Conversely, all but one sleeper shark caught in Falkland Islands waters have been relatively small (<200cm TL) and immature. Low bycatch rates of elasmobranchs in this longline fishery may be due to conservation measures put in place to increase the sustainability of the toothfish harvest (e.g. longline gear prohibited shallower than 600m, and implementation of the 'umbrella' gear), which have likely helped reduce elasmobranch bycatch as well. The low abundance of sharks and skates in the deep-sea longline suggests a relatively low impact of this fishery on elasmobranch populations, while at the same time providing an opportunity to increase our knowledge on these poorly studied species.

Keywords: Patagonian slope, skates, sharks, species composition, abundance, data deficient.

Biodiversity and conservation status of Chondrichthyes from the Northern Coast of South America

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Chondrichthyes are among the most endangered vertebrates in the world. Estimates indicate that around 75% of elasmobranch species are under some level of extinction threat. This lead to the inclusion of several species in the IUCN Red List of Endangered Species, and the creation of national plans of action for their conservation in various countries. For this analysis, in the Northern Coast of South America (NCSA: 8.800 km), occurrences of 166 marine and estuarine species were computed in the following order: Colombia (76), Venezuela (119), Aruba (66), Curaçao (61), Bonaire (38), Trinidad & Tobago (76), Guyana (71), Surinam (82), French Guyana (77), and Brazil's Amazon Coast (BAC – Amapá, Pará, Maranhão states: 63). These regions provide several ecological conditions ranging from deep waters, shallow coral reefs, and upwelling areas in the southern Caribbean to large estuarine waters with the Amazon-Orinoco rivers plume. We revised published species occurrences throughout the area to evaluate their conservation status globally following IUCN and for each country with endangered species lists. Out of the 166 species recorded, only 2.4% are considered to be CR, followed by 3% as EN, 10.2% as VU, 14% as NT, 20.5% as LC, and 39.1% as DD, while 10.2% had no information. The only countries with endangered species lists are Brazil (BAC: 13), Venezuela (13), and Colombia (30). However, despite the lists of somewhat updated species in some countries, there is a great lack of knowledge about their chondrofauna and conservation status in the area, since many species have not yet been evaluated. Data on species distribution, habitat use, nursery areas, and conservation status are scarce and mostly present for a few Carcharhinidae and Dasyatidae species. As a general pattern, most of the catches in the area are obtained through artisanal fisheries. However, several taxa have experienced severe declines throughout the evaluated range, such as *Isogomphodon oxyrhynchus*, *Pristis* spp., *Carcharhinus* spp., *Sphyrna* spp., *Fontitrygon geijskesi*, *Hypanus gutattus*, *Styracura schmardae*, *Gymnura micrura*, *Diplobatis colombiensis*, *Narcine bancroftii* and *Rhinoptera brasiliensis*. The greatest threats recognized for the species inhabiting the NCSA are overfishing caused by predatory fisheries, lack of fisheries inspections and data, and key habitat destruction. Furthermore, around 50% of the species in the area lack basic biological information and could be under some level of extinction threat. Therefore, it is a critical conservation region for the Chondrichthyes and urgent conservation action is needed to decrease the effects on their populations.

Updated conservation status assessment of *Carcharhinus porosus* (Ranzani, 1839) based on published data and demographic analysis

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The smalltail shark, *Carcharhinus porosus*, is a coastal species that reaches 120cm in total length found off Maranhão's coast (northern Brazil). This species matures within six years and has a slow growth rate when compared to other similar-sized coastal sharks. In Maranhão, shallow water elasmobranchs are common in bycatch due to the use of gill nets directed to bony fishes. In the 1980s, *C. porosus* corresponded to 43% of elasmobranchs captured in the area, 80% of those being juveniles, suggesting a profound effect on recruitment. This species had an 85% decrease on the total biomass captured since 2004 and is considered threatened (2002 and 2004) and as critically endangered (CR) in Brazilian waters since 2012. However, it is considered as data deficient by IUCN due to lack of information throughout its global distribution. Here, we used fecundity, catch, and growth rate data from 1,128 *C. porosus* individuals captured in Maranhão between 1984 and 1987 to estimate mortality and exploitation rates. This coast is considered the species' global center of abundance. Results pointed towards a strong population loss due to low harvesting resilience. Population growth rates (λ) varied substantially (λ = -0.833 – λ = 1.092), but only Jensen's model yielded a positive population growth rate. Total mortality ratio (Z) estimated catch curves an elevated value (Z = 0.704) from the age of fishing recruitment (three years). The demographic analysis evidenced it to be subjected to overfishing for at least three decades with an exploitation rate of 65% above the mortality equilibrium threshold, an evidence of population collapse. When applying the results herein, and of previous studies to the IUCN criteria for endangered species, we highlight three points that should be key in considering a review of current conservation status for this species: (1) its distribution has decreased substantially after recent taxonomic revision – now restricted to the Atlantic ocean; (2) biomass caught plummeted by 85% in its global center of abundance since 2004 and has not recovered; (3) its life history characteristics alone already tells that the species is weakly resilient to anthropogenic disturbance. Hence, *C. porosus*, which actually fits in regional assessments in Brazil A4db, should also be considered globally by the IUCN as CR. Urgent conservation actions, such as fishing exclusion areas in key regions, may contribute to ensure that local extinction can be slowed down or even prevented.

Keywords: Smalltail shark, mortality estimates, demographic studies, northern Brazil.

Effects of mass extinctions on the diversification of Neoselachii orders

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Identify factors that shaped clades diversity dynamics is the key of macroevolutionary studies. Mass extinctions are among the most important global events for the evolution of biodiversity. Understanding the effects of these events on marine biodiversity is still incipient. Sharks and rays (order Neoselachii) undergone the last three mass extinctions and could be used as a model to explore the effects of catastrophic extinctions on marine biodiversity evolution. The aim of this study was investigated whether the Permian (~251 million years ago), Triassic (~200 Ma) and Cretaceous (~66 Ma) mass extinctions have affected diversification rates of Neoselachii orders. We obtained 6,695 fossil occurrences for fifteen orders from the Paleobiology Database in a genera taxonomic resolution, encompassing ~358 Ma of the fossil record. Additionally, we obtained 1,139 occurrences of extant species of rays and sharks from an annotated cheklist. Using the PyRate software, we estimated parameters of preservation process, speciation and extinction times for each species, from which we obtained speciation and extinction rates for each Neoselachii order. We ran PyRate for 500,000,000 generations of MCMC (Markov Chain Monte Carlo) algorithm, using 10 replicates and initial 20% as burn-in period. The chains convergence were evaluated in Tracer software (adopting ESS>200). The speciation, extinction and diversification rates graphics were implemented using R-3.4.3 platform. According to our results, none of the fifteen orders show alteration in diversification rates related to mass extinction events. Orectolobiformes did not show reliable results. Heterodontiformes, Pristiophoriformes, Rajiformes, Rhiniformes, Squatiniformes and Torpediniformes showed no relevant variation over time in analyzed rates. Carcharhiniformes, Hexanchiformes, Lamniformes, Myliobatiformes, Pristiformes, Rhinobatiformes and Squaliformes demonstrated a decline in the speciation rate, followed by a posterior stabilization. Except for Synechodontiformes, the other seven Neoselachii orders presented an increase in the extinction rate 10 Ma ago, reflecting a decline in the diversification rate for each of these groups. Synechodontiformes, the only extinct order, showed a small decline in speciation rate, resulting in a decrease in diversification rate. We concluded that mass extinction events do not affected diversification rates of the Neoselachii orders. Six orders did not present variation on diversification rate, while eight orders showed a declining diversification rates.

Keywords: big extinctions, extinction rates, sharks, speciation rates, rays.

The role of competition on Neoselachii macroevolutionary patterns

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Biodiversity is modeled by speciation and extinction events in a constant replacement of species. These changes are driven by biotics and abiotics factors and ecological interactions. The current knowledge on macroevolutionary patterns is biased by continental clades, and studies of marine biota is still sparse. In this regard, previous works have found a pattern of increasing extinction rate in recent evolutionary dynamics of Neoselachii. From an eco-evolutionary perspective, one important contributive phenomenon to this pattern are species competition among Neoselachii species and among Neoselachii organisms with other emerging clades. In this study we examined the role of intraclade competition among Neoselachii orders and interclade competition between Neoselachii orders and Delphinida (Mammals: Odontoceti) in the Neoselachii orders extinction rates. We analyzed 6,695 Neoselachii occurrences within fifteen orders (Carcharhiniformes, Heterodontiformes, Hexanchiformes, Lamniformes, Myliobatiformes, Orectolobiformes, Pristiformes, Pristiophoriformes, Rajiformes, Rhiniformes, Rhinobatiformes, Squaliformes, Squatiniformes, Torpediniformes and Synechodontiformes), which covers the entire clade existence from 358 million years to presente, and 524 Delphinida occurrences, all extracted from Paleobiology Database (genera taxonomic resolution). For each order we analyzed the fossil occurrence using PyRate program according to a birth-to-death model. Simultaneously, it inferred the preservation process, speciation and extinction rates and origin and extinction times for each species. Afterwards, we analyzed the effect of order competition on extinction rates. We performed 500,000,000 of Markov Chain Monte Carlo generations and 10 random replicas, excluding the first 20% of the data (burn-in phase). For the chains convergence, we considered ESS>200 on Tracer software. We used the R plataform to generate the graphs of competition among orders. Our results showed the effect of intraorder competition only among six orders. Lamniformes extinction rates were affected by Myliobatiformes, Rajiformes and Rhinobatiformes; and Squaliformes extinction rate declined in result of competition with Orectolobiformes. Regarding to interclade competition with Delphinida, this clade caused an increase in Hexanchiformes, Myliobatiformes, Pristiophoriformes and Squaliformes extinction rates. We concluded that between sharks orders the competition does not show strong influence on sharks extinction rates. Meanwhile, rays orders and Delphinida have a strong effect on sharks extinction rates.

Keywords: Delphinida, extinction, interaction, rays, sharks.

Informing and Sensitizing: The importance of digital media for the conservation of sharks in Brazil

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Sharks, in Brazil, undergo overfishing and accidental catches, and several species are endangered. Sharks are also subject of social rejection and phobia, because of the negative image and prejudice promoted by movies, newspaper, magazines, and more recently the digital media. In Alagoas state, Northeastern Brazil, this reality is far from different. News about sharks are transmitted in a sensationalist and untrue way to the population, which creates even more barriers to conservation efforts. This study aims to understand and survey news about sharks in Brazil and Alagoas in the digital media. To attain this, we performed a keyword search method on the internet limiting the period from 2012 to 2017. The keywords searched were: "Shark + Alagoas", "Shark + Northeast", "Shark + Brazil" and "Shark". The news found were classified as adequate or inadequate according to their content. News which dealt with sharks as scary animals using repulsive adjectives and highlighting their negative interactions with human beings, without any scientific basis, were considered discriminatory and classified as inadequate. The news that used a scientific basis were qualified as appropriate. The searches resulted in 84 national news and 29 news from Alagoas. The majority of the results was considered inadequate, 67% of the national and 75% of the ones from Alagoas (n = 56 and 22, respectively), and more than 50% of all the news showed images of dead sharks, depreciating them. Our results highlight the medias' incompetence to disseminate correct information about sharks, causing untold damage to conservation due to negative publicity and the diffusion of inaccurate knowledge. This approach is supported due to a huge commercial interest in sharks' image because its sensationalist potential to generate repercussion increases digital media access. However, this approach main problem is the impact of this mistaken information on the society, since it encourages phobia, rejection, prejudice, fishing and consequently the lack of popular support for shark conservation. There is a need for a change in the awareness of society to conservation. In this way, appropriate approaches of media is indispensable to provide to the reader adequate information on shark biology and thus to help shark conservation and even decreasing the chance of incidents.

Keywords: Elasmobranchs, Communication, Internet.

Global genetic population structure of the smooth-hammerhead shark *Sphyrna zygaena*

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The smooth hammerhead shark, *Sphyrna zygaena*, is a worldwide coastal-pelagic and semi-oceanic species. It is caught with several types of gear in both coastal and oceanic fisheries, as a bycatch and a target species. In some areas, all size classes and reproductive stages are captured. Their fins are highly valued by the international shark fin trade. This shark is listed in Appendix II of CITES, which comprise species that need trade regulation and management. There is a lack of species-specific data to assess population trends due to mislabelling and illegal, unreported and unregulated fishing. As the species is currently assessed as Vulnerable globally in the IUCN Red List of Threatened Species, further investigation into threats, population trends, catches and life-history parameters throughout its whole distribution are recommended. For these reasons, we aimed to investigate the global genetic population structure between the three ocean basins using molecular markers. Analyzing 276 individuals with 769 base pairs of the mtDNA control region we found ten polymorphic sites, 12 haplotypes, low haplotype and nucleotide diversities of 0.541±0.032 and 0.00199±0.00011, respectively. In the AMOVA, we obtained an overall $\Phi ST = 0.72753$ with p = 0.0001 showing a strong genetic differentiation among the ocean basins. The FST pairwise range was from -0.00863 to 0.87078 between sampled locations. The Mantel test characterized the isolation by distance (r2 = 0.799863, p = 0.004) with correlation between genetic distance and geographic distance. The haplotype network also shows no haplotype sharing between the Atlantic and the Pacific Oceans. Determining the spatial patterns of genetic diversity and the degree of isolation or connectivity between populations is fundamental to the study of population dynamics, understanding barriers to gene flow and evaluate conservation units. This is the largest known genetic survey for the smooth-hammerhead shark and these results will contribute to implementing conservation and management plans, conservation units and extinction risk evaluation.

Keywords: *Sphyrna zygaena*, mtDNA control region, genetic population structure, gene flow, conservation.

DNA barcode of a shark finning seizure in Brazil: Implications for wildlife trade surveillance and conservation

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Sharks are characterized by life history traits such as high longevity, slow growth, late sexual maturity, low fecundity, site fidelity, and form reproductive aggregations. In commercially exploited species, these traits are associated with an elevated extinction risk, what make them susceptible to overfishing. The high demand for shark fin soup triggers an increase in the capture and their retention onboard besides encouraging illegal activities such as finning, which consists in the capture of sharks for fins removal followed by the carcass discarding. Shark finning is forbidden in Brazil and also by several nations, while fishing is currently regulated and allowed. Despite this international economic activity, there have been few efforts to implement a species-specific level monitoring system by fishing nations for elasmobranchs, so it is difficult to evaluate the global fin trade environmental effects and for food security. The species-level identification is fundamental for the development of monitoring protocols for sustainable fisheries management and trade surveillance. In 2012, on a routine supervision, the Brazilian Institute of Environment and Renewable Natural Resource (IBAMA) identified the finning practice and seized in the city of Natal, in Rio Grande do Norte State, approximately 3.5 tons of dried fins from two foreign fishing fleet companies. After sampling the seized fins, we used a DNA Barcode identification protocol for characterizing the shark biodiversity. The COI gene sequencing of 220 samples identifies eight different species, six belonging from the family Carcharhinidae (*Prionace glauca*, *Carcharhinus falciformis*, *C. obscurus*, *C. galapagensis*, *C. perezi*, *C. brachyurus*) and two from Lamnidae (*Isurus oxyrinchus*, *I. paucus*). These species are currently threatened or near threatened, and some are protected in Brazil, where their capture and trade are prohibited. Identifying the extent of illegal fishing and underreporting catches are crucial for fisheries management. All seizure materials were incinerated, and the responsible fishing companies were legally punished. Apart from that, illegal shark fishing seizures can provide a conservative estimate of illegal, unreported and unregulated fishing in Brazil, although with the DNA sequencing costs reduction and the constant techniques updating resulted in a wider accessibility to these methodologies, such as DNA Barcode, which can facilitate its implementation by environmental monitoring agencies for trade and fishing activity surveillance, improving the quality of species-specific data, which is fundamental for planning for fishery management and fishing resources conservation.

Keywords: DNA Barcode, COI, finning, surveillance, conservation.

Preliminary data of elasmobranch composition and relative abundance in the Trindade Island, using three different survey methods

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The Trindade Island (20°31'30" S 29°19'30"W), located 1,200 km from the Brazilian coast, off Espírito Santo state, is part of Vitória-Trindade seamount chain. In such a remote environment, the development of aquatic research is very difficult (e.g. transportation costs, fishing logistics), thus little is yet known about elasmobranch diversity and ecology in that region. From August 16 to October 15, 2017, 11 longline sets, 19 BRUVs deployments and 25 free diving visual-census surveys were made around the island to assess the species composition of sharks and rays and to assess their relative abundance (catch per unit of effort- CPUE). The longline was set at the surface, with an effort varying from 16 to 20 circle hooks 16/0 arranged in 500 m of primary line. The captured animals were laced parallel to the inflatable boat, measured for total, fork, pre-caudal and inter-dorsal lengths, tagged with a conventional tag, had a tissue biopsy sample taken from the rear tip of the first dorsal-fin, had the hook removed and then released. BRUVs occurred during 60 minutes interval and visual censuses varied from 23 to 80 minutes. The total CPUE was 0.02 individuals per hook, capturing four *Carcharhinus perezi* (all females), ranging from 200-220 cm; and one *Sphyrna lewini*, female, of 163 cm of total length. BRUVs were launched in 20-30 m depth and only registered one species of elasmobranch, the spotted eagle ray, *Aetobatus narinari*. Visual censuses mean OPUE (observation per unit of effort) was 0.02, which registered four nurse sharks, *Ginglymostoma cirratum*, six *C. perezi* and one *S. lewini*. Each method has its own advantages and limitations. Longlines are effective to assess species and size composition of elasmobranchs, but require high fishing effort, have a higher potential to inflict injuries to the caught specimens, and are more selective for sharks than rays. BRUV is a cost-effective method and registered species that were not observed by the other methods. Since BRUVs only had one register of elasmobranch, the OPUE would not be representative, but this method can work well as a complement to visual censuses. The three methods were all non-lethal and carried out for the first time in Trindade Island as a pilot project, but did provide good preliminary data to assess the local community of elasmobranchs, generating important information for their conservation. In the next expeditions, satellite tagging will be integrated to the elasmobranch monitoring program.

Keywords: oceanic habitat, population structure, Southwestern Atlantic Ocean.

The Weddellian Province and the extant rays in the Southern hemisphere

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The life story strategies of some ray groups make them ideal candidates for investigate biogeographic patterns by its distribution. Possibly the most informative of these groups are the skates. The skates have very high species diversity; skates have an extreme non-migratory life mode and are exclusively bottom dwelling fishes at any age, beginning from eggs with fibrillar filaments for attachment to the bottom. The cosmopolitan distribution of the group is accounted for by its large age. Most skate species live in the shelf and upper slope up to 1000 m of depth, which does not allow them to move across deeper marine regions. They are most diverse at higher latitudes and are replaced in warm temperate to tropical waters by stingrays (Myliobatoidei). The late Cretaceous/Early Tertiary Weddellian Zogeographic Province was an area of shelf habitat encompassing part of Australasia, tip of Southamerica and the Antarctic Craton as a bridge. The opening of the Drake Passage in the Oligocene period, enabled the cold waters of the Pacific Ocean to penetrate in the south Atlantic, causing drastic effects on the thermophilic fauna of the Province. Perhaps here we can find an explanation to the dispersing of the genera in the Trygonorrhinidae Family; to the disjunctive distribution of *Sympterygia* skate species, to the remarkable endemism in Australasia and South America, and to the intrusion of the *Zearaja* species in the South-West Atlantic.

Keywords: Weddell Province, endemism, Antartic bridge, batoids distribution.

Demographic analysis of the Brazilian Sharpnose Shark, *Rhizoprionodon lalandii* on the northern coast of Brazil (Maranhão)

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The Brazilian sharpnose shark (*Rhizoprionodon lalandii*) is a small coastal species found in the western Atlantic from Central America to Uruguay. In the state of Maranhão (northern cost, Brazil), this species was incidentally caught as bycatch in gillnets between 1990 and 2000, and ranked the fifth most frequently caught elasmobranch in this fisheries. After this period, the population of *R. lalandii* of Maranhão declined, and now, the species is rare in fisheries. Thus, the specific aims of the present study were to provide demographic parameters to contribute to the management and conservation of this species in northeastern Brazil. Data were collected on reproductive biology and age and growth of *R. lalandii* from literature references and they were used to estimated natural (M) and total (Z) mortality rates, which corresponded to M = 0.452 and Z = 0.723, resulting in a fishing mortality rate (F = Z - M) of 0.271. The mortality rate that corresponds to the population equilibrium (Z') was 0.363, indicating that even without fishery exploitation (M only), mortalities are very high for the species, resulting in a slight annual population decline (r = -8.9 %). When we use data with Z values from the age of fishing recruitment (2 years), the annual population decline is approximately 36%. The elasticities estimated by Leslie matrices show that the survival of the juveniles individuals (<2 years) is a preponderant factor for the population equilibrium. Although it is a small and fast-growing species, the demographic data of the population of *R. lalandii* do Maranhão show that the main causes of the decline of the species were overfishing and capture of young individuals, and management measures are necessary to control catches.

Keywords: demography, fisheries Maranhão.

Fisheries capture impact on metabolic rate of a commercially exploited species, *Mustelus antarcticus*

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Overfishing is the main cause of the alarming decline in chondrichthyan populations. The effects of fisheries capture extend well beyond immediate death; bycatch species (unwanted capture) are released back into the environment to an unknown fate, as injuries and long-term physiological, physical and behavioural consequences can ultimately lead to delayed mortality. Metabolic rates (MR) are a measure of the amount of energy animals invest in different biological process and determine the rates of almost all these activities, such as growth and reproduction. Research on fisheries stress effects on MR would be highly relevant for the assessment of the sustainability and the effects of fisheries. Nevertheless, few studies have investigated baseline MRs in Chondrichthyans and, to our knowledge, no study exists on the impact caused by fisheries practices on MRs. In this study, we use MR assessment, measured using respirometry, to compare the effect of simulated gillnet capture on *Mustelus antarcticus*. This species is an active, demersal, facultative ram ventilator and is quite sensitive to stress. *M. antarcticus* is commercially exploited, but due to existing management measures, a large number of individuals are released back after capture, making it relevant to study the effect of fisheries stress. In *M. antarcticus* simulated gillnet capture produced delayed mortality of up to 60%; MRs between survivors and dead individuals was not found to be significantly different, suggesting that other variables, not related to respiratory performances, are responsible for delayed mortality. Contrary to what was expected, the MR of stressed animals were in general significantly lower than their baseline MR. Up to date, reduction of the MR in response to acute stress has not been reported for chondrichthyans, and it is probably caused by an underlying secondary stress-related change. This suggests that gillnetting effects are highly energetically demanding and that the only way these fishes can cope with them and avoid immediate death is to shut down unnecessary biological activities, such as growth and reproduction. Ultimately, this energy relocation can seriously impact these activities and their future outcomes.

Keywords: fisheries impact, bycatch, metabolic rate.

A global review of the extinction risk status of ghost sharks (Holocephali).

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Ghost sharks are the often-forgotten group of cartilaginous fishes that, together with the sharks and rays, make up the class Chondrichthyes. Despite their global distribution and presence and utilisation in some fisheries, ghost sharks remain largely data-poor. Their conservative morphology can make accurate species identification problematic, and most species inhabit the deep-sea, further confounding our ability to study this group of fishes. A recent investigation has fully revised the phylogenetic classification of the group, resulting in revised distributions and implications for national and regional management. Using this updated taxonomic revision, the status of all ghost sharks (55 species) has been reviewed and assessed by applying the IUCN Red List of Threatened Species Categories and Criteria. This assessment is part of theIUCN Shark Specialist Group's Global Shark Trends Project, which is assessing the global status of all chondrichthyan fishes (~1 250 species). This is the first reassessment to be completed for an entire subclass of chondrichthyans, and includes many species which have been evaluated for the first time. The global status of ghost sharks and future research directions to address knowledge gaps will be discussed.

Keywords: holocephalan, data deficiency, extinction risk, IUCN Red List.

Historical reconstruction of Pacific angel shark, *Squatina californica*, catches from the northwest Mexico (1960-2015) and their analysis by data-poor assessment methods.

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Squatinidae is one of the most threatened shark families in the world and the Pacific angel shark (*Squatina californica*) is listed as "Near Threatened" by the IUCN. In 2013, when Mexico was ranked fifth among nations with the highest shark catches in the world, Pacific angel shark landings in Mexico had decreased but still represented 3.4% of the total shark catches in the country. Recently, the absence of Pacific angel shark landings at sites with historical records of this species has been reported. *S. californica* status has not been assessed in Mexico due to the deficiency or poor quality of the catch records, the lack of effort data available, and an incomplete knowledge of the biology of the species (e.g., catch size and sex composition). To assess the Pacific angel shark population, we reconstructed the landings of this species from 1960 to 2015 using recent approaches from other fisheries around the world. We used the official data of total shark landings in northwestern Mexico as a baseline to estimate the proportion of *S. californica* from 1960-1999 using information from different data sources (scientific articles, reports, or gray literature). From 2000 to 2015, we used the official Pacific angel shark landing records that included species composition information. The level of uncertainty of the reconstructed data was estimated for the whole landing series. Pacific angel shark landings began to increase during the 1960s, with high increases after 1976 and peaking at the end of that decade. Other landing peaks were estimated to be in 1993, 2000, and 2007. All peaks were followed by a decline (60% average) within the next three years. The Pacific angel shark is captured in greater quantities in the Gulf of California than along the Pacific coast of Baja California. Inside the Gulf of California, the state of Sonora is responsible for the highest landed volume of this species. Our historical catch reconstruction is being used to assess the population of *S. californica* with data-poor assessment methods that will contribute to better-informed management efforts of this shark species in Mexico.

Keywords: Pacific angel shark, historical catch reconstruction, data-poor methods, Mexican Pacific.

Enhancing global shark and ray conservation through the Convention on Migratory Species: A progress report

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The Convention on the Conservation of Migratory Species (CMS) is a global environmental treaty that provides a platform for governments to address the conservation challenges posed by wide-ranging animals. Thirty-four shark and ray species have been listed on the CMS Appendices since 1999. For Appendix II-listed elasmobranchs (blue shark, porbeagle, Northern hemisphere spiny dogfish, dusky shark, makos, hammerheads, threshers, silky shark, white-spotted wedgefish, and common guitarfish), Parties have committed to work internationally toward conservation agreements. For Appendix I species (white shark, sawfishes, basking shark, mobulid rays, angelshark, Mediterranean common guitarfish, and whale shark, all of which are also listed on Appendix II), Parties are obligated to grant strict protections. Whereas CMS has great potential to improve the outlook for many elasmobranchs, the listing of species is outpacing implementation of associated conservation commitments. For example, many CMS Parties have yet to ban retention of the giant manta ray, which was listed on Appendix I (and II) in 2011. The shortfin mako has been listed on Appendix II for a decade, and yet there are still no international catch limits. Results from an in-depth review of Parties' performance and related progress with respect to CMS elasmobranch obligations -- including advances, inadequacies, obstacles, and recommendations for improvement -- will be presented.

Keywords: elasmobranch, protection, international, policy.

Preliminary data of capture-induced abortions in freshwater stingrays *Potamotrygon motoro* in the Upper Paraná Basin (Southwest Brazil)

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A characteristic of viviparous elasmobranchs that are intriguing researchers is the high rate of abortion that these animals present after capture. Although these events have been reported for years, no studies identify the possible causes of this rate and the physiological changes that follow this process. The objective of this study was to evaluate the frequency of abortions during the gestational period and the relationship of these events with plasma glucose levels in *Potamotrygon motoro*. Females adults were collected from October/17 to February/18 (8 October/17; 12 November/17; 11 December/17 and 10 January and 10 February/18) in the Upper Paraná Basin, Ilha Solteira/São Paulo, with the use of harpoons (SISBIO 50019-2). Plasma glucose was measured from December to January (1) at the moment of collection in 26 specimens, (2) after abortion in 13 and (3) after 5 hours of the capture in 31. They were transported live to the Laboratory of Animal Physiology Studies (LEFISA), FEIS-UNESP/Ilha Solteira, where were anesthetized and euthanized for further necropsy. The gestational period of this species was comprised from November/17 to January/18, with no females pregnant in October/17 and only one in February/18. The frequency of abortions was 100% in the pregnant females collected (12 Nov/17; 10 December/17; 10 January/18), with the occurrence of animals in other reproductive stages only in December/17 (2 females at final vitellogenesis stage). The average number of offspring aborted was 3.6±1.15 in November; 3.7±1.85 in December and 2.4±0.8 in January. Glucose data showed no relationship between the time of collection and the moment of abortion (p <0.05 for all the months evaluated) and showed a direct relation with the transport of the animals to the laboratory, with values significantly higher comparing the time of the collection and handling time, in January and February 2018 (p=0.003 and p=0.015 respectively). From these preliminary data it was possible to suggest that the frequency of abortions/premature birth is high, but there is not a direct relationship between this event and plasma glucose levels. We suggest that the increase of glucose levels was related to the stress that occurred due to the animal transport and not due to abortion. Additionally, it is possible to suggest that the gestational period of this species is from November to January. This work intends to follow the analysis of the hormonal profiles, osmolytes and other substrates, in order to elucidate the physiological pattern of the parturition in this species.

Keywords: elasmobranchs, freshwater stingray, parturition, stress, reproductive period.

Metabolism of lipids and fatty acids in freshwater stingrays *Potamotrygon falkneri* reproduction

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The recent inundated Sete Quedas Falls to build the Itaipu dam provided that several species endemic to the lower rio Paraná basin successfully colonized and spread over the upper rio Paraná, one of them is the freshwater stingray *Potamotrygon falkneri*. These species becomes extremely important, since the colonization of habitats previously unexplored through anthropic influence, seems to be determinant for the emergence of physiological specializations. The objective of this work was to characterize the lipid and fatty acids metabolic profile of *Potamotrygon falkneri* in different stages of the reproductive cycle of the species. The collections were carried out upstream of the Porto Primavera reservoir, which is located in the municipality of Castilho / SP (20º 87´05.53``, 51º49`01.81``), with the use of harpoon and active fishing (SISBIo nº 50019-1). The animals collected were anesthetized and euthanized, with subsequent extraction and determination of lipid concentration and analysis of polar and neutral fatty acid chromatography. The results obtained allow us to conclude that there is a tendency to increase the concentration of lipids in muscle and gonadal tissues during the stage of vitellogenesis. The analysis of fatty acids showed a pattern of mobilization of the hepatic and muscular fatty acids to the gonads, manly polyunsaturated fatty acids, very important in the development of embryos and juveniles.

Keywords: reproductive cycle, substrate mobilization, freshwater stingray, exotic species, trophonema.

"Banco Brasileiro de Mantas": sharing information for scientific research on *Mobula birostris*

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Research on large free-ranging marine pelagic animals is challenging due to logistic and financial restrictions. Fieldwork is often away from the coast, facing maritime and meteorological adverse conditions, and relying on costly vessels and specialized crew. The task is particularly harder when dealing with migratory animals that roam over vast oceanic distances, like the giant manta ray (*Mobula birostris*). Global collaborations and data sharing among researchers are likely to improve both scientific research and conservation of those species worldwide. With that aim on mind, we developed a freely available on-line database of M. birostris records along the Brazilian coast as a tool to share the information collected on the field with other conservation programs and research projects all over the globe. The Banco Brasileiro de Mantas (BBM) (Manta Ray Brazilian Database) contains images of observed individuals along with spatial and temporal associated data. The identification of individuals of a particular species is a vital requirement for many aspects of ecological research and conservation and individuals of manta rays (*Mobula birostris* and *Mobula alfredi*) – both listed as vulnerable to extinction – are easily distinguished by a unique set of patches and spots in the ventral region of their bodies. Once the individual gets an ID on the database, each further observation of that individual provides an opportunity to observe its behavior, condition, sexual maturity, size and even its anthropic levels along a time axis. At the same time, we have tapped into the growing interest of the tourists for the knowledge and conservation of marine environments to support them as agents in the service of science. Aiming to multiply the opportunities to collect data, since 2010 the Mantas do Brasil project´s team started to encourage recreational divers to take pictures of manta rays for scientific purposes. The participants are invited to upload the pictures and sighting associated information directly to BBM, which works as a two-way tool: researchers and citizens-scientists update the information, increasing the database and also can consult the data on the screen, using several search filters which facilitate the access to the information, like gender, color patterns, ID number, name, place or date of the sighting, among others. With this initiative, Mantas do Brasil Project aims to foster young professionals to develop their research career in a collaborative way and adding efforts for the conservation of manta rays.

Keywords: data bank, photo identification, citzen science, online database.

Worldwide shark attacks are correlated with phases of the moon

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Shark attacks on humans long have been a global topic of concern and interest. While the prime causes of shark attacks are varied, review of long term (1960-2016) data in the International Shark Attack File has revealed a lunar correlation. In this analysis, we show that worldwide shark attacks are correlated to moon phase using data from 2,157 confirmed, unprovoked attacks involving multiple selachian phyletic lines. Percent illumination of the moon's surface was retroactively determined to categorize the lunar phase at time of attack. Shark attacks were significantly higher during New Moon and Full Moon illumination phases (0-9% and 90-100% illumination, respectively). Nineteen percent of shark attacks occurred during the New Moon phase and 21% took place within the Full Moon phase, whereas attacks in the eight other lunar illumination categories ranged from 6-9%. Results of this study suggest that the risk of shark attack is predictable using phases of the moon and that human beach safety vigilance should be enhanced during New and Full Moon periods.

Keywords: shark attack, sharks, lunar, moon, predation, beach safety.

Local ecological knowledge about rays among fishermen, residents and tourists from Armação beach, Florianópolis-SC, Brazil

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Although rays are important elements between top predators and basal levels on food webs, they receive less attention than sharks in researches and management initiatives. It could be due to several factors, but also because there are few data about this taxon. When traditional scientific information is incomplete, local ecological knowledge (LEK) of communities could be relevant information available to researchers and stakeholders. However, because of the personal characteristics, the LEK could be different among different actors in society. Thus, the objective of the study was to evaluate the LEK on occurrence, distribution, reproduction and feeding of ray species among local residents, fishermen and tourists at Armação beach in Florianópolis. The hypothesis was that the local residents and fishermen have greater LEK about the rays than tourists, and fishermen must know more about the rays than the residents. Individual interviews were conducted with 25 fishermen, 43 local residents and 42 tourists. Most fishermen eat rays meat (96%), followed by local residents (77%) and tourists (31%), with a significant difference among groups. The mean value of LEK level of the fishermen was significantly higher than that of the others two groups and the LEK level of the local residents was higher than the tourists. The explanatory variables "Gender" (Male / Female) and "Group" were the ones that most explained the model. Moreover, the responses of the fishermen were more diverse, complete and in agreement with the scientific literature. The group of tourists is more unaware of the presence of rays in shallow areas and not so far from human population as they believed. Once the success of rays' conservation depends on the ability of researchers and educators to communicate their ecological functional role and to promote a change in attitudes, here we show that difference on LEK could evidence the need for different management strategies and awareness.

Keywords: conservation, elasmobranch, public awareness, management, marine ecology.

Spatial and temporal distribution and environmental preferences of sharks in the Natural Protected Area Archipelago of Revillagigedo

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Sharks of different species and sizes coexist in the same areas, due to habitat partitioning, which may be related to the availability of prey, the type of habitat and environmental conditions, among other factors. The understanding of the differential use of the habitat is important, because it is necessary to have detailed information of the community present in a certain space and time. Therefore, conducting studies in protected natural areas could serve as a better study model for this purpose. This study aims to describe the spatial and temporal variation in the shark communities of the Archipelago of Revillagigedo. For this, we conducted 380 underwater visual censuses (UVC) of sharks in 6 dive sites around 3 islands of the archipelago during 2 seasons of tourism trips (from a single diving company, Nautilus liveaboards), from December 2015 to June 2016 and December 2016 to June 2017. 365 dives presented at least one shark (96.1%). 13,921 sharks were recorded (8,186 in the first season and 3434 in the second) belonging to 9 species of 3 families. *Triaenodon obesus* and *Sphyrna lewini* were the dominant species (83.3% of the total abundance, and occurrences of 87% and 36% respectively). Conversely, 4 species had low relative abundance, <1% of the total abundance, and a frequency of occurrence <5% of the census. *T. obsesus* was the most abundant species in all the islands and was 6 times more abundant in Roca Partida (43.9±2.5 SE ind/diving) than in the other islands (6.7±0.5 SE ind/diving in San Benedicto and 6.1±0.6 SE ind/diving in Socorro). In addition, *S. lewini* and *Carcharhinus galapagensis* were the other dominant species in Roca Partida (19.2±3.9 SE and 6.1±0.9 SE ind/diving, respectively) and *S. lewini* and *C. albimarginatus* in San Benedicto (3.3±0.8 SE and 1.9±0.4 SE ind/diving, respectively). The abundances in Socorro were less than 2 ind/diving.

Keywords: habitat partitioning, community assemblage, abundance, occurrence probability.

Genetic diversity, phylogeography and population structure of freshwater stingray *Paratrygon* spp. in the Amazon and Orinoco basin of Colombia

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There is controversy regarding the number of species and phylogenetic relationships among the family Potamotrygonidae, which groups freshwater stingrays distributed in the majority of river basins in South America. In Colombia, these stingrays have economic value, since they are important in the ornamental fish market. However, due to the lack of information related to biological, genetic, taxonomic, and evolutionary aspects of their biology, it is difficult to manage populations of these fish species. The freshwater stingray *Paratrygon* spp. is part of this family and is found in both the Colombian Amazon and Orinoco. Only one species has been described for this genus (*Paratrygon aiereba*) but some authors suggest that additional species of *Paratrygon* spp., may be found in these basins, but variation in their coloration hinders proper species identification. We amplified and sequenced portions of three molecular markers: fragments of two mitochondrial DNA (mtDNA) genes (Cytochrome oxidase subunit 1–COI 600 bp and Cytochrome b–Cytb 400bp), and as well a fragment of one nuclear DNA marker (nuADN) the Recombination activating gene 1–Rag1 900bp). In samples of 41 individuals within of the basins and sub-basins, the Amazon basin was divided in Loretoyacu, Putumayo sub-basins and main channel of the Amazon; the Orinoco basin was divided in Bita, Tomo, Meta, Dagua sub-basins and main channel of the Orinoco. In order to evaluate the phylogeographic and phylogenetic patterns, the population structure and the genetic diversity of the freshwater stingray *Paratrygon* spp. In Colombia. Our results suggest high population structure with significant values $p \leq 0.05$ of (θ CT and fst), the population differentiation is between Orinoco and Amazon, since different mtDNA haplotypes were not shared between basins (Orinoco vs. Amazon). The maximum likelihood phylogenetic analysis for a concatenated data set that includes the three genes of *Paratrygon* spp. Showed differentiations between the populations composed of three clades corresponding to each geographic area suggesting reproductive isolation. However, we found genetic diversity within populations. These results support the idea that there are at least two significant evolutionary management units for *Paratrygon* spp. in the Colombian Amazon and the Orinoco. The International Union for Conservation of Nature (IUCN) has classified the species *Paratrygon aiereba* as deficient data (DD) and our genetic results should be considered in local management plans and conservation programs in these two regions to promote the use of *Paratrygon* spp. as a valuable ornamental resource of in a sustainable manner.

Keywords: Cyb, COI, Rag1, conservation genetics, high genetic structure.

Shark species landed by a coastal artisanal fishing fleet: a review of 35 years of research

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Here we review shark species composition information available after 35 years of research on the capture and landing of sharks by a coastal artisanal fishing fleet. The fleet operates in northeastern Brazil, more specifically, along the central coast of Ceará State. This traditional fleet is composed of wind-driven 'jangadas' (5 to 9m in length) and motorboats (7 to 15m) and target different teleost fishes. Fishing gears include hook and line, longline, and fishing nets, which are deployed at depths varying from 10 to 120m. Captured fish is landed at the Mucuripe Inlet, in Fortaleza. Landings occur daily. Landings of sharks by this fleet have been recorded along different time periods from the 1980's to present-day. Six species from three families were recorded in the 1980's. Since then, these numbers have reached a total of 18 species from eight families. A total of 38 shark species are known to occur in Ceará marine waters. Therefore, the studied fishing fleet capture, land, and trade specimens from 47% of the shark species known to occur in the region. Three species have been continuously recorded along these decades: the Nurse shark, *Ginglymostoma cirratum*, the Blacknose shark, *Carcharhinus acronotus*, and the Tiger shark, *Galeocerdo cuvier*. On the other hand, 11 species were recorded in only one decade. Nine of them are of no concern to fisheries management. This is because they are mostly pelagic or relatively deeper water species that are only occasionally or rarely captured by the studied fleet. However, the remaining two species are of relatively concern because they were last recorded in the 1980's. These species are the Smalltail shark, *C. porosus*, and the Bonnethead shark, *Sphyrna tiburo*. They are coastal, being vulnerable to the fishing gears used by the fleet, but they have not been recorded for almost three decades.

Keywords: fisheries, northeastern Brazil, Western Equatorial Atlantic.

Notes on reproduction, feeding habits and morphometry of the Brazilian endemic skate *Gurgesiella dorsalifera*

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Gurgesiella dorsalifera is a deep-water small-sized benthic skate with a restricted geographic distribution in the southern and southeastern Brazilian slope. Due to its rarity and discard in bottom trawling commercial fisheries, little is known about its biology. Furthermore it is categorized as "Vulnerable" by the IUCN Red List of Threatened Species. In this context, the objective of this work was to analyze aspects of the reproductive and feeding biology, as well as morphometric relationships of this species. A total of 110 specimens were collected in a scientific bottom trawl cruise, between the cities of Santos and Cananéia (SP), in July and August of 2003, at 492-501 m depth. The length at which 50% of the population reached maturity (L50) was calculated. Stomach contents were weighed and identified to the smallest possible taxon. The importance of relative index (IRI) was calculated based on the Frequency of Occurrence (%FO) and the Percentages Numbers (%N) and Weight (%W) of the preys. Twenty-five measures were analyzed and the minimum, maximum, mean and median values were obtained. To determine the relative growth of the species, the variables were log-transformed and the regression curves were fitted in relation to disc width (DW). F-tests were performed to test the significance of the allometric coeffient (b) in relation to isometry (b=1). The L50 was 376.03 mm for males, corresponding to 66.03% of the maximum TL recorded. Females had L50 of 405.51 mm corresponding to 70%. Both sexes reached maturity with approximately three-quarters of the maximum TL recorded, suggesting a possible late maturity, which is a frequent characteristic in elasmobranchs, especially for deep-water species. Sexual differences in size of maturity might represent different energy costs attributed to reproductive activities and influencing somatic growth of females. Nineteen categories of food items were identified, which Crustacea as the most important group of the diet (47.9% IRI), followed by Actinopterygii (39% IRI), Mollusca (10.5% IRI), and finally Sipuncula (2.6% IRI). Of the 25 measures analyzed, 4 presented isometry, 2 positive allometry (referring to the clasper), and 19 presented negative allometry. The predominance of negative allometry indicates a pattern in the growth of the species, in which the DW grows in a greater proportion in relation to the variables analyzed. It was verified that females reach larger TL and DW, as already observed for several rajoids and possibly reflecting differences in the disc shape of each sex, once males present a bell-shaped disc.

Keywords: allometric, diet, maturity, rajoid.

Comparative anatomy of gill arches and associated structures of *Squalus acanthias* across ontogeny

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Deep-sea fishes are increasingly becoming targeted by fisheries, resulting in the need for improved understanding of their biology and ecology using such habitats throughout their life history. The physiological impacts of increased fishing on deep-sea elasmobranchs specifically are not well known due to a lack of information, for instance in variation of gill-arches between species and across ontogeny. Sharks have five to seven gill arches that open to the environment through individual gill slits. Gill arches support gill tissue that enable gas exchange for respiration. They also support the feeding apparatus, aiding in jaw protrusion, volume control of the buccal cavity, prey manipulation, and ingestion. Improving our knowledge of the anatomy of deep-sea squaliform gill arches may inform ecological information that is useful for predicting the impacts of increased fishing pressure on their physiology. While squaliform sharks have served as model organisms due to their small size and high survival in controlled environments, previous comparative anatomy studies have traditionally focused on feeding mechanisms and the associated skeletal components, musculature, and the nervous system. This study examined the anatomy of gill arches and associated structures of *Squalus acanthias* across ontogeny (i.e., embryos, subadults, adults) using cleared and stained specimens. To better describe the variation in these features within the Squaliformes, we compared the structure in *S. acanthias* to three other deep-sea squaliforms. Here, we provide detailed descriptions of gill arches in *S. acanthias*, *Etmopterus hillianus*, *Centroscyllium fabricii*, and *Centrophorus niaukang* using comparative analyses of cleared and stained gill-arch structures. The structure of the gill arches is similar among the species examined. In all species the hyomandibula, ceratohyal, and basihyal, pharyngobranchial and epibranchial have a similar form. The structure of the hypobranchial, basibranchial, and basibranchial copula, however, is variable, especially within *C. fabricii* and *E. hillianus* relate to the *S. acanthias* and *C. niaukang*. The information presented here suggests that depth and temperature may relate to variation in the anatomy of the gill arches, since the species examined occupy dissimilar maximum depth zones, and have likely adapted the strictures to maximize their feeding and respiratory mechanisms efficiency for survival.

Keywords: deep-sea squaliforms, gill anatomy, life history, clear and stain.

Morphology and DNA Barcoding highlights the presence of a cryptic skate species in the South-west Atlantic Ocean

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The yellownose skate, *Zearaja chilensis*, is a large skate that has been reported from the coasts of Chile in the Southeastern Pacific to Southern Brazil in the Southwestern Atlantic. Due to its geographical range, biological traits, and levels of exploitation, this species was listed as vulnerable by the IUCN. Recent molecular studies have called into question the conspecificity between specimens from these opposite coasts of South America, which can have implications for the conservation status of the species. The aim of this study is to verify the identity of specimens identified as *Z. chilensis* in Argentina with respect to specimens from Chile. A total of 50 specimens from Argentinean waters (AW) and 22 from Chilean waters (CHW) were examined in order to compare their external morphology, spinulation pattern, clasper, and egg capsules. Tissue samples (AW=12, CHW=2) were obtained and sequence data for the Cytochrome Oxidase Subunit I (COI) gene were generated. Additionally, public sequences were obtained from BOLD (AW=25, CHW=8). Despite its external similarity, several traits were consistently different between specimens from both regions. Adults from AW presented longer preorbital length and shorter distance between first gill openings than those from CHW. AW specimens presented 3-5 rows of caudal thorns, whereas most specimens from CHW had only one row. Dermal denticles were restricted to the rostral area in AW skates, whereas in CHW skates most of the dorsal surface of the disc was covered with denticles, with a smooth area in the centre of pectoral fins. Major differences in clasper morphology were also found. For instance: in AW specimens, terminal bridge (tb) is straight towards tip of dorsal terminal 2 cartilage (dt2) and sentinel (st) does not reach tb, whereas in CHW specimens tb is curved towards tip of dt2 and st reach tb; ventral terminal cartilage of CHW has a longer apophysis and the outer edge is wider than those from AW. Egg capsules of AW skates had wider lateral keels than these of their Chilean counterparts. Molecular analysis revealed two well defined cohesive clusters, corresponding to AW and CHW specimens, respectively. Average K2P distance between groups was 3.4%, a value substantially higher than expected for intraspecific differences. Indeed, BINs analysis (algorithm that clusters barcode sequences into OTUs) assigned the sequences to different BINs. These integrative results strongly support that specimens from Argentinean waters known as *Z. chilensis* correspond to a different nominal species than those from Chilean waters.

Keywords: Rajiformes, longnose skates, hidden diversity, genetics, morphological features.

Effects of large sharks on coral reef fishes in the subtropical Atlantic

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The effects of sharks on prey behavior and survival are largely unknown, despite equivocal results from a handful of studies conducted in discrete habitats. As a result, this area of research has become a breeding ground for debate. To advance the study of the ecological effects of sharks on their prey, we investigated the behavioral responses of transient sharks on seven families of fish and one marine reptile, using baited remote underwater video stations in Biscayne Bay, FL, USA. A total of 157 hours of footage was analyzed for a series of parameters used as a proxy for estimating the risk of habitat as well as the behavioral risk imposed on prey species. Prey arrival times and residency were significantly correlated with predator abundance and habitat type, with open habitats (seagrass) driving the longest times. Burst swimming and schooling in prey species was correlated with the presence of sharks and moray eels and were highest on coral reefs. Our results suggest risk effects from sharks are highly context-specific, which should provide important new insights into the role sharks and other mobile marine predators play on coral reef habitats.

Keywords: behavior, BRUV, ecology, risk, predation risk.

Deep sea rays in the southern Gulf of Mexico

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For a period of five years (2011-2016), there were 233 specimens sampled from the deep sea on board the oceanographic research vessel Justo Sierra. These specimens belonging to 11 different ray species: Anacanthobatis folirostris, *Breviraja nigriventralis*, *Cruriraja cadenati*, *C. rugosa*, *Dactylobatus clarkii*, *Dipturus oregoni*, *D. teevani*, *Leucoraja garmani*, *L. lentiginosa*, *Pseuroraja fisheri*, *Tetronarce nobiliana*. From which there were three main species as the most abundant ones: *C. rugosa* (34), *L. garmani* (42) and *L. lentiginosa* (118). These species were subjected to a statistical analysis in which there were substantial differences on the bathymetric distribution in relation to different periods during a year as well as variations on the size distribution in relation to depth. *C. rugosa* presented differences in the space-time distribution; they were found at lower depths during the summer and higher depths during the fall. Females of the *C. rugosa* showed a positive correlation in the size-depth distribution ($R2=0.9$; $F=0.9$; $p=0.003$). In *L.garmani*'s case, there was also a difference in the size-depth distribution of the females ($F=4.21$; $p=0.0405$), the largest average TL was found at the 200-299 m range. In terms of space-time for this species distribution, males demonstrated differences in the bathymetric distribution, being present in shallower waters during the summer. *L. lentiginosa* was the most prominent out of the three species. It was found and sampled to a greater depth than reported previously by other authors (852 m). Females of this species showed differences in the size distribution in relation to depth as well: ($F=3.8323$; $p=0.016$), with the 800-899 m range being the one with the largest sizes. Furthermore, for females in this group there is a noticeable change in the space-time distribution ($T=2.56$; $p=0.006$), also being found at lower depths during the summer. In general terms, we appreciate a coexistence between *L. lentiginosa* and *L. garmani*, and a remarkable habitat difference with the *C. rugosa*. Furthermore, *C. cadenati* was recorded for the first time in the south of the Gulf of Mexico; and it is also the first time that the presence of *B. nigriventralis* was reported in the Gulf of Mexico.

Keywords: rays, Gulf of Mexico, distribution, abundance, new records.

Diet differentiation of two sympatric batoids (*Myliobatis chilensis* and *Pseudobatos planiceps*) between two geographic regions off the coast of Peru

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Understanding how diet changes spatially can help predict how species will respond to changes in prey availability at a local level, as well as their potential ecological role in different habitats. This study used stomach content analysis to examine the diet of the Chilean eagle ray (*Myliobatis chilensis*, n=231) and the Pacific guitarfish (*Pseudobatos planiceps*, n=252) in two geographic regions: the central and northern coast of Peru, between March 2012 and July 2016. Inter and intra-specific dietary differences were observed in both batoids (P<0.05, PERMANOVA). Both species showed evidence of diet partitioning. While fish dominated the diet of *M. chilensis* (75%PSIRI), both crabs (46%PSIRI) and fish (26%PSIRI) were abundant in the diet of *P. planiceps*. Higher trophic level feeding and dietary specialization were observed in *M. chilensis*, when compared with *P. planiceps*. At the intra-specific level, geographic region was identified as an important driver in the diet variability of both batoids. Trophic niche breadth was higher on the northern coast for both species due to an increase in invertebrate consumption. At the central coast, *M. chilensis* showed a diet dominated by fish (88%PSIRI), while at the northern coast their diet was based on fish (46%PSIRI), crabs (25%PSIRI) and mollusks (23%PSIRI). *P. planiceps* fed on crabs (55%PSIRI) and fish (27%PSIRI) in the central coast, while on fish and stomatopods (23%PSIRI, respectively), crabs and shrimps (~18% PSIRI, respectively) in the northern coast. *M. chilensis* had a higher trophic level at the central coast (TL=4.1), while *P. planiceps* showed the same trophic level in both oceanographic areas (TL=3.6). Sex had little influence on the diet of either species, except on *M. chilensis* at the northern coast, where males showed greater consumption of fish, and females consumed mainly crabs and mollusks. An ontogenetic shift in diet composition was observed for both species in the study zones. A shift from soft-body prey to hard-body prey was observed in large sizes, as well as an increase in trophic level. Our study revealed differences in these species diets between geographic regions, likely due to differences in local prey availability and habitat use. This work contributes to the scarce information on the feeding ecology of two commonly exploited batoids' of the southeast Pacific and presents novel information on habitat-specific diet preferences that can be used in future regional trophic models.

Keywords: batoids, feeding partitioning, trophic position, foraging habitat, Southeastern Pacific.

There's no place like home: seasonal patterns of natal philopatry in juvenile blacktip sharks

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The blacktip shark (*Carcharhinus limbatus*) is a large coastal shark and a species of major recreational and commercial importance in the waters of the southeastern United States. The Gulf of Mexico and southern Atlantic coasts of the US represent nearly continuous habitat for this species, yet genetic studies have demonstrated that females are regionally philopatric to Gulf or Atlantic nursery areas. Terra Ceia Bay, on the Gulf coast of Florida, is a well-studied primary nursery area for blacktip sharks. Pups are born in the nursery during late spring and summer, show strong site fidelity for the first few months of life, then emigrate from the nursery in late fall. Previous studies involving recaptures of conventionally-tagged blacktip sharks and short-term (18 month) acoustic telemetry suggested at least some degree of natal philopatry occurs annually for the first few years of life, but the extent of this behavior is unknown. Ten-year coded acoustic tags were surgically implanted in young-of-the-year (YOY) blacktip sharks captured in Terra Ceia Bay to examine long-term patterns of natal philopatry and seasonal site fidelity. Results from the first two years of the study suggest that approximately half of the sharks, both male and female, that survive their first summer and emigrate from Terra Ceia Bay will return to their natal nursery for part or all of the subsequent season. Home ranges for older juveniles overlap with those for YOY blacktips and sharks from multiple annual cohorts displayed similar movement patterns. These results provide preliminary evidence of interannual site fidelity and support the theory of long-term natal philopatry in this species.

Keywords: nursery area, acoustic telemetry, site fidelity.

Habitat use by three species of shark-like batoids and its implications for the management of a marine protected area of southeastern Brazil

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In this study, we investigated the habitat use by three species of shark-like batoids, *Pseudobatos percellens, P. horkelii* (Rhinobatidae) and *Zapteryx brevirostris* (Trygonorrhinidae), around the Anchieta Island, a near shore marine protected area (MPA) of southeastern Brazil.We tested the hypothesis that the size of the MPA it is not enough to fully protect the species, using a fish-based assessment. A total of 27 individuals (*P. percellens* n=3; *P. horkelii*, n=2; *Z. brevirostris*, n=22), ranging from 39 to 63,5 cm of total length, were fitted with external acoustic transmitters and monitored with a combination of passive and active monitoring, from August 2012 to February 2014. Results showed that individuals stayed from four to 28 days inside the MPA, mainly in depths around 16 m, over muddy bottom. Detections of rays in shallower areas of the MPA, over sandy or rocky bottom, were not present within the array or during the manual tracking. Four individuals of *Z. brevirostris* were detected during three days around a receiver located outside the MPA, close to the shore, around 12 m depth. Any individual returned to the detection zone after the first detections. These findings suggest that the design of the MPA should be revised, since its limits seem to cover an area smaller than to that used by the species. The intense practice of trawling fisheries around the MPA, associated with a short-term monitoring, may have led to the low number of detections and negatively affected a better understanding ont he seasonal movements of the species. However, movement data can enhance MPA design and be useful for an adaptive management of these areas, with important implications for the conservation of shark-like batoids, which use coastal areas as nurseries and are high vulnerable to by-catch.

Keywords: acoustic telemetry, non-lethal methods, spatial ecology, habitat connectivity, Rhinopristiformes.

Beyond Boundaries: Ecological Niche Modelling of Manta ray distribution in the Western Central Atlantic

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The Western Central Atlantic (WCA) hosts a population of manta rays whose distribution and habitat preference is poorly understood to date. Obtaining this kind of information is crucial to achieve effective implementation of targeted conservation measures. In this study, we use ecological niche modelling (ENM) to predict the distribution of two species of sympatric manta rays (*Manta birostris* and *M.* sp. cf *birostris*) in the wider Gulf of Mexico and Caribbean basin from satellite tracking data of six manta rays and sightings from divers working on offshore platforms. ENMs were created using generalized linear models, generalized additive models, boosted regression trees, and maximum entropy models; the predictions of all the models were then combined to create an ensemble ecological niche model (EENM) of manta ray distribution. EENM has not been used to study the spatial ecology of manta rays at this scale before, and could prove itself to be a powerful tool in conservation planning. The predictions of the model indicate that suitable areas for manta rays should be situated near the coast, where waters reach depths of 59±50m, sea surface temperature is 27.9±0.5 °C and chlorophyll-α concentration is 0.56±0.48 mg m-3. In the study region, key predicted suitable areas are likely to be located along the coasts of the USA, Mexico, Nicaragua and Venezuela. Only 34% of the predicted suitable habitat is encompassed by the present network of marine protected areas, with just 0.2% in areas completely closed to fishing activities. The conservative life of oceanic manta rays (i.e. slow development, late maturity, and low fecundity) make this species sensitive to even moderate increases in mortality rates; for this reason, the existing network of protected areas may be likely to offer little protection to manta rays. Manta rays in the Caribbean basin are most likely isolated from other populations of manta rays worldwide, and *M.* sp. cf *birostris* is endemic to this region; therefore, recolonization of the area following local extinction would be extremely unlikely, and could result in the loss of a unique species. Future conservation planning in the region should explicitly include the needs of manta rays in its targets, with a particular focus on areas identified as key habitats for these species co-occurring in the WCA.

Keywords: spatial ecology, Caribbean, *Manta birostris*, Central America, conservation, marine protected areas.

Population assessment of nurse sharks (*Ginglymostoma cirratum*) in Belize

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The nurse shark (*Ginglymostoma cirratum*) is classified as a data deficient species on a global scale by the IUCN, as its abundance and population trends are largely unknown. The Western-Atlantic population of this species is furthermore classified as near threatened because of pressures exerted upon it by fishing activities and habitat degradation. There is therefore a need to obtain additional information on the abundance, distribution, and conservation status of these sharks. In Belize, nurse sharks can be found along the entire coast, and represent an important touristic attraction that brings millions of dollars into the economy every year. Although nurse sharks are fully protected by Belizean fisheries law, illegal fishing is known to occur and threatens the long-term persistence of the population. Furthermore, despite their popularity and economic importance in the country, Belizean nurse sharks remain understudied. Here, we present the results of the analysis of a combination of transect surveys and baited remote underwater videos (BRUVs) to provide the first assessment of the Belizean nurse shark population. Analysis of catch per unit effort (CPUE) of sharks recorded in BRUVs (N° of sharks recorded/hour) revealed relative abundance of nurse sharks to be highest at Glover's Reef, while CPUE at Turneffe Atoll was almost ten times lower, despite the atoll having been declared a marine reserve during the first year of this study. Indeed, no difference in CPUE was found between all sites located within the boundaries of protected areas and sites located outside them. Absolute abundance of nurse sharks was estimated using distance sampling analysis of transect sightings; Lighthouse Reef Atoll was the region that hosted the highest number of sharks, followed by the Southern Belizean reef and Turneffe Atoll (Glover's Reef was not covered by transect surveys). The total nurse shark population of Belize was preliminarily estimated to be in the range of 8,000-20,500 sharks. Thanks to a vast area of suitable habitat for nurse sharks present in the country, and legislation already in place for the safeguard of the species, Belize could represent an important hotspot for nurse sharks in the Caribbean region. The data presented here hence offers a baseline for the long-term monitoring of the Belizean nurse shark population and future conservation planning for this species in the country. This study furthermore improves our understating of nurse shark abundance and distribution in the wider Caribbean basin, providing a measure of comparison for future studies in other regions.

Monogamous sawfish: First paternity assessment in the Endangered narrow sawfish *Anoxypristis cuspidata* reveals genetic monoandry

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Observations of mating behaviour in the wild often differ dramatically from the true genetic mating system of a species. For marine species, even direct observations of mating behaviour are difficult to obtain. Elasmobranchs employ a wide range of reproductive strategies and inadequate understanding of these mating systems can hinder conservation and management efforts. Sawfishes (family Pristidae) are arguably the most threatened family of marine fishes, with all five extant sawfishes categorised as either Critically Endangered or Endangered on the IUCN Red List. Despite this, many aspects of sawfish reproductive behaviour and basic ecology remain unknown. This study aims to characterise the genetic mating system of Endangered narrow sawfish *Anoxypristis cuspidata* for the first time. Multiple paternity (or genetic polyandry) is a phenomenon where multiple males sire offspring within a single litter and which may have implications for genetic diversity, as well as the future viability of a population. Multiple paternity has been reported in 28 of the 32 elasmobranch species examined to date, although these studies have focussed almost entirely on sharks. Notable sampling limitations appear throughout the literature: small sample sizes due to the opportunistic nature of wild paternity studies (typically requiring mortality of gravid females), the difficulty in sampling complete litters and the limited availability of species-specific microsatellite markers. In this study, however, microsatellite analysis of 16 gravid *A. cuspidata* females and their 176 intrauterine embryos revealed no evidence of multiple paternity (i.e. more than two paternal alleles at two or more loci per litter). This provides the first evidence of genetic monoandry (i.e. a single male sire per litter) in a batoid. The findings of this study highlight the importance of species-specific evaluations of genetic mating systems and reiterate the need to better understand the influence of multiple paternity, or lack thereof, on population genetic diversity.

Keywords: batoids, genetic mating systems, microsatellites, reproductive behavior.

Variations in the electrosensory system of Australian elasmobranchs

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All chondrichthyans possess ampullae of Lorenzini that allow them to detect weak electrical fields in their surrounding environment. Recent research into this sensory system revealed that the distribution and morphology of these ampullary organs vary across species and may be influenced by environmental factors. This presentation summarises newly recorded variations in the electrosensory system of several species of elasmobranchs found on the East coast of Australia and how their ampullary organs are influenced by their diet, lifestyle, and environment. The topic of ontogeny in the morphology of the electrosensory system of elasmobranchs will also be touched upon, detailing observed differences between embryos, juveniles and adults of certain species. Typically, the ampullary pores of rays are distributed over their heads and pectoral fins, compared to those of sharks that are restricted to their heads and aggregate in different distinctive patterns depending on the species. The ampullary canals of species that prey upon burrowing infauna possess a peculiar quasi-sinusoidal shape, compared to the usually straight canals encountered in species targeting pelagic prey. Batoids tend to possess alveolar ampullae which contrasts with the finger shaped ampullae of most galeomorph sharks, but the internal structure remains mostly similar across both superorders, with the exception of the shape of the supportive cells that separate the receptor cells present in each ampulla. More specifically, the supportive cells of rays protrude heavily into the ampullary lumen, a feature never observed in sharks, and the function of which has yet to be revealed.

Keywords: morphology, sensory biology, electroreception.

Fine-scale movements of juvenile blacktip reef sharks (*Carcharhinus melanopterus*) in a shallow nearshore nursery

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Little is known about the fine-scale movements and habitat use of juvenile sharks in nearshore areas and the factors that drive their behaviours. Active acoustic tracking was used to investigate movements and habitat use of juvenile (683 ± 58 mm TL) blacktip reef sharks (*Carcharhinus melanopterus*) at Orpheus Island, Australia. Six juveniles were tracked for over 65 hours. Juveniles moved in synchrony with tidal cycles, always remaining within very shallow sandy reef flat or reef crest waters during outgoing, low and incoming tides, while using inundated mangrove habitat during high tides. Individuals never left the bay in which they were tracked or entered deep water beyond the fringing reef, restricting their movements within water <60 cm deep. In general, linearity and rate of movement were significantly higher during running tides when juveniles were moving with the incoming or outgoing tides, whilst they were significantly lower during higher tide heights when juveniles were occupying mangrove habitats. The observed behaviour was most likely a predator avoidance strategy, suggesting this is one of the main drivers influencing the movements of these juvenile blacktip reef sharks. The importance of mangrove root habitat use by juvenile blacktip reef sharks in coastal nursery areas indicates this may be an important habitat to protect to ensure survival.

Keywords: active acoustic telemetry, nursery area, predator avoidance, habitat use, tidal variation.

Plastics on the menu: Microplastics present in Indonesian Manta ray feeding habitats

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Microplastics have emerged as a major threat to the marine environment. Recent research advances have shed light on global microplastics estimates, threats to biodiversity, and key focal regions for intervention. Yet there are few reports assessing the potential for microplastic ingestion by threatened large filter feeders, such as manta rays, in regions heavily impacted by plastic pollution like Indonesia. Here, we evaluate the microplastic concentrations found in critical feeding habitats for manta rays (*Mobula alfredi*) in two areas fraught with marine plastic pollution, Nusa Penida and Komodo National Park, Indonesia. Using a 200-micron plankton net, we assessed microplastics found in the top 0.5m of the water column during the predominantly wet and dry seasons over two years (2016-2018). Microplastic abundance in manta rays feeding grounds appears to be seasonally influenced in Nusa Penida, with higher concentrations of microplastics during the wet as compared to the dry season (0.48 pieces/ m3 Vs 0.03 pieces/m3, respectively). Conversely, seasonality does appear to play a large role in microplastic abundance in the manta ray feeding grounds in the Komodo National Park with overall microplastic concentrations ranging from 0.28 to 0.56 pieces/m3. Given the large quantities of water manta rays must filter to meet their daily energy demands, feeding activity in these locations will likely result in microplastic ingestion that over time may expose these vulnerable animals to associated treats, including toxins. The upper theoretical microplastic ingestion rate estimates for manta rays feeding in these two Indonesian locations are 40 pieces per hour. A seasonality trend in the microplastic abundance in Nusa Penida suggests that prior to the onset of the wet monsoon season is an ideal time for concentrating marine debris intervention and prevention efforts from land based sources such as rivers and coastlines.

Keywords: pollution, ecology, marine, megafauna.

How hot is too hot?: Temperature's role on the physiology, behaviour, and development of a benthic shark.

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Egg-laying elasmobranchs are inherently vulnerable to changes in environmental conditions, as embryos lack the ability to regulate their internal temperature. Thus, they depend on external environmental conditions to influence the rate of development, metabolic requirements, and hormone expression which can ultimately impact fitness.Port Jackson shark eggs, *Heterodontus portusjacksoni*, from two locations (Jervis Bay, NSW and Adelaide, SA) were held under three different temperatures (control, control +3°C - predicted climate change, and temperatures from alternate collection site) to examine the effect of temperature on the physiology, behaviour, and overall embryonic development between different populations. Specifically, we used respirometry techniques to measure oxygen uptake rates across key developmental stages until hatching. Following hatching, juvenile sharks underwent a critical temperature methodology to examine if the thermal maximas and the temperature thresholds that prompt movement differ between populations and/or treatments. Sharks reared under elevated temperatures developed much faster and required more oxygen across development. Upon hatching juveniles from Jervis bay, raised at predicted end of century condition, displayed a two-fold increase in oxygen uptake rates compared with ambient conditions and were able to tolerate temperatures up to 34.967°C; 1.5°C greater than sharks reared at Jervis Bay ambient temperatures. Furthermore, twenty percent of the neonates maintained at elevated temperatures from Adelaide, exhibited developmental abnormalities such as irregular spinal development. Our data suggests that although some changes may seem beneficial (e.g. decreased gestation time), there are deleterious developmental costs (e.g. increased metabolic requirements, as well as an increased occurrence of developmental abnormalities) which may become exaggerated under future climate scenarios.

Individual identification of sharks through dorsal fin: a new approach thanks to advances in computer science.

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The individual identification of the sharks of a population is the fundamental step to be taken if we want to conduct studies such as population estimates, behavioral evolution with age, hierarchy identification. When working with large and open populations, this process becomes even more difficult. One of the most commonly used methods is the identification of individuals through the photograph of their dorsal fin, which can act as a fingerprint for considerable time intervals. Comparing images is a time-consuming task, for human operators; however, defining automatic systems for image comparisons is not easy, because of variations in lighting, saturation, contrast, orientation and position of objects in images. In this work we propose an alternative approach for helping at automatically identifying sharks from pictures of their fins, by taking advantage from results in different areas of computer science. Indeed, sequence alignment is a common task in Computer Science: two sequences are compared in order to understand whether they feature some common areas. For instance, this is extensively used in bioinformatics in order to identify regions of similarity between DNA sequences. In the proposed approach, images of fins are not directly compared; instead, using advanced image processing techniques, contour of fins are recognized, extracted and then represented as ordered sequences of symbols. Each sequence representing a fin is stored in a database along with the identifier of the associated shark, so that, given a picture of a fin, various sequences alignment and machine learning techniques are employed in order to identify the most correlated fin stored in the database. Eventually, this allows users to uniquely identify a shark from new unseen photos of it.

Keywords: computer science, sharks, individual identification, dorsal fin.

First report of whale shark strandings in the Gulf of California, Mexico

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From historical records from 2000–2018, we assembled the first report on whale shark strandings in Mexican waters. Information on whale shark strandings came from two primary sources: (1) public records from both local and national newspaper articles and; (2) first hand sightings made by scientists, field specialists, and reliable fishermen reports. Several stranded individuals were measurement for scientific record and sex identified, but for the majority of historical records there is a lack of robust or reliable measurements, and total length (TL) if not known was estimated by examining all available photographic evidence and any other freely available information. Strandings occur irregularly, but we report data on 14 whale shark strandings between 2012 -2018. The majority of strandings were reported along the inner western coastline of the Gulf accounting for as much as 70% of all stranding records. Furthermore, stranding sites for the most part coincided with relatively shallow coastal areas and around known foraging sites for the species. With relatively few stranding records of whale sharks reported along the eastern coast of the Gulf of California. The lack of stranding reports along this coastline may be due to the preferred migratory pathways in which the species use within the Gulf or simply the lack of inhabitants or coastal towns along this vast coastline, limiting the chance of reports. No noticeable preference for strandings were seen in the records and strandings appear to happen sporadically during all calendar months. In summary, this report presents the first stranding report for the species in this region of the world and highlights potential stranding sights which may be further inspected to ensure swift recovery of animals if stranding occurs, or better govern better vigilance from governmental or environmental originations in the entire Gulf of California.

Keywords: whale shark, strandings, Gulf of California, conservation.

Use of BRUV system in identification of sharks and rays population in Persian Gulf, Kish Island.

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Persian gulf is considered as special natural habitat for coral reefs and fishes, because of its high salinity and temperature. The role of sharks to preserve such a marine ecosystem cannot be overemphasized. Shark catching is forbidden in Iran as an Islamic country; yet, there are many fishing boats as illegal shark hunters with export purposes. Therefore there are few scientific documents about shark identification in this area. We used BRUV to identify the residential shark population in kish island, It seems that the obtained data definitely helps future projects aiming toward conservation of marine life. We deployed our h-BRUV system within 5-7 m water depth in kish island (located in southern of Iran in northwest of Persian gulf, N 26.5403, E 54.0114).

The assay repeated 4 times a day and lasted at least 2 hours. A total number of 40 successful deployments were done between November and December 2017. Our BRUV system recorded eleven separate species (3 out 11 were sharks) and 7 families of sharks and rays (2 out of 5 were sharks). The maximum number (MAX.N) of encounters was three. The time to first appearance was 17 to 54minutes. The species recorded include *C. melanopterus*, *C. amblyrhinchos*, *S. lewini*, *Urogymnusasperrimus*, *Dasyatispastinaca*, *Aetobatusnarinari*, *Neotrygonkuhlii*, *R. productus*, *Torpedo mamorata*, *Narcine bancroftii* and unknown ray species. BRUV system is a viable and non-destroying method to study and identify sharks and rays.

Keywords: shark, ray, BRUV, population.

A case study for an improved understanding of small-scale shark fisheries from a South Pacific Island perspective

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Limited information is available on small-scale shark fisheries across the South Pacific. As large-bodied fishes tend to be at greatest risk of overfishing, it is critical to improve our understanding of the socio-economic drivers of small-scale shark fishing activities, and subsequently to build comprehensive management measurements at the national level. This study investigates shark catches in Fiji's subsistence and artisanal fisheries and assesses the related socio-economic drivers. In 2017, semi-structured interviews were conducted with 213 respondents (171 males and 42 females) throughout the Fiji Islands, of whom 66.2 % reported catching sharks. Of those fishers who caught sharks, 62.4 % stated that the catches were not intended, 18.4 % stated they released caught sharks, while 81.6 % retained the shark catch. Various reasons were cited for shark retention with the most common explanation being to meet dietary needs. Only 15.6 % of the interviewees caught and sold sharks, yet we found that fishers who gain additional income from the sale of shark meat had higher absolute and mean catch rates compared to fishers who retained sharks for dietary needs only. Overall, less fishers reported catching sharks compared to a previous survey in 2013. Additionally, the shark fin trade in Fiji has decreased and shifted from an export oriented market to one dominated by domestic outlets. Fishers' identification of elasmobranch species was based on an identification poster. Tissue samples were taken from specimens that were available at the time of interviews, from which DNA barcoding revealed that at least five species of elasmobranchs (four sharks and one ray species (*Rhynchobatus australiae*) were caught. In addition, several fishers across the northern islands of Fiji reported catching or observing sawfishes. However, this study cannot provide proof of these claims. Our work, which adds to the existing baseline data of shark utilisation in Fiji, demonstrates a decreasing relevance of shark fisheries for income generation, but an increasing utilisation of shark meat as a substitute for traditional food fishes.

Keywords: elasmobranchs, South Pacific Islands, management, livelihoods.

Molecular species identification of two southern African endemic catshark genera, *Haploblepharus* and *Poroderma*

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Accurate species identification is paramount for effective conservation and management strategies for sharks, particularly for species affected by fisheries and species of conservation concern. Southern Africa is a shark biodiversity hotspot, including a large proportion of endemic species, particularly within the catshark family, Scyliorhinidae. Some species, including *Haploblepharus* species, display a high degree of intrageneric morphological conservation, with many diagnostic morphological and meristic characters overlapping between congeners. Molecular tools, such as DNA barcoding using the cytochrome oxidase subunit 1 (CO1) gene, and other molecular species identification markers, can be used to evaluate the degree of molecular divergence and differentiation between species. These molecular markers can be used in conjunction with classical taxonomy for species identification and to verify taxonomic assignment. We sampled three *Haploblepharus* species (*Haploblepharus edwardsii*, *H. fuscus*, and *H. pictus*), and two *Poroderma* species (*Poroderma africanum* and *P. pantherinum*), from multiple locations throughout their distribution range. Sequence data from three mitochondrial genes; CO1, nicotinamide adenine dehydrogenase subunit 2 (NADH2), cytochrome b (Cytb), and one nuclear ribosomal gene, internal transcribed spacer 2 (ITS2), were analysed to assess the level of divergence and differentiation between species within the two genera *Haploblepharus* and *Poroderma*. We compared and evaluated the most suitable combination of molecular markers for species identification in five catshark species. All molecular markers were able to differentiate between *Poroderma* species, with fixed nucleotide differences observed between *Poroderma* species in all gene regions. Sequence divergence between *Poroderma* species was, however, low in all gene regions (CO1: 1.08%; NADH2: 1.10%; Cytb: 1.40%; ITS2: 1.08%). CO1 sequences from *Poroderma* species clustered into one Barcode Index Number (BIN) on the Barcode of Life Database (BOLD); below the 2% sequence divergence threshold for species delineation for sharks according to previous studies. Barcode Gap Analyses, however, found that intraspecific divergence was lower than interspecific divergence, evident of a barcode gap present for this genus. Little to no sequence variation was observed between *Haploblepharus* species using multiple molecular markers (COI: 0.04%; NADH2: 0.48%; Cytb: 0.00%; ITS2: 0.05%). No markers adhered to barcode gap analyses or sufficient interspecific genetic distances to delineate *Haploblepharus* species. Future research on *Haploblepharus* will incorporate an integrative approach to species identification, by combining morphometric and meristic analyses with a genomic approach.

Assessment of population genetic structure of juvenile white shark (*Carcharodon carcharias*) in Northeast Pacific

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The white shark (*Carcharodon carcharias*) is an important apex predator that distributes throughout tropical and temperate waters worldwide. Particularly in the Northeast Pacific (NEP) population, the life cycle of white shark begins in coastal waters; newborns remain seasonally in nursery areas such as the Southern California Bight (SCB) in the USA, Sebastian Vizcaino Bay (SVB) in Baja California and possibly in the Gulf of California. Juvenile sharks move between coastal locations as they grow and finally recruit to adult population. The white shark is a species with slow growth rate and relatively low reproductive potential, which make its populations vulnerable to incidental catch, especially the incidental catch of juveniles. Previous population genetics studies reported that juveniles from SCB and SVB might be more likely to have their mothers in GI, a philopatric adult sub-population at NEP, although the genetic patterns were analyzed with mtDNA. In the present research, population genetic structure and sibship were evaluated between juvenile white sharks from NEP coastal locations and GI adults using nDNA (microsatellite loci). The null hypotheses of panmixia was rejected due a slight but significant genetic structure over all localities from NEP (Fst=0.051, p=0.0001; Rst=0.055, p=0.0001). Pairwise comparisons indicated slight differences between SCB vs SVB, and SCB vs GI, but they were not significant after Bonferroni correction. Sibship assignment analysis indicated moderated probabilities for six pairs of full-siblings (0.41 - 0.66), and up to 30 possible half-siblings (0.20 - 0.66), mainly related between SCB and SVB. Results suggest that juvenile's genetic structure pattern seem to be weaken by a high connectivity between white shark nursery areas at the NEP. Previous mtDNA results joint to these genetic patterns (nDNA) suggest that males may be diluting the genetic differentiation pattern that females promote.

Keywords: white shark, microsatellites, sibship analysis.

Improved accuracy and enhanced value of BRUVS through application of individual photo-identification

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Baited Remote Underwater Video Stations (BRUVS) have become widely used for monitoring relative abundance of sharks. Refinements such as the use of software to detect individuals have been introduced, but differences in the method used by researchers to quantify numbers observed can lead to differences in estimated relative abundance. In two widely separated coral reef locations in the Caribbean Sea and Indian Ocean, we have tested the extent to which individual photo-identification can be applied to BRUVS a) to enable more accurate estimates of the number of individual sharks visiting the BRUVS, b) to provide an indication of individual foraging ranges and c) to generate population estimates through application of mark-recapture methodology. In both locations the mean number of individuals (N_{ind}) of the more common shark species detected at a BRUVS was higher than the most widely used measure of abundance, the maximum number of sharks observed on screen at any one time (N_{max}). In the Cayman Islands the overall ratio of N_{ind} to N_{max} was 1.15 for Caribbean reef sharks (*Ginglymostoma cirratum*) and 1.32 for nurse sharks (*Ginglymosto macirratum*), though only 1.00 for blacktip sharks (*C. limbatus*). In the Seychelles the equivalent values were 2.45 for blacktip reef sharks (*C. melanopterus*), 1.35 for grey reef shark (*C. amblyrhynchos*) and 1.13 for tawny nurse sharks (*Nebrius ferrugineus*). The number of individuals of these species re-sighted on additional BRUVS during the same sampling campaign was very low (2 – 9 %), suggesting either that the effective population sizes of the species was considerable larger than the numbers actually observed or that the home ranges of most individuals are relatively small. However, both for *C. perezi* in the Caribbean and *C. melanopterus* in the Indian Ocean, re-sightings data was compatible with acoustic tagging data indicating that many individuals range over significantly larger distances (up to 100 km for *C. perezi* and 5 km for *C. melanopterus*) than might have been anticipated. The results demonstrate that application of photo-identification to BRUVS imagery can both improve the accuracy of abundance estimates and provide non-invasive data on individuals' ranging behaviour.

Keywords: mark-recapture, foraging range, home range, abundance estimates.

The effect of seasonality and sex on the movements of Smalltooth Sawfish (*Pristis pectinata*)

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Sawfishes are a family of five species of rays with toothed rostrum. They are also the most threatened elasmobranch family. The Smalltooth Sawfish (*Pristis pectinata*) is a critically endangered species endemic to subtropical and tropical regions of the Atlantic Ocean, but the only known viable populations have been found along the coast of Florida as well as in the coastal areas of the Bahamas. These populations may be "lifeboats" for the recovery of the species. In this study, we use passive acoustic telemetry making use of hundreds of receivers in the i-Tag, FACT, and ACT arrays along the U.S. Atlantic and Gulf coasts, particularly off Florida, to track the movements of adult and large juvenile *P. pectinata*. Between May 2016 and April 2017, 16 large juvenile and adult sawfish were implanted with V16 transmitters with 10-year battery lives in Florida waters, and others will likely be tagged in spring 2018. As of January 2018, Seven of the nine females and five of the seven males implanted with the transmitters have been detected on more than 140 receivers ranging from off the coast of Brunswick, Georgia to the lower Florida Keys and along the Gulf coast to Sarasota, Florida. We use a kernel density estimation to find areas and habitats of high use to aid in defining Critical Habitat for adult sawfish. We analyze these data to understand how these movement patterns change as functions of season and sex to determine if sex-dependent differences in migration exist and to assist in determining the locations of potential mating aggregations. We also evaluate the distribution of important habitats and aggregation sites for adult smalltooth sawfish as a function of the distribution of commercial and recreational fisheries effort in order to assess bycatch mortality risk. Preliminary data analysis suggests that the adult and large juveniles spend most of the late fall to early spring (October-March) in and around the Florida Keys, while there is more movement further up the coast during the late spring to early fall (April-September), with males possibly traveling further north than females. Potential winter aggregation sites occur primarily in the lower Florida Keys in areas of high bottom trawl and bottom longline exposure. Spring and summer aggregation sites occur along the east coast of Florida from Jupiter to Cape Canaveral as well as in the northern part of Florida Bay in areas where exposure to recreational fisheries are high.

Keywords: Florida, acoustic telemetry, V16, critical habitat.

Wait, we're still alive! Contemporary persistence of Sawfish (*Pristis* spp.) in Honduras

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The populations of sawfish species have decreased dramatically worldwide due to overfishing and the destruction of their habitats, leading to the IUCN Red Listing of critically endangered species. Historically, the Pristidae family is represented in Honduras by two species, the Largetooth sawfish (*Pristis pristis*) and Smalltooth (*Pristis pectinata*). Our national study focused on assessing the historical distribution of sawfish and highlighting contemporary sightings or captures in relation to current threats facing remaining populations. Surveys were conducted in 18 communities along both the Pacific and the Atlantic coasts between September 2015 and January 2018. With a focus on surveying traditional fishers (n=220), results reveal a significant reduction in the historical distribution in all areas from the 1980s onwards. Prior to this decade, Largetooth were commonly encountered along the Pacific coast, and both species were regularly encountered throughout all Atlantic coastal departments of Honduras, with the exception of the Bay Islands, where there was not enough data to conclude that these species occupied this area. Departments with the most recent sightings in the Atlantic include the remote departments of Colón and Gracias a Dios. Recent sightings indicate that *P. pristis* persists in small numbers in remote areas of mangrove of the Pacific coast. Loss of habitat, overfishing - notably using unsustainable fishing techniques, and a lack of protective legislation or support for their conservation thwart the persistence of these species even in these remote sites. Improving food security, knowledge and community-based conservation efforts could underpin the recovery of these critically endangered species in Honduras.

Keywords: Central America, IUCN, critically endangered, distribution.

Home range, movement and trophic opportunism of grey reef sharks, *Carcharhinus amblyrhynchos*, around two grouper (Epinephelidae) spawning aggregations in Pohnpei, Micronesia

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Twenty female grey reef sharks (*Carcharhinus amblyrhynchos*) were captured and acoustically tagged inside two grouper (Epinephelidae) (fish) spawning aggregation (FSA) sites in Pohnpei (Federated States of Micronesia) in 2010 and 2012 to examine spatial habitat use, marine protected area effectiveness and indications of utilization of FSA by sharks for trophic opportunism. Tagged grey reef 24 sharks were detected using an array of 15 and 28 acoustic receivers at Ant Atoll and Pohnpei (Island), respectively, with individuals detected over a range of 1 to 1359 d. Findings suggest that small-scale marine protected areas (MPAs) are insufficient to provide major conservation benefits. Instead, home range sizes (as linear distance) and occasional long-distance dispersal identify the need for larger scale MPAs or other management measures that account for these spatial requirements. Findings also identi-fied significantly higher detections during grouper reproductive periods, both seasonally and during lunar cycles linked to spawning. These findings suggest that at least some sharks utilize FSA as a preferred, seasonal feeding site. While some individuals appeared to show high fidelity to the main island, 9 females crossed the deep channel separating Ant and Pohnpei. Based on detections across the array, wide individual variations in movement and spatial requirements exist, suggesting the most effective protection measure for grey reef sharks is a total catch and possession ban. Future studies of these animals should incorporate all life history stages and both sexes across a wider range of habitats that include continuous, non-continuous and isolated reef habitats to fully understand the spatial habitat use and management needs of this species.

Keywords: passive acoustic telemetry, FSA, marine protected areas.

It's not all about shark fins and fin soup: Sale and consumption of sharks and rays in Honduras during the Lenten season

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The Lenten season is a catholic celebration that encompasses forty days before the Good Friday in Easter week or Holy week. One of the popular traditions in Honduras for this time of the year is the preparation of a soup based on dried salted fish. The markets and supermarkets of Honduras sell several types of dried salted fish. One of these products popular among consumers for its lack of spines is known as "Cecina", which is mostly derived from filleted shark and ray. In March 2016, a pilot survey of 7 local markets and 4 supermarket chains in the capital Tegucigalpa identified and quantified Cecina sales. In 2011 the country was declared as a Shark Sanctuary, establishing an indefinite moratorium for this taxa, however the ban does not include rays. During Lent in 2017 a full standardized survey was applied to 12 markets across 4 primary cities in Honduras (Tegucigalpa, San Pedro Sula, La Ceiba and Choluteca) to describe product origin and national and regional trade flows of Cecina. A total of 39 surveys were conducted with seafood vendors, of these 97.4% sold Cecina during Lent, the season of highest demand. Price per pound at the time of the study varied between US$3.97 and US$6.38. Nearly half of vendors surveyed (43%) confirmed that product provenance was from La Moskitia, La Ceiba (23%), Tela (4%) in the Atlantic area. Majority of Cecina vendors (82.7%) know that this product is derived from shark and/or ray fillets. This study highlights that despite the ban on shark captures and sales, a fishery targeting shark and rays continues to supply the local demand for Cecina. Results from this study are being combined with fisheries independent studies to generate a perception survey on consumption and an outreach campaign to inform the public of the provenance of Cecina and the status of sharks and rays with the aim of reducing consumption of these products.

Keywords: shark sanctuary, holy week, traditions, illegal wildlife traffic.

Reef shark connectivity: A case study using multiple genetic markers

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Understanding connectivity, dispersal and sex-biased behaviours of sharks is important for defining the boundary of a stock and therefore the scale of management required. Genetic markers in the form of microsatellites (msats), Single Nucleotide Polymorphisms (SNPs) and mitochondrial DNA (mtDNA) can uncover if gene flow is shared between populations across a region. Our study set out to define the population structure of three reef associated species; the silvertip shark (*Carcharhinus albimarginatus*), the grey reef shark (*Carcharhinus amblyrhynchos*) and the scalloped hammerhead (*Sphyrna lewini*). We investigated the genetic population connectivity of each species using a mixed-marker approach including - mtDNA, msat loci and a panel of genome wide SNPs developed from double digest restriction site associated DNA sequencing. We estimated the dispersal potential and connectivity between locations across the Indo-Pacific Ocean for n=170, n=450 and n=576 samples of *C. albimarginatus*, *C. amblyrhynchos* and *S. lewini* respectively. This study is the first to compare results of nuclear msat and SNP markers for any elasmobranch and provides an important comparison between the analytical powers of each marker type for population genetic studies. Our findings suggest varying levels of gene flow across the Indo-Pacific region for each species and the identification of sex-biased behaviours likely occurring and contributing to observed genetic patterns. These findings provide valuable information for geneticists undertaking population genetic assessments in addition to providing robust connectivity estimates for these three species of sharks.

Keywords: population genetics, fisheries, single Nucleotide Polymorphisms, Indo-Pacific Ocean.

Community and population level effects of the 2010 Deepwater Horizon oil spill on deep-sea sharks in the northern Gulf of Mexico

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Prior to the Deepwater Horizon (DwH) oil spill, knowledge was limited concerning the deep-sea communities of the northern Gulf of Mexico (GoM), particularly for the larger, more mobile fishes such as the deep demersal sharks. Because the spill occurred at 1,500 meters, these communities were directly affected. Over seven years (2011-2017), we used novel and standardized surveys to assess the potential effects of DwH on the deep demersal sharks in the northern GoM at depths of 200 to 2,000 m. During 15 research cruises, 548 demersal longline and traps sets were made from off Louisiana to southwest Florida, including sites near the DwH (Macondo) wellhead and throughout DeSoto Canyon. Nearly 6,000 fishes from more than 100 species were captured including 1,602 sharks and skates from 36 species ranging in size from 20 cm *Etmopterus virens* and Galeus area to 500 cm *Hexanchus griseus*. We investigated changes in community structure and relative abundance over space and time since the oil spill as well as toxicological responses to DwH. GoM deep-sea fish communities are diverse and spatially heterogeneous and community structure is likely driven by edaphic factors, sources of productivity, and depth. Species diversity and community structure remained stable over the course of the study. The shark community is dominated by three species (*Squalus cubensis, S. clarkae* and *Centrophorus uyato*) and toxicological responses of these species to oil exposure peaked three years after the oil spill. However, these effects did not translate into discernible population level effects and toxicological responses appeared to return to a baseline five years after the spill. However, more recent data suggest the toxicological responses to oil exposure may still re-emerging in these taxa highlighting the need for long-term monitoring of potential DwH oil spill effects on deep-sea fish populations.

Keywords: oil spil, toxicology, population, deep-sea, community.

Sexual maturity scale of females and males of the hammerhead shark *Sphyrna corona*

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Sphyrna corona is a hammerhead shark of commercial importance captured in the industrial and artisanal fishing operations in the Colombian Pacific. From histological analyses and macroscopic examination of the reproductive structures, a sexual maturity scale was established. Sixty-four individuals were sexed, measured and eviscerated, and their gonads were extracted and fixed in formalin. A maturity index was described and assigned to each reproductive structure, according to its development stage, and a macroscopic maturity scale was defined for each sex. Transversal and longitudinal cross-sections of 5 and 8 μm thick of each structure were stained following the Harris' hematoxilin-eosin protocol. Five stages of sexual maturity were established for each sex. For females these states were: immature, maturing-virgin, mature-non-gravid, mature-gravid, and mature-postpartum. In males, the maturity stages were: immature, maturing-virgin, mature-non-reproductive, mature-sexually active, and mature-post reproductive activity. Both sexes had functional and paired reproductive structures. The development of the ovarian follicles and oviducts varied depending of the maturity stage of the female. Some dense masses containing groups of sperm stored for fertilization were observed in the oviducal glands. The uteri were tubular and exhibited an epithelium, a muscular layer, and an adventitious layer. In immature and maturing females, the uteri were very thin while in mature females the uteri's walls were well developed. Gravid females presented uteri with eggs and embryos in uterine compartments covered with a membrane. Eigth spermatogenesis stages were found in the testes. Mature males presented; thickened testes testicular lobes with all spermatogenesis stages, and testicular tubules and ducts with abundant spermatozoa. The epididymus and vas deferens were composed by an epithelium and a muscular layer. Spermatozoids were found in both mature-non reproductive and in mature-sexually active males. The seminal vesicle, observed as atube covered with a cubic epithelium surrounded by a muscular layer, appears thick and rolled in mature-sexually active males and flaccid in mature-post reproductive activity males. The reproductive structures of *S. corona* coincide with those described for other placental viviparous species as *S. tiburo*, *S. zygaena* and *S. lewini*.

Keywords: Sphyrnidae, reproductive structures, histology, reproduction, viviparous species.

Environmental and physiological regulation of stingray camouflage

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Many reef fishes exhibit dynamic coloration and body patterns that can change under nervous or hormonal control. Lowe et al (1996) showed that hammerheads in high UV environments have higher skin melanin concentrations, which likely functions as a protective mechanism against UV damage. However, several species of benthic sharks and rays likely alter melanin concentrations in the skin to provide background matching for camouflage. The yellow stingray (*Urobatis jamaicensis*) is a benthically-oriented elasmobranch with elaborate spot patterns that provide effective camouflage within its habitats. This patterning, when coupled with the ability to alter melanin concentrations in response to background color, could increase background matching effectiveness in these species. The yellow stingray has been anecdotally noted to lighten or darken skin color. However, despite the wide array of studies conducted on color change for enhanced background-matching capabilities in bony fish, this ability remains understudied among elasmobranchs. To investigate this, we housed rays in either black or white tanks for one week and photographed the rays daily. On the last day, blood and tissue samples were collected to quantify key hormones and skin melanin concentrations. Stingrays in black tanks significantly darkened skin color over the seven-day period whereas rays in white tanks significantly lightened their skin color during the same period. However, skin melanin concentrations did not differ between rays maintained in all black or all white tanks after seven days. Hormone concentrations will be quantified in order to further examine the underlying physiological mechanisms that control color change.

Keywords: camouflage, melanin, stingray, physiology.

Shark Management Alert in Real-Time: synthetic results of a 2014-2017 trial using SMART drumlines in Reunion Island

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In 2014, the innovative "Catch-A-Live"® system, based on the MLI-S© GPS satellite buoy, was invented in Reunion Island in order to equip SMART (Shark Management Alert in Real-Time) drumlines, thanks to the implementation of a real-time strike alert system allowing the fishing operator to immediately intervene and quickly recover and release the catch when needed. In particular, between January 2014 and February 2017, up to 20 SMART drumlines (SDLs) have been deployed along the west and southwest coast of Reunion Island, aiming to target bull (*Carcharhinus leucas*) and tiger sharks (*Galeocerdo cuvier*) in shallow waters close to popular beaches in the frame of two consecutive experimental shark control programs. On a total of 58,770 hours of cumulative fishing operations, more than 14 different species have been caught with 50.1 % of the catch composed of specimen from the two targeted shark species. A total of 269 animals have been caught, with a global survival rate of 86.9 %. A total of 78.4 % of the by-catch specimen were released as they were retrieved in a good condition, and 37.3 % of them were tagged for long term monitoring, as well as 18 tiger sharks and 1 juvenile of bull shark. SMART drumlines used in an operational way during these trials have been proven to be efficient to properly catch and manage big animals, including sharks, in order to intercept them in coastal waters when shark attack is an issue, or to catch and release them in the frame of ecological studies.

Keywords: control, green strategy, SMART drumlines, survival rate, bycatch, catch and release, tagging.

Investigating potential factors influencing low whale shark sightings at a central Red Sea aggregation

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Whale sharks (*Rhincodon typus*) are known to aggregate at various locations globally. One small aggregation is found at Shib Habil, a nearshore reef located along the central Saudi Arabian Red Sea coast near the town of Al Lith. Monitoring at this aggregation has been ongoing for 8 years, revealing a seasonal aggregation of both male and female juvenile sharks from March through May. However, during the 2017 season an alarmingly low number of sharks were sighted during both tourism and research visual surveys. Surveys from 2010-2016 showed an average of 51 sightings a year, while in 2017 there were only two confirmed sightings. Declines in whale shark abundance have been recorded at other aggregations and often attributed to changes in oceanographic parameters. Therefore, remotely sensed data was accessed in order to analyze trends in various parameters over the last decade, to determine potential changes influencing whale shark occurrence in the central Red Sea. The Al Lith region is under a great deal of environmental stress including; an artisanal fishing fleet, prawn farm, fish farms, and recent declines in coral cover. Continued development within the region and potential for increasing tourism throughout the Saudi Red Sea, as part of the vison for the nation, makes understanding the dynamics that effect whale shark presence evermore pressing.

Keywords: whale sharks, remote sensing, aggregation, Red Sea.

Evidence for systemic age underestimation in shark and ray ageing studies

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Numerous studies have now demonstrated that the most common method of ageing sharks and rays, counting growth zones on calcified structures, can underestimate true age. I reviewed bomb carbon dating (n = 15) and fluorochrome chemical marking (n = 44) age validation studies to investigate the frequency and magnitude of this phenomenon. Age was likely to have been underestimated in nine of 29 genera and 30% of the 53 populations studied, including 50% of those validated using bomb carbon dating. Length and age were strongly significant predictors of occurrence, with age typically underestimated in larger and older individuals. These characteristics suggest age underestimation is likely a systemic issue associated with the current methods and structures used for ageing. Where detected using bomb carbon dating, growth zones were reliable up to 88% of asymptotic length (L∞) and 41% of maximum age (AMax). The maximum magnitude of age underestimation, ΔMax, ranged from five to 34 years, averaging 18 years across species. Current perceptions of shark and ray life histories are informed to a large extent by growth studies that assume calcified ageing structures are valid throughout life. The widespread age underestimation documented here shows this assumption is frequently violated, with potentially important consequences for conservation and management. In addition to leading to an underestimation of longevity, the apparent loss of population age-structure associated with it may unexpectedly bias growth and mortality parameters. Awareness of these biases is essential given shark and ray population assessments often rely exclusively on life history parameters derived from ageing studies.

Keywords: age validation, bomb carbon dating, Chondrichthyes, fluorochrome marking, life history, longevity.

Worldwide distribution of trophic and feeding ecology of elasmobranchs

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Elasmobranchs' population depletion has long become an international concern. Several studies demonstrate that as a consequence of these populations' decrease, marine ecosystems are undergoing serious dynamic changes. Since trophic and feeding ecology provide essential information concerning resource partitioning and network dynamics, which are fundamental matters to identify and predict community dynamics' changes, recognizing knowledge gaps about this subject is imperative. Therefore, our aim was to detect which geographic regions, environment and taxonomic groups within elasmobranchs are in lack of information regarding this topic and consequently need further attention. Using the key-words "diet", "elasmo*" and "feeding", we searched for papers regarding the trophic and feeding ecology of elasmobranchs at the Scopus database finding 942 matches. Of all these, 291 fit the criteria (i.e. feeding studies about elasmobranchs) and hence were reviewed. We found that the Ethiopian zoogeographic region, despite its high biodiversity, is poorly studied (6.5%) in comparison to the Nearctic (31.4%), Neotropical (24.5%) and Australasian (16.9%) regions. The Oriental region also had few studies (6.2%). The United States (19.7%), Australia (14.8%) and Mexico (9.0%) are the leading countries publishing about this subject, followed by Brazil (7.9%). Once elasmobranchs' species are mainly marine, most studies (96.5%) comprised this environment. Still, we found that freshwater and estuarine species require more attention, since studies concerning these species were scarce, representing only 1.0 and 2.5% of all, respectively. The total number of sharks' and rays' species studied showed no significant difference (182 and 152, respectively), yet most of the articles reviewed concerned sharks (73.9%) instead of rays (19.2%) and only a few of them studied both (6.9%). That finding exposes the dissimilarity between the amount of attention provided for each group. Within sharks' families, Carcharhinidae (n = 79), Triakidae (n = 39) and Lamnidae (n = 35) were the most studied, whilst Rajidae (n = 22), Dasyatidae (n = 12) and Arhynchobatidae (n = 10) were the most studied rays' families. Besides that, we found that of all articles reviewed, 149 (35.5%) concerned Vulnerable, Endangered or Critically Endangered species exclusively or amongst others. However, when regarding studied elasmobranchs species, only 76 (23.2%) were classified within those categories, revealing the need to improve our knowledge about threatened species' ecology. Besides, we noticed that there has been an increase in studies concerning elasmobranchs' trophic and feeding ecology over the last 20 years. Nevertheless, this review shows that many gaps about this subject still remain.

Keywords: conservation, diet overview, elasmobranch diet, threatened species, zoogeographic regions.

Sarasota Bay: a newly defined nursery for blacktip sharks (*Carcharhinus limbatus*) on the Gulf coast of Florida

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Nursery areas provide juvenile sharks with abundant prey and protection from predators. Defining these Essential Fish Habitats is an integral component of effective species management and conservation plans. The blacktip shark (*Carcharhinus limbatus*) is a species of major economic importance in the Gulf of Mexico. The Gulf coast represents nearly continuous habitat for this species, but parturition is thought to occur in discrete nursery areas. Sarasota Bay, on the Gulf coast of Florida, is a 56-mile-long urbanized coastal lagoon system, comprised of five embayments, joined by the Intracoastal Waterway and separated from the Gulf of Mexico by a complex of barrier islands. Once heavily polluted, Sarasota Bay was named an Estuary of National Significance in 1989 and both water quality and seagrass coverage have increased dramatically since that time. Several species of teleost fishes are abundant, including juveniles of economically important species, but elasmobranch populations were previously unknown. A seasonal (May through October) monthly gillnet survey of the largest embayment, Sarasota Bay proper, began in 2016 to assess the distribution and relative abundance of elasmobranch species in this estuary. Young-of-the-year (YOY) and juvenile blacktip sharks were encountered in northeastern Sarasota Bay in 2016 and 2017 and relative abundance was comparable to that in Terra Ceia Bay, a well-known nursery area for this species. Coded acoustic tags were surgically implanted into YOY blacktip sharks to assess residency time and site fidelity to this portion of the bay. Acoustic telemetry revealed frequent use of the area throughout the summer and early fall months. Further, a tagged animal was detected leaving Sarasota Bay just prior to the landfall of Hurricane Irma and returning to the hypothesized nursery area immediately after the storm had passed. Periodic residency in this area continued through late fall, when the animal emigrated from Sarasota Bay as water temperatures began to drop. These results align with the Heupel et al. (2007) criteria for shark nursery areas. Blacktip sharks were also tagged in adjacent Terra Ceia Bay and there were no movements of animals between these two areas, supporting the definition of Sarasota Bay as a separate and distinct nursery area for blacktip sharks.

Keywords: residency, site fidelity, acoustic telemetry, philopatry, hurricane.

Effects of provisioning on the behavior and space-use of great hammerhead sharks, *Sphyrna mokarran.*

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Food attraction and provisioning are becoming increasingly popular to enhance ecotourism experiences. However, such activities remain controversial owing to the limited understanding of their long-term implications on the behavior and ecology of the target species. Consequently, there is little consensus on how to manage ecotourism appropriately. Here, we examine how daily provisioning activities influence the behavior, movements and space use of great hammerhead sharks, *Sphyrna mokarran*, in Bimini, Bahamas. Between January 2017 and May 2017, 104 shark dives were attended to quantify individual differences in the daily food uptake of the sharks. Observation data were then compared to Dynamic Brownian Bridge Movement Models created from acoustic monitoring data to examine space use pattern differences between provisioned and non-provisioned sharks. Thirty individuals were identified of which 28 attended provisioning events regularly. Provisioning indexes, calculated as the number of provisioning events an individual shark attended divided by the total number of events, ranged from 0.01 to 0.66. Sharks consumed up to 16 kg bait per individual per dive. Known philopatric sharks that repeatedly use Bimini as overwintering site displayed significantly higher provisioning indices, food uptake and appeared earlier at the provisioning site on a daily basis. The amount of consumed bait was a significant determinant of how much time individuals spent in proximity to the acoustic receiver in close proximity to the dive site and we documented individual differences in the local space use patterns of the sharks. By quantifying individual differences in feeding and space use patterns, we provide first insights into ecotourism impacts on great hammerhead sharks.

Keywords: wildlife tourism, artificial feeding, endangered species, dynamic Brownian bridge, elasmobranch.

Exploring occurrence and abundance of reef sharks in the Pacific

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There is increasing concern over the status of global sharks and rays with as many as 25% of species threatened with extinction. In conjunction with pressure from fishing activities, at-risk populations also face the threats of changing climate conditions and other human impacts. Based on these concerns it is important to understand the current status of populations to allow future investigation and understanding of how species and populations respond to pressures and management interventions. The Global FinPrint project is an international initiative to define the relative abundance of sharks and rays that occur in coral reef habitats. Baited remote underwater video surveys are being conducted to define species occurrence, richness and relative abundance to provide a baseline from which to define future species and population trends. Here we present data collected from 14 countries in the Pacific region and examine the variability among locations and potential capacity to improve the status of sharks and rays where needed. Differences in species richness were evident among countries ranging from 4 to 18 species as well as variability in relative abundance among species and locations. Potential reasons for variability will be explored and discussed. With coral reefs being some of the world's most threatened ecosystems, this research is critical to our future management of these habitats and the predator populations that rely on them.

Keywords: baited remote underwater video, abundance, Global FinPrint.

Great white shark population structure and sporadic founding events through transoceanic migrations

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Population structure and species dynamics serve a crucial role in shaping conservation efforts and species management. The great white shark, *Carcharodon carcharias*, adds a layer of complexity to conservation and management due to its rarity and dynamic pelagic lifestyle. Acquiring a large amount of genetic data through sampling many individual white sharks provides a more accurate schematic of their global population structure, abundance, and genetic connectivity. On December 7, 2015 the carcass of a female white shark (Total length=332 cm, mass=312 kg) washed ashore on Wrightsville Beach, NC. Conducting a genetic analysis of this individual will add information on a new female adult white shark to the global and Northwest Atlantic white shark database. We amplified and sequenced 830 bp of the mitochondrial control region (mtDNA) of this individual. Analysis of this mtDNA sequence with 478 other white shark mtDNA control region sequences obtained from GenBank revealed 87 different haplotypes across 7 populations worldwide. The creation and analysis of a haplotype network and Bayesian phylogenetic tree revealed a close relationship between the female white shark washed ashore in NC and a South African haplotype indicating the possibility of a recent sporadic founding event between the Northwest Atlantic and South Africa.

Keywords: population structure, transoceanic migrations, Great white shark, genetics, mitochondrial DNA, sequencing, sporadic founding events, migration, GenBank.

Island treasure hunt: The search for Galápagos bullhead sharks

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Demersal sharks are thought to have limited dispersal capacity due to their physiological and behavioral adaptations to living on or closely related to the sea floor. However, some shallow-water demersal species have managed to thrive at geographically remote locations, such as oceanic islands and seamounts. Here they may have low levels of population connectivity. This isolation may lead to local demographic rates and a lack of replenishment from adjacent locations, making local stocks more susceptible to human exploitation and natural disturbance. The Galápagos bullhead shark (*Heterodontus quoyi*) was described as early as 1840, but to date little scientific information exists for this species. The benthic shark is thought to have a small geographic range limited to the coast of Perú and the Galápagos Archipelago. Since 2015, the Galápagos bullhead shark project aims to shed light on the geographic distribution, life history, demographic and genetic structure of this elusive species. Here we introduce a unique combination of non-invasive sampling methods, including underwater blood collection, which may be applicable to other demersal sharks. Between 2015 and 2017, a total of 149 tissue samples (67 females and 82 males) and 136 blood samples (59 females and 77 males) were collected from seven locations on five islands. Moreover, we present first results on detailed body morphology, sexual dimorphism and ontogenetic changes of these characteristics. Photogrammetry was used to obtain 23 body measurements in males and 21 in females. The preliminary results suggest that the presented combination of underwater sampling methods could be applied to obtain a range of samples and data from other demersal elasmobranchs that can be handled safely underwater. In the future we will combine morphological measurements with life history data, such as size at maturity, and genetic/genomic techniques to assess population subdivision in the eastern Pacific. The integrative approach may improve the description of ecologically and genetically distinct units of the Galápagos bullhead shark population covering its entire geographic range. The results may ultimately be used to develop effective strategies for local and regional fisheries and conservation management.

Keywords: demersal sharks, geographic isolation, body morphology, sexual dimorphism.

Global population structure of the common smoothhound shark, *Mustelus mustelus*: Implications for conservation and fisheries management

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Fisheries management for threatened species has become a focus for many conservationists in recent years. While reliable catch and abundance data are required to accurately monitor a species' susceptibility to fishing pressure, knowledge of the connectivity between populations is essential especially when dealing with a globally distributed species. This is the case with the commercially important common smoothhound shark, *Mustelus mustelus*, which occurs in the Mediterranean, North and South East Atlantic, and South West Indian oceans. This study aimed to investigate the global structuring and connectivity of this species across biogeographical regions, using both mitochondrial and nuclear markers. Firstly, the mitochondrial control region (CR) was sequenced in the global sampling set, and used to infer haplotypes and reconstruct phylogenetic relationships between these regions. A total of 26 haplotypes were identified (mean h = 0.861; mean Π = 0.0042), with little to no differentiation (φST: 0.002 – 0.067, P < 0.01) discernable between the ocean basins. Secondly, F-statistics, multivariate analysis and Bayesian clustering supported a total of eight genetic clusters (FST: 0.064 – 0.280, P = 0.001), with genetic distance correlated to geographical distance (r2 = 0.207, P = 0.003). Overall, the populations were characterised by low to moderate genetic diversity, with the Mediterranean populations appearing to have the lowest genetic diversity on a global scale. A cautious approach to the management of the species should be taken, as some regions appear to have a degree of connectivity despite being significantly differentiated. Ultimately, this study provides a baseline assessment for the global management of this threatened coastal shark.

Keywords: population differentiation, mitochondrial CR, microsatellites, gene flow, demersal shark.

Developing strategies to reduce shark mortality in commercial tuna longline fisheries

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The incidental capture of sharks in commercial fisheries targeting tuna and billfish is having a negative impact on pelagic shark populations. Due to finning bans most sharks are no longer retained and are discarded at sea. Recent studies have shown that some shark species sustain high levels of post release mortality due to injuries incurred during the fishing interaction. Researchers have identified the three main factors that lead to mortality in sharks; 1) the physiology of the species where some are more susceptible to the lethal effects of stress, 2) the duration of the interaction and 3) the methods used to release the animal. In collaboration with the Pacific Islands Regional Observer Program (PIROP) and local commercial fishers we are assessing the effects that handling and discard practices used in the Hawaii and American Samoa tuna longline fisheries have on the release condition and survivability of sharks with newly established condition criteria and handling codes that are recorded by at-sea observers. Post-release survival rates were validated with survivorship pop-off archival satellite tags (sPAT).

PIROP observers were trained in the use of the new shark focused condition and handling codes and on methods of deploying satellite tags on sharks over the rail of longline vessels while the sharks are in the water and prior to discard. These efforts have generated quantitative estimates of total fishery mortality rates for blue, bigeye thresher, silky and oceanic whitetip sharks and revealed high levels of survivorship to 30 days for animals that were in good condition at the vessel. During this study we also found that the most prevalent release method for sharks is to cut the line that they are captured on, thereby releasing sharks with trailing gear; hook, wire leader, a 45 gram weighted swivel and monofilament of varying lengths ($\mu = 7.3$ m). To assess the effects of the trailing gear on survivorship, long term PATs were placed on blue sharks released by cutting the line. Delayed mortality (beyond 30 days) was high for these animals. Our results highlight the utility of investigating the post release fate of discarded species to determine handling and release methods that will increase survivorship potential.

Keywords: shark bycatch, post-release mortality, best handling practices.

Determining habitat utilization and home ranges of the central Pacific scalloped hammerhead shark

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Scalloped hammerhead sharks (*Sphyrna lewini*) were determined to be at risk of extinction in four of six distinct population segments and listed under the United States Endangered Species Act in 2014. These determinations were made primarily using genetic and fishery data with little to no information regarding the species' movement behavior or habitat use requirements. This species utilizes shallow embayments as nursery areas and Year 1 pups have high fidelity to their natal grounds rendering them highly susceptible to anthropogenic impacts in these areas. The long-term fidelity of adults to pupping/ nursery areas was previously unknown. In this long-term telemetry study beginning in 2008, 27 male scalloped hammerhead sharks were tagged with acoustic and/or satellite tags in and around a nursery area in Kaneohe Bay, Hawaii USA. Movements of these individuals indicated seasonal use of the inshore areas of the bay during summer. Several animals were annually acoustically detected on inshore receivers in the same embayment over a period of several years. Horizontal movements away from the bay indicate that the tagged animals were highly associated with the Hawaiian Archipelago. Vertical movements were dynamic with repeated, deep dives to depths beyond 800 m conducted at night. These results indicate that, at least for males, there may be a 'Hawaiian' resident population and points towards the importance of maintaining healthy ecosystems within important nursery areas. Similar research should be conducted with adult females.

Keywords: telemetry, shark movement, Scalloped hammerhead shark, nursery, critical habitat.

Can personal shark deterrents reduce the risk of bites from white sharks?

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The recent increase in shark-human interactions has led to the development of a broad range of personal shark deterrents targeting different sensory organs. Rapid commercialisation of these deterrents has resulted in a lack of independent, rigorous and peer-reviewed tests to inform the general public about the efficacy of such devices. Yet, manufacturers often make unsubstantiated claims about the efficacy of their products. This has already given some members of the general public a false sense of security, leading some people to put themselves at greater risk of shark interactions than they normally would because of the reliance of these devices. The efficacy of five commercially available personal shark deterrents (Shark Shield Surf+, Rpela, SharkBanz bracelet, SharkBanz leash, and Chillax Wax) were field-tested on white sharks. Sharks were enticed to consume a bait (southern bluefin tuna) attached to a surf board imitation while exposed to one of six treatments: one of the five deterrents or a control board with inactive deterrents. A total of 300 trials were undertaken (50 for each of the six treatments) during which ~20 different white sharks approached the bait more than 1,500 times. Deterrents using electric fields elicited the strongest response, with less baits consumed compared to other deterrents and control trials. Magnetic fields and olfaction-based deterrents had limited effects on white shark behaviour. Our study provides empirical evidence of the efficacy of these devices and their ability to affect the behaviour of potentially dangerous sharks. Such information will be useful to private and governmental agencies as well as the general public to make informed decisions about the use and suitability of these devices for occupational and recreational activities, and will therefore likely reduce risks of shark interactions.

Keywords: deterrent, mitigation measure, sensory organs, shark interactions, surfing.

GenoJaws: A global study of shark populations using contemporary and retrospective analyses

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Knowledge of species responses to past environmental changes is vital for understanding current patterns of shark biodiversity. In this context, collections of archived specimens, such as jaws and vertebrae, in museums and other repositories represent exclusive DNA "log-books" for climate change research. GenoJaws is a collaborative investigation of global populations of large sharks developed in response to a need for greater understanding of both current and historical populations of tiger (*Galeocerdo cuvier*), grey nurse/sand tiger (*Carcharias taurus*), mako (*Isurus oxyrinchus*) and white sharks (*Carcharodon carcharias*). By applying a population genomics approach to contemporary and archived historical samples, we aim to provide inferences on temporal changes of population structure, robust estimates of population trends and possibly identify genetically based adaptation to exploitation and global change. Here we provide an overview of the project and point to the potential policy and management implications and hope to encourage the contribution of additional samples to the project.

Keywords: population genomics, ancient DNA, shark jaws, Exome-capture, effective population size.

Trophic relationships and mercury contamination of deep sea sharks in the Gulf of Mexico

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The mechanisms of species coexistence comprise an important theme in ecology, and coexistence of demersal fishes including elasmobranchs into discrete depth bands is an important theme in deep sea biology. However, not much is known about the effects of ecological interactions on this zonation. Deep sea sharks have received relatively little research attention despite being potentially important predators in deep demersal fish communities and that they make up nearly half of all global chondrichthyan fauna. These fishes are important components of deep sea food webs and are vulnerable to fishery exploitation. Six relatively common shark species that partially overlap on a depth gradient and demonstrate a range of feeding habits and movement patterns provide an interesting system in which to conduct a detailed investigation of the trophic ecology and potential for competition or niche partitioning of these coexisting mesopredators. Trophic ecology will be investigated using both stomach contents analysis and light stable isotope analysis ($\delta13C$, $\delta 34S$, $\delta 15N$). Trophic niche overlap will be estimated using stable isotope spatial niche metrics. Potential for competition between coexisting species will be determined by comparing spatial niche metrics in depth habitat sympatry to depth habitat allopatry, with the expectation that competition would cause a shift in niche size and overlap between sympatry and allopatry. As long-lived mid to upper trophic level predators, elasmobranchs are also susceptible to carrying high loads of bioaccumulating toxicants and may facilitate the long-term persistence of these contaminants in marine food webs. Methylmercury (MeHg) is a particularly concerning contaminant in fishes because high levels of contamination can put humans at risk for reproductive and neurological problems via fish consumption. There is special interest in MeHg in northern Gulf of Mexico food webs because of the hypothesis that the 2010 Deepwater Horizon Oil Spill created ecological conditions ideal for increased methylation of ambient mercury. Preliminary data show that deep sea sharks can carry relatively high concentrations of MeHg in their tissues and the typical bioaccumulation pattern of increasing MeHg contamination with fish size, but high individual variation and differences in slope between species. MeHg bioaccumulation patterns can be influenced by multiple factors, such as size, sex, taxon, trophic ecology, ontogeny and depth habitat. Differences in MeHg bioaccumulation patterns for sharks feeding in different food webs (benthic, mesopelagic) and on different dominant prey categories will be investigated.

Keywords: deep sea, trophic ecology, stable isotopes, stomach contents, mercury.

The great white shark count: estimating the abundance of the white shark in southern Africa with a model integrating several long term datasets - preliminary results.

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Paramount to the success of any regulatory action is a basis on sound scientific knowledge and a regular assessment of progress. This project aims to assess the status and trend of the white shark (*Carcharodon carcharias*) assemblage in southern Africa by deriving the first robust regional estimates of past and present shark abundance that accounts for movement within and outside of the study area. An accurate estimate of abundance is a vital index for the management of the white shark in the region. Several independent datasets have been collected in the past in an attempt to estimate the abundance of this species and this work aims to unify these estimates within an integrated framework. Preliminary results of an integrated population model combining acoustic and satellite telemetry datasets with a photo identification record spanning nearly two decades of research across four study sites are presented. 38 individuals were fitted with SPOT transmitters, 35 of which, plus an additional, 5 were surgically implanted with RCODE acoustic transmitters. Over 1 terabyte of photographic encounter records will be processed to identify individuals using a novel automated computer vision system. The model then aims to account for biases introduced by animals that are in the study site but not sampled photographically, particularly when bait is used for attraction, by developing a hierarchical state space model that links the underlying movement of individuals with the observation process that results in successful photographic identification, and ultimately, the mark-recapture model. Drivers of movement between aggregation sites, the influence of this movement on seasonal relative abundance and temporal and spatial trends reflecting the health of the population will be explored.

Keywords: mark-recapture, hierarchical modelling, state space model, telemetry, photo identification.

Movement networks predict the dynamics and vulnerability of reef predators

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Measuring and predicting predator-meditated connectivity of isolated habitats is an important prerequisite for effective conservation. While predator movements can influence important ecological processes, they also inform species vulnerability. We ask how do the movements and overall spatial connectivity of reef shark activity spaces impact their risk of exposure to illegal fishing? Using a movement network approach, we characterise mobility patterns in two sympatric species of reef-associated shark, grey reef (*Carcharhinus amblyrhynchos*) and silvertip (*Carcharhinus albimarginatus*) between isolated atolls inside one of the world's largest marine protected areas, British Indian Ocean Territory (BIOT). Inferring behaviour for over 100 sharks from >3 years of acoustic tracking data we show that reef shark movements observe a heavy-tailed distance-decay function. We relate shark movement network metrics and activity space estimates to spatially explicit risk data gathered by MRAG (Marine Resources Assessment Group), who have been responsible for the enforcement of the reserve over the last eight years. We reveal distinctly different behavioural patterns between the two species, including the swim rates and frequencies with which they transition between different atolls and discuss how this impacts their putative risk to illegal, unreported and unregulated (IUU) fishing activity that persists in the MPA today. By modelling movements using novel network approaches we reveal behavioural patterns in globally-distributed reef sharks, helping us evaluate how movement dynamics influence species mortality trajectories.

Keywords: connectivity, elasmobranch, illegal fisheries, mobility patterns, spatial networks, telemetry.

Dietary habits of *Gymnura lessae* revealed through DNA meta-barcoding of stomach contents

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The northern Gulf of Mexico is home to a diverse assemblage of benthic rays. Despite this, relatively little is known about basic aspects of their ecology, including dietary habits. The smooth butterfly ray, *Gymnura micrura*, was recently reclassified as three separate species of ray; as such, there are no diet studies for the Gulf of Mexico species of *Gymnura (Gymnura lessae)*. We analyzed stomach contents of *Gymnura lessae* obtained through a two-year fisheries-independent trawl survey in the Northern Gulf of Mexico. A total of 482 stomachs were extracted and 191 of those contained prey items. The high percentage of empty stomachs found is consistent with other *Gymnura* species, and can be attributed to intermittent feeding, extended periods of digestion, and high rates of regurgitation observed during sampling. For non-empty stomachs, most prey items were heavily digested, so we employed the use of DNA meta-barcoding to gain finer resolution and thus greater insight into feeding habits for this species. Compared to traditional stomach content analysis, the number of specific prey items identified via DNA meta-barcoding increased fivefold, and prey species richness doubled. No non-teleost remains were found in any stomach, indication a high degree of specialization. Three species of fish made up 81% of the index of relative importance (%IRI) at the species level. Fish in the families Sciaenidae and Engraulidae together accounted for most of prey items at the family level (99%IRI). The high degree of teleost specialization we found is consistent with other *Gymnura* species. Further analysis will be done to examine how prey selectivity varies by size, sex, and location.

Keywords: *Gymnura,* batoid, diet, meta-barcoding, Gulf of Mexico.

Age underestimation in batoid fishes – does it affect our ability to manage fisheries?

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Band pairs in vertebral centra have been used to age batoids for over 60 years. However, the instances where the number of band pairs underestimate the age of the individual are increasing, particularly in large adults of many species. These age estimates are still used in the construction of stock-assessment models that dictate how batoid fisheries are managed. To reconcile the fact that the input data into stock assessment models is biased we examined the effect of intentionally biased age data on stock assessment model results. Length-at-age data for little skate, *Leucoraja erinacea*, and winter skate, *L. ocellata*, were biased ±10% and ±25% of the lifespan for (1) all ages and (2) mature ages only. For each species, these eight scenarios and an unbiased (normal) scenario were modeled with the von Bertalanffy growth model and applied to a statistical catch-at-age model. Estimates of maximum sustainable yield (MSY) and fishing mortality at maximum sustainable yield (FMSY) were qualitatively compared across ageing bias scenarios in the context of current biological reference points. As age underestimation is identified in more batoid species, research on the implications of biased age estimates incorporated into stock assessment results is crucial until an alternate method to estimate batoid age is found.

Keywords: vertebral centra, skates, age bias.

Characterisation of bull and tiger shark populations from Reunion Island

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While they have always occurred, shark attacks increased since 2011 in Reunion Island (western Indian Ocean), raising concern about safety for bathers and surfers and impacting the touristic economy. In order to manage the shark risk, local authorities, municipalities and the French government implemented a shark risk management plan, which included a fishing program and scientific research, especially on dead animals, among other actions. Since 2012, 115 and 152 bull and tiger sharks were caught and dissected. The sex ratio was balanced and close from unity for both species and the size range was large and covered both adult and juvenile stages. Various biometric measurements and samples were collected during each dissection to conduct trophic ecology, reproductive biology, population dynamics and population genetic analyses. Here I present an overview of the research conducted locally and the state of knowledge on bull and tiger shark populations from Reunion Island. I highlight differences and similarities with populations from other regions of the world. Overall, Reunion Island hosts a population of bull sharks close from other populations of east and south Africa both in terms of morphology and genetic, and very different from the Atlantic and Gulf of Mexico. For tiger shark, differences are less marked between populations. These results are discussed both in ecological terms and at the light of the shark risk management.

Keywords: stable isotopes, microsatellites, growth curves, gonado-somatique index, LT50.

CRA – An organisation to manage and reduce the shark risk in Reunion Island

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Reunion Island is a young French oceanic island of the western Indian Ocean. Its geomorphology leads to steep slopes that limit coastal ecosystems to a narrow band along the shore. Coral reefs fringe only on the lee west coast, while most of the island is open to the ocean. In this context, large marine predators can access coastal areas very easily, and especially sharks, which can interact with recreational beach users. Shark attacks have always occurred around the island, since the first event of colonisation. In recent years, the management of shark risk became of primary importance as it negatively impacted economic growth of the island along the coast and toward the ocean. After a series of shark attacks, some being fatal and essentially attributed to the bull (*Carcharhinus leucas*) and the tiger (*Galeocerdo cuvier*) shark, the French government and local authorities decided to create a new agency to help with shark risk management. Firstly, this organisation, named Centre de Ressources et d'Appui sur le Risque Requin, will assist municipalities and local administrations with the implementation of projects that would help reducing shark attack risk. Secondly, it will develop a scientific politics to improve the knowledge on sharks and rays and to develop an internationally recognised expertise in this study area, conservation, and sustainable management of these species. Finally, this institution will coordinate the communication inside and outside the island. All actions follow a sustainable development approach, taking into account the environment, the economy and the society.

Keywords: attacks, management, mitigation, innovation.

DNA Barcode in the identification and conservation of rays

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Among Chondrichthyes, there are approximately 1200 described species of sharks, rays, and chimeras. Only rays, corresponding to more than half of these species and, in Brazil, there are more than 70 already described. To properly evaluate and conserve biodiversity, it is fundamental to identify different species. Recently, traditional morphological identification methods were complemented by modern methods, such as DNA Barcode, that uses molecular markers to identify species based on genetic characteristics of each taxon and by a sequences similarity score on a reference library, the Barcode of Life Data System (BOLD). The present study aims to identify Brazilian rays species using DNA Barcode method and complement the Brazilian rays biodiversity database. So far, 36 individuals have been sequenced, 25 of the species spiny butterfly ray, *Gymnura altavela* and 11 of longnose stingray, *Hypanus guttatus*, scoring similarity ranges from 95 to 100% with BOLD sequences. Both species are currently listed as "Vulnerable" and with "Data Deficient", respectively, in the Red List of the International Union of Conservation of Nature and Natural Resources (IUCN). Biological data supplementation is imperative for conservation efforts for endangered species, as well as for those that lack biological data for proper assessment. To sum, the use of molecular tools is an effective method for species identification and have several applications for conservation and fisheries management.

Keywords: conservation genetics, molecular biodiversity, barcode, elasmobranch.

Sharks and stingrays landed in the largest fishing port of Alagoas, Northeast Brazil.

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Sharks and stingrays are sensitive to intense and unmanaged fishing. Characteristics such as late sexual maturity, low fecundity and longevity make them the most threatened group of marine fish in Brazil. The city of Piaçabuçu, located near the estuary of the São Francisco river, is the largest fish producer in Alagoas, Northeastern Brazil. Aiming to evaluate and characterize the fishery production of sharks and stingrays of Piaçabuçu, landings were monitored from 2014 to 2017, with the collaboration of the local fishermen (colony Z - 19). Eight Families and 21 species of elasmobranchs, commercially classified as "sharks" and "stingrays", were identified. Of the registered species, 67% are threatened nationally or internationally: *Ginglymostoma cirratum*, *Carcharhinus porosus*, *C. obscurus*, *C. signatus*, *C. perezi*, *C. falciformis*, *C. leucas*, *C. limbatus*, *Isurus oxynrinchus*, *Sphyrna lewini*, *S. mokarran*, *Manta birostris* and *Mobula tarapacana*. From the amount of fish landed during this period, sharks comprised 79,320 kg (average / year = 1,652.5 kg, SD = 1,027.8) stingray 67,650 kg (mean / year = 1,409.3 kg, SD= 607 kg, 4 kg), representing 3.64% of the local fishery production. An increase in elasmobranch production during this period was observed, from 13,869 kg and 11,443 kg in 2014, to 24,958 kg and 20,013 kg in 2017, for sharks and stingrays respectively. It represents an increase of 80% in the landing of sharks and 75% of stingrays, with significant differences among the years (Anova, F=3.76, p=0.017). Despite this value, local fishermen report that most of the catches of elasmobranch occurs accidentally in gillnet, trawl fisheries, small longlines and handlines directed to other groups more valuable commercially (Penaeidae, Scombridae, Carangidae, Centropomidae, Sciaenidae, Coryphaenidae, Lutjanidae and Epinephelidae). However, there is register that large sharks are targeted on longline fisheries, with 150-300 hooks on average, by a small fleet of about ten vessels. Due to this increasing in landings which include endangered species, there is a need to implement alternatives to prevent such incidental catches in the region in addition to continued monitoring and an strategy of spread of information on fisheries legislation.

Keywords: fishing, fishery monitoring, fishery production.

The secret life of a deep-sea lanternshark – of populations, parasites, environmental challenges and mysterious strandings

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Deep-sea sharks play an important ecological role maintaining food web balance, yet they are vulnerable to heavy commercial fishing pressure due to their slow growth rates and low reproductive capacity. Knowledge of their population structure, life history and resilience is integral to sustainable management at appropriate spatial and temporal scales. The velvet belly lantern shark, *Etmopterus spinax* is a small-sized deepwater shark, which is often captured as by-catch in commercial deep-water fisheries and discarded due to its low commercial value. A decline has been observed in some areas attributed to excessive fishing pressure. Despite being a commonly found shark, there is a lack of knowledge about its population structure, ecology and response to environmental or anthropogenic changes. In our multidisciplinary study, we aim to unravel what constitutes a population in a deepwater shark, using *E. spinax* as a model species, and how these populations differ from each other. Analyses combining genetics, chemistry and parasite data from multiple areas in different countries revealed significant differences between but not within regions. Zooming into much smaller spatial scales, we detected for example seasonal abnormalities in a Norwegian fjord were an *E. spinax* population exhibits repeated mass stranding events, potentially related to changes in environmental conditions or disease, or a combination of the two. Various hypotheses are currently investigated, especially in light of similar recent strandings of various species on the US coast in California, searching for potential similarities and drivers. Overall, understanding what drives population differences and susceptibility to unfavorable conditions will help the management and protection of populations at appropriate scales. Due to its extensive latitudinal distribution, *E. spinax* could be a useful model species for understanding some of those crucial factors and their consequences to population persistence along environmental gradients.

Keywords: genetics, chemistry, life history, fisheries, epidemiology.

Mysterious strandings of a deepwater shark in Norwegian fjord

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Many shark strandings have been reported and investigated across the world, especially within the last few years. If the rate of those strandings does in fact increase or if there are merely better monitoring programs in place today, is not clear. What we do know however is that in the majority of cases we don`t know why a given stranding occurs where and when it does. In some cases the culpitts causing the death of stranded sharks could be identified, what is unclear in most cases however is the question of "why now?". What might change the resilience of a local shark population making them locally susceptible to biotic (e.g. parasites, bacteria, fungi) or abiotic (e.g. salinity, oxygen, temperature) factors? We explored reported cases of shark strandings across the globe, looking for trends and similarities. In Norway, we detected that a velvet belly lantern shark, *Etmopterus spinax*, population exhibits repeated mass stranding events in a deep fjord system. *E. spinax* is a small-sized deepwater shark, which is often captured as by-catch in commercial deep-water fisheries and discarded due to its low commercial value. Locally, populations can be large and catches are mostly separated by sex. We sampled 400 *E. spinax* from a recent stranding event, and tested various hypotheses based on previously reported cases, expert consultation as well as local environmental data. This investigation into the causes and drivers of such strandings is especially timely in light of similar recent strandings of various species on e.g. the US coast in California. Results and the most likely scenario will be discussed, and lively discussions about causes and potential new hypotheses are strongly encouraged.

Keywords: causes, biotic, abiotic, resilience, environmental.

Critical areas for elasmobranchs in the coast of Pernambuco: a focus on the use of habitat

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The coast of the state of Pernambuco is 187 km long displaying a variety of marine ecosystems such as mangroves, estuaries and reefs. Elasmobranchs are ecologically important in these habitats due to their role in structuring the dynamics of ecosystems. The occurrence of elasmobranch species was reviewed identifying different habitats through Brazilian nautical charts and environmental maps. In the absence of local data, potential essential habitats, used by species, were identicated from information of literature about ecosystems along the coast of Pernambuco. The potential and confirmed habitats for coastal species are: mangroves, muddy bottom estuaries, sandy bottoms up to 10m depth, reefs (rocks and corals), sandy bottoms 10m to 20m depth and coralline bottoms over 20m depth. Among habitats, two areas have great ecosystemic value: the Santa Cruz Estuarine Complex and the Sirinhaém River Estuarine Complex. The Myliobatiformes species as *Aetobatus narinari*, *Hypanus americanus*, *Hypanus guttatus*, *Hypanus marianae* and *Urotrygon microphthalmum* and the shark, *Rhizoprionodon porosus*, use those complexes for giving birth, growth and foraging having muddy bottoms were the most important habitat. Both areas due to their relevence should be the priority for conservation, public policies and for management plans aiming at fisheries regulation.

Keywords: habitats, nursery, estuary, foraging, conservation.

Sharks and stingrays in the street market: Out of the sea, on the dish

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Street markets are traditional places for selling fish. In Brazil, there is a lot of this kind of market where trade is carried out daily, although there are no estimated numbers of volume or species involved. At the city of Penedo, Alagoas, Northeast Brazil, placed 48 km distant from the littoral, the main target on trade at the street markets has been historically freshwater fish from the São Francisco river, probably due to its location at the margins of the river. Nowadays, fish both cultivated and from marine origin are more important on markets due to their diversity and volume traded. We have been monitoring points of sale at the main street market in Penedo, from 2014 to 2017, aiming to elucidate which elasmobranchs species are commercialized, their numbers, age group and how the fish are processed before the trade. The individuals were identified, photographed, weighed, the total length measured (TL). During this period, 41 visits were made to 8 points of sale. Five families, 7 genera and 10 species were recorded among the 373 specimens, namely: Sphyrnidae (76 *Sphyrna lewini*, TL 37-100 cm and 1 *S. mokaran*,TL 80 cm); Carcharhinidae (200 *Rhizoprionodon porosus*, TL 28-120cm; 4 *R.* cf. *lalandii*,TL 41.4 cm; 44 *Carcharhinus limbatus*, TL 50-2500 cm; 3 *Galeocerdo cuvieri*, CT 1500-2500cm); Myliobatidae (2 *Rhinoptera bonasus*, CT 24-51cm); Aetobatidae (4 *Aetobatus narinari*, TL 30-73cm) and Dasyatidae (1 *Hypanus americanus*, TL 54 cm; 38 *H. guttatus*, TL 29-69 cm). Two species, *Sphyrna lewini* and *S. mokarran*, are listed as critically endangered (CR) and endangered (EN) in Brazil. Neonates and juveniles are sold entire or only eviscerated and adult specimens are sold sliced. These numbers are underestimated, due to the commercialization of carcasses, which have no identification conditions (2.9%). We emphasize that sharks and stingrays' neonates correspond to 70.5%, juveniles 23% and adults 6.5%. We confirm that small markets, placed far from the littoral, can be important consumers of the sharks and stingrays' meat, including neonates, juveniles and endangered species, and that there is a need for changes in traditional conservation strategies. We suggest the implementation of adequate management measures, as well as the monitoring of fishing activities, since all catches occur in the southern coast of the State, adjacent to the São Francisco river estuarine region and 93.5% of the individuals sold in Penedo city are neonates and juveniles, including endangered species, indicating a possible nursery area.

Keywords: trade, monitoring, neonates.

Morphological characterization of the dermal denticles of the dorsal trunk region of seven species of sharks landed in the Peruvian coast

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Dermal denticles, also called placoid scales, are hard structures that cover the skin of sharks. The main function of these structures is to protect the body. They present a great variety of forms associated with different parts of the body and species. The objective of the present study was to morphologically characterize the denticles of the dorsal trunk region of shark species landed in the Peruvian coast. Forty specimens from different sampling points were obtained at different dates. Seven species of sharks, *Notorynchus cepedianus* (n=17, 492.50+147.36 mm TL), *Echinorhinus cookei* (n=1, 2100 mm TL), *Prionace glauca* (n=2, 269.28+21.94), *Mustelus mento* (n=3, 901.67+258 mmTL), *Mustelus whitneyi* (n=7, 499.10+151.90 mm TL), *Triakis maculata* (n=5, 404.80+13.63 mm TL) and *Isurus oxyrinchus* (n=6, 159.95+15.46 mmm TL) were sampled. Skin samples were obtained from the dorsal region (in front of the first dorsal fin) of the trunk of each specimen. Denticles description was carried out by observing the samples in a 100X scale stereoscope, photographing and measuring the denticles. Denticles of *N. cepedianus* are separated from each other, presenting low density, crown with the shape of a cross, three cusps, one ridge and with a peduncle. *E. cookei* denticles present a dispersed distribution, low density, with numerous ridges in the peduncle and absence of a crown. *P. glauca* presents denticles in an adjoining distribution, low average density, crown with rhomboid shape, 3-5 cusps, 3-5 ridges, presence of peduncle and presence of microrelief. Denticles of *M. mento* have a superimposed distribution, medium density, oval shape crown, one cusp, the presence of a peduncle and the union of the peduncle with the crown is visible. *M. whitneyi* presents a superimposed distribution, medium density, triangular shape crown, one cusp, three ridges, the presence of a peduncle and visible union of the peduncle with the crown. *T. maculata* presents a separte distribution, medium density, oval shape crown, one cusp, three ridges, the presence of a peduncle and visible union of the peduncle with the crown. *I. oxyrinchus* presents a superimposed, high density, crown with serrated form, three cusps, three ridges and presence of the peduncle. In conslusion, the dermal denticles of these seven shark species present morphological differences that provide an effective identification tool, being able to improve the biological and fishing information taken at the landing points of peruvian coast.

Keywords: description, Elasmobranchii, placoid scales, Peru, taxonomy.

Northern Peru becomes the new aggregation area for whale sharks

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The whale shark *Rhincodon typus*, the largest fish in the ocean, is worldwide categorized as endangered due to its large population decline. Even though it is a giant, information on its life cycle and natural history is still quite scarce. In the Eastern Pacific, the only well known aggregations are in the Gulf of California (Mexico) and in the Galapagos Islands (Ecuador). Moreover, most of the known aggregations are composed mainly by juvenile males. Our previous studies identified northern Peru as an area used by whale sharks seasonally. From October 2014 to January 2018, we conducted 62 boat surveys to search for whale sharks and collected data on size, gender, behavior, location and took pictures for photo-identification. We also obtained data from non-dedicated surveys and collaborators. All photo-ID sharks were compared with the database from Mexico to find matches. We encountered a total of 203 sharks, and obtained photos from 195 of them, which resulted in 95 unique sharks. The identified sharks that were sexed were composed by 77% males and 23% females. Males were on average 6m long (range 3-9, n=48) and females 7m (range 3-10, n=14). Sharks were observed during the austral spring and summer with the highest observations in December and November and most of them were observed feeding. No matches were found with the Mexican database. Our findings highlight northern Peru as an important aggregation area in this region, with a new population that, so far, has no connectivity with Mexico and that is composed by both juvenile and adult males and females, making it unique and important to study and to preserve. This research is the first study on whale sharks in Peru and was essential for issuing the national legislation that now protects them. Moreover, whale sharks have become the first shark protected in Peru.

Keywords: *Rhincodon typus*, photo identification, mixed aggregation.

Assessing the role of magnetic-based navigation in spatial ecology of the bonnethead, *Sphyrna tiburo*

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The bonnethead, *Sphyrna tiburo*, is a small coastal shark found throughout the Northwest Atlantic in nearshore and estuarine environments. *Sphyrna tiburo* is abundant, making the animal an ideal model species for studies on habitat and space use. Tracking data indicate this species moves along long stretches of coastline, with individuals acoustically-tagged in South Carolina traveling as far south as Cape Canaveral, FL. Despite these long distances, recent studies in South Carolina show individuals are philopatric and return to the same estuaries on an annual basis. This fidelity suggests *S. tiburo* has the ability to recall an environment to successfully navigate back to from an alternate location, however, the mechanism behind this behavior remains unknown. For decades, researchers have postulated that the philopatric behaviors of elasmobranchs are facilitated by an ability to navigate using cues provided by the earth's magnetic field. Laboratory trials are currently being conducted to further our understanding of the effect of geomagnetic parameters on the spatial ecology of *S. tiburo*. A system of Merritt coils has been built around an experimental tank, enabling our team to finely manipulate the perceived geomagnetic field. Within the experimental tank, *S. tiburo* is tethered with a harness so swimming is unimpeded. By independently manipulating different components of the geomagnetic field, we will determine if *S. tiburo* can perceive and use these cues for orientation. To supplement this data, we are also conducting displacement trials with *S. tiburo*, where magnetic geologgers will document the spatial occurrence of geomagnetic variables during homing behaviors. This research will provide a framework for understanding the role of magnetic-based navigation in the spatial ecology of elasmobranchs and propose additional techniques for investigating the philopatric tendencies of *S. tiburo*, a model species for studying movement patterns in coastal sharks.

Keywords: philopatric, migration, site fidelity, geomagnetic field.

Philopatric migrations and intra-estuarine space use of the bonnethead, *Sphyrna tiburo*

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Bonnetheads, *Sphyrna tiburo*, are small coastal sharks that have been shown to conduct philopatric migrations, returning exclusively to specific estuaries in South Carolina. In 2015, we began tagging bonnetheads in the North Edisto River, SC (NER) to study philopatric migrations and intra-estuarine space use. To date, we have tagged 45 bonnetheads with V16 acoustic transmitters. These bonnetheads have been shown to exhibit temperature driven migrations, returning annually to the NER. During migration periods, the bonnetheads are detected in nearshore and estuarine arrays throughout Georgia and mid-Florida. The furthest southern detection occurred off the coast of Cape Canaveral, Florida, and the further offshore detection occurred in Gray's Reef National Marine Sanctuary. Residency in the estuary has typically occurred from early April to October. Three water quality loggers are positioned in the NER, in addition to an array of 21 VR2W acoustic receivers. While present in our array, most sharks are detected over 90% of the days from their arrival until their departure. This array has allowed us to quantify the effect of environmental variation on the intra-estuarine space use of the bonnethead. While many studies have investigated the habitat and space use of bonnetheads, few have examined the effect of individual variation. Our use of acoustic telemetry enables us to determine how individual variation affects space use. Recent work has shown that sharks have distinct personalities that are persistent over time. For this reason, we expect that repeatable and persistent individual variation will account for a significant portion of space use patterns. This research will expand on our current insight into the spatial ecology of the bonnethead and will increase our understanding as we are able to monitor repeated space use patterns of the same animals.

Keywords: acoustic telemetry, residency, site fidelity.

Tonic immobility as a substitute for chemical anaesthesia during surgical implantation procedures on elasmobranchs

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Tonic immobility is a widely used technique for the surgical implantation of acoustic tags in elasmobranchs (sharks, skates, and rays), yet it is still not broadly recognised as an acceptable procedure by many regulatory bodies, animal care committees, and even journal ethics standards. To highlight its regular use and applicability as a field procedure, a literature search was conducted on the anaesthetic technique adopted for all existing elasmobranch-focused acoustic telemetry papers, up to 31 December 2013. A total of 57 studies was identified that contained relevant details on surgical procedures. The majority of these studies (43, or 75.4%) employed tonic immobility, while 10 (17.6%) used general chemical anaesthesia, and 4 (7%) used local chemical anaesthesia. These studies identify that tonic immobility provides an effective technique for surgical implantation in elasmobranchs, offering several benefits over chemical anaesthesia, both from a practical and animal welfare perspective. Practically, rapid induction and recovery optimizes the surgical procedure, desirable under often complex field conditions, where general chemical anaesthetics prolong duration, and administration is often unfeasible because of the size of study animals. Benefits over chemical anaesthetics for animal welfare include no risk of overdose, no uptake of chemicals to body tissues (and subsequently food web), minimal disruption to respiration, thereby reducing potential for negative sublethal impacts that influence post-release behaviour, and immediate and full recovery. Given these benefits and its long-standing use in field studies, it is recommended that tonic immobility be recognised as an acceptable substitute for chemical anaesthetic during surgical implantation procedures on elasmobranchs. Further investigation into the physiological and sensory effects of tonic immobility on elasmobranchs will increase clarity and help bridge the gaps in stances on the issue between field biologists, veterinarians and regulatory bodies.

Keywords: acoustic telemetry, best practice, shark handling, tagging, animal welfare.

Cabo Pulmo National Park: a success story of top predator recovery in the Gulf of California

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Sharks were common in Cabo Pulmo before the 1980s when their abundance declined mainly due to overfishing. The Cabo Pulmo National Park (CPNP) was established in 1995 as a no-take zone, within 15 years the ecosystem recovered and top predators returned. There was an increase in shark abundance and today it is possible to find 12 different species. Bull sharks (*Carcharhinus leucas*) and blacktip sharks (*Carcharhinus limbatus*) are now highly resident in CPNP and use specific sites within the park. In this study we analyze the residency and movement patterns of 20 bull sharks using passive acoustic telemetry. Most sharks were tagged in May and June 2016, and their presence was detected by an array of 16 acoustic receivers (VR2W) previously deployed within the CPNP. The data show the mean residency index (RI) was 0.365 (SD±0.2143). During the warmest season (August to November) individuals were not detected in the coastal receivers, however, they were present throughout the rest of the year. We also carried out underwater and land censuses to determine the relative abundance of sharks, and found that both bull and blacktip sharks were more abundant in February and March. The residency and presence of top predators reveal that unlike other areas in the Gulf of California where sharks are absent with little signs of recovery, the CPNP represents a successful story of marine conservation.

Keywords: telemetry, sharks, residency, marine reserves.

Population structure and demographic history of *Telatrygon zugei* (Elasmobranchii, Dasyatidae) revealed high levels of genetic differentiation of stingrays in the Indo-West Pacific

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The family Dasyatidae (Order Myliobatiformes) is one of the largest families of cartilaginous fishes. It is comprised of 19 genera and at least 86 living species. *Telatrygon zugei* is commonly found within estuarine, coastal, and continental shelves and forms a significant component of the elasmobranch bycatch by demersal fisheries in Southeast Asia, the coastal Seas of China, and Japan. We collected 244 samples from eight geographic locations along the coast of the Indo-West Pacific including Andaman Sea, the Gulf of Thailand, the China Seas, and the Ariake Bay of Japan. Multiple molecular markers, including two mitochondrial genes, Cyt b and ND2, and eight microsatellite loci were employed to evaluate population genetic structure and population demographic history. High levels of genetic variation between populations were identified. Phylogenetic analysis partitioned haplotypes into two lineages that are estimated to have diverged during the early Pleistocene. Microsatellite-based Bayesian clustering clearly identified four genetic groups, and population subdivisions were strong (overall ST = 0.867, P < 0.0001), suggesting that pale-edged stingray exhibit higher divergence across geographical regions and lower differentiation along continuous coastal habitats. Pleistocene demographic expansions were examined using neutrality tests and Bayesian skyline analyses in each genetic group of *T. zugei*. Moreover, the Bayesian simulations of population history based on microsatellite data pinpointed population decline in all populations during the Holocene. The climate oscillations and current hydrologic cycles in the Indo-West Pacific appear to be responsible for pale-edged stingray population structure and demographic history. The genetic distance value among different populations can be as much as 4.2%, being more than 10 times higher than those of within species level divergence in chondrichthyans (0.39%). Thus, we inferred that *T. zugei* distributed in the Indo-West Pacific may contain cryptic species. These results are critical for defining management units and species biodiversity to guide future management strategies and conservation of stingray fisheries throughout the distribution areas of the fish.

Keywords: pale-edged stingray, cryptic species, sharks and rays conservation, Asia.

Testing a novel satellite-linked technology to track large marine fauna

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Tracking animals with satellite-linked tags can provide valuable information on broad-scale movements, but the quality and amount of information is constrained by battery life and downloading technology of the tags, and the tags are expensive. With the support of the European Space Agency, a new microchip named ARTIC was developed and integrated into a novel animal tracking device. The new tag has a transmitter that sends short messages of less than a second to the Argos satellite network and, before uploading its archived data, must receive a return "handshake" signal indicating whether a satellite is overhead, thereby reserving battery life for effective data transmission. When a satellite is in range, collected data are uploaded in binned packages. The tag's novelty is based on its ability to both receive and transmit data, its significantly increased battery life span, its expanded data storage, and its comparatively low cost, potentially an order of magnitude less expensive than current models. The tag can log light-based geolocation, temperature, and pressure. The bidirectional communication capacity of the tag also allows for real-time uploading of collected data, as opposed to only archiving it. The longer battery life will allow researchers to track a single animal for up to several decades, which will generate valuable insight into long-term movement patterns. First prototypes of the tags, developed by the data-logger manufacturer Star-Oddi, are being deployed on large sharks to test their technical features and field performance. These and other field trials and controlled comparisons with current satellite tagging technologies will show the potential of the new tags for telemetry research on different animal types.

Keywords: PSAT, SPOT, Argos, sattelite tag.

Outcome of the first regional shark & ray stock, fisheries & management assessment for the Wider Caribbean Region

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Effective management and conservation of marine resources requires aregional approach, especially in parts of the world with a high number of small island countries, such as the Caribbean. During 2017, FAO commissioned the 1st ever assessment of sharks and rays in the wider Caribbean region on behalf of the Western Central Atlantic Fisheries Commission (WECAFC), the regional fisheries management group for teh area. We present the results of this assessment, which provided the background to a Regional Plan of Action for sharks in the Wider Caribbean region that was presented to all stakeholders at a WECAFC meeting in October 2017 in Barbados.The assessment was based on existing stock and management information provided by Caribbean nations on all shark and ray fisheries (targeted and bycatch), information available from FAO's Fish StatJ databases and a literature review. This information was augmented with a survey on shark fisheries, management and perception filled-in by 15 of 34 WECAFC member countries (Antigua & Barabuda, Barbados, Belize, Cuba, Dutch Caribbean, French Antilles, Guyana, Grenada, Honduras, Nicaragua, Panama, St. Vincent & the Grenadines, Surinam, USA and the EU). There is limited information available on the status of shark stocks in the region apart from aggregate data for sharks and/or rays. The only country to conduct assesments is the US for species in the South Atlantic and Gulf of Mexico. The Gulf Smooth hound (*Mustelus sinusmexicanus*), Dusky shark (*Carcharhinus obscurus*) Atlantic Smooth Dogfish Shark (*Mustelus canis*), Atlantic Sharpnose (*Rhizoprinodon terraenovae*). Blacktip shark (*Carcharhinus limbatus*) and Bonnethead (*Sphyrna tiburo*) were assessed between 2012 and 2015. For most coutries, historically these species where not deemed economically important and there was little incentive to collect data on population sizes or other demographics. There is consensus that sharks in the region have exhibited a strong decline in the past three decades and this has driven an effort to improve their management. Although species specific catch information is lacking for most nations, the regional assessment indicates that even though only a few nations have targeted elasmobranchs fisheries, they are a frequent bycatch in both coastal and pelagic fisheries throughout the Wider Caribbean region and shark products are frequently sold and consumed there. Management for sharks and rays in the region is patchy and highly diverse between nations.The outcomes of the assessment form a basis for future research, management and conservation action at a region level through cooperation among the WECAFC members. Bonnetheads, *Sphyrna tiburo*, are small coastal sharks that have been shown to conduct philopatric migrations, returning exclusively to specific estuaries in South Carolina. In 2015, we began tagging bonnetheads in the North Edisto River, SC (NER) to study philopatric migrations and intra-estuarine space use. To date, we have tagged 45 bonnetheads with V16 acoustic transmitters. These bonnetheads have been shown to exhibit temperature driven migrations, returning annually to the NER. During migration periods, the bonnetheads are detected in nearshore and estuarine arrays throughout Georgia and mid-Florida. The furthest southern detection occurred off the coast of Cape Canaveral, Florida, and the further offshore detection occurred in Gray's Reef National Marine Sanctuary. Residency in the estuary has typically occurred from early April to October. Three water quality loggers are positioned in the NER, in addition to an array of 21 VR2W acoustic receivers. While present in our array, most sharks are detected over 90% of the days from their arrival until their departure. This array has allowed us to quantify the effect of environmental variation on the intra-estuarine space use of the bonnethead. While many studies have investigated the habitat and space use of bonnetheads, few have examined the effect of individual variation. Our use of acoustic telemetry enables us to determine how individual variation affects space use. Recent work has shown that sharks have distinct personalities that are persistent over time. For this reason, we expect that repeatable and persistent individual variation will account for a significant portion of space use patterns. This research will expand on our current insight into the spatial ecology of the bonnethead and will increase our understanding as we are able to monitor repeated space use patterns of the same animals.

Keywords: FAO, stock assessment, Caribbean, WECAFC.

The effects of an open access fishery on hammerhead shark stocks in Trinidad, to eat or not to eat

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Hammerhead shark populations, particularly of the larger species, are declining globally and Trinidad and Tobago's populations are no exception. There are at least five species of hammerheads found in Trinidad and Tobago: *Sphyrna lewini* (Scalloped Hammerhead), *S. tudes* (Smalleye Hammerhead), *S. mokarran* (Great Hammerhead), *S. media* (Scoophead), and *S. tiburo* (Bonnethead). Castro (1987) identified *S. tudes* as the second most abundant shark encountered in the commercial catch and *S. lewini* as the fourth most important. However, current information at the species level is unavailable as the Trinidad Fisheries Division either groups all hammerheads together or assigns them to the more general 'shark' class while the Tobago Department of Marine Resources and Fisheries does not record shark catches at all. Trinidad and Tobago was ranked as one of the top ten exporters of shark fins to Taiwan and there is a high demand locally for the meat (in the cultural dish 'bake n shark') and oil. Our study sought to enumerate and describe the current hammerhead catches of this prominent, open access shark fishery. We surveyed fisherfolk and collected fisheries dependent data at landing sites across Trinidad to determine which hammerhead species are caught most and which size classes and sex are frequently landed.

We gathered information on where, when and how the hammerheads were caught. Results show that *S. lewini* are now the most common hammerheads landed and all surveyed have been juveniles. *S. tudes* were infrequently encountered which is drastically different to 2nd most abundant shark in the fishery 30 years ago. Only one *S. mokarran* has been sampled and no *S. media* or *S. tiburo* have been seen. *S. tiburo* was formally described as significantly contributing to the northeast coast fishery and the most abundant small shark caught off the south coast (Castro 1987). Declines in abundances of hammerheads were reported by 88% of the local fishers surveyed as well. Fishers identified the north coast of Trinidad as the best location to catch hammerheads using primarily gill nets and especially during the months of January to March which may be indicative of where and when juvenile recruitment occurs. This work is ongoing and future studies will seek to identify nursery habitats and primary use periods, as well as investigate connectivity around Trinidad and Tobago and throughout the Western Atlantic. Our research will provide the background information needed to develop appropriate management plans to conserve these vulnerable species.

Keywords: shark population declines, hammerhead nursery, hammerhead fishery, shark management.

Reproductive philopatry, population structure and demography of the raggedtooth shark (*Carcharias taurus*) in South Africa

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Reproductive philopatry is a behaviour where animals remain or return to specific areas for mating, gestation or pupping. Philopatric behaviour has been documented in various marine animals and previous studies have shown that shark populations may be characterised by regional genetic structure at scales of 100s of kilometres due to reproductive philopatry. The identification of philopatric grounds related to reproduction is crucial in mitigating biodiversity impacts driven by overfishing, bather protection nets and destruction of philopatric areas due to anthropogenic effects. Due to restricted gene flow between these units, the probability of reproductive mixing and population recovery as well as genetic diversity is reduced. In this study, two mitochondrial and 12 microsatellite markers are used to investigate how reproductive philopatry shapes the genetic structure of raggedtooth sharks (*Carcharias taurus*) along the south-east coast of South Africa. Samples from young of the year and juvenile sharks (N = 104) with restricted movement outside of their specific nursery areas, as well as adult sharks (N = 85) in their mating ground off KwaZulu-Natal (KZN) were analyzed. The South African *C. taurus* population is characterized by a contrasting pattern of high genetic diversity based on nuclear microsatellites and very low maternally-inherited mitochondrial gene diversity. Although no significant differentiation could be detected among nursery areas, our results indicate that genetic structure might be weakened by movements of older juveniles with wider migration range into neighbouring nursery areas. Even though it is possible that females return to the same nursery where they were born to reproduce, there seems to be sufficient gene flow to inhibit the formation of partially independent reproductive units. However, our findings of a group of adult male sharks caught during mating season at Zinkwazi off the coast of KZN, showing an unexpectedly high degree of relatedness and genetic differentiation to adult sharks sampled at other locations in KZN, highlights the need to further investigate the very elusive behaviour and migration pattern of male sharks. The integration of genetic data with tag-mark-recapture data will further improve our understanding of this species' behaviour by delivering a more complete picture of migration and demography. Ultimately, this project will guide management decisions for successful and sustainable conservation of these apex predators.

Keywords: *Carcharias taurus*, philopatry, microsatellites, mtDNA, tag-mark-recapture.

The Cayman Sharklogger Programme: citizen science in support of shark conservation

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The global decline of sharks has made their population assessment and monitoring more important than ever, yet obtaining reliable population estimates of key species remains difficult and expensive. Citizen science initiatives are increasingly recognized for their potential in monitoring population estimates and ecological patterns. In the Cayman Islands, we have been operating a "Sharklogger" programme - a citizen science initiative involving volunteer professional and recreational divers. Participating divers log all their dives, recording not only the presence but also the absence of sharks. Unlike simpler public sightings schemes this method can be adapted to provide information on a) relative abundance, b) popuation estimates, c) population demographics, d) individual home ranges and e) behaviour patterns. Between January and December 2017, Cayman Island Sharkloggers logged 9,615 dives and recorded 1,880 sharks, of which 17 carried dorsal fin tags, attached during scientific long-lining. The data covered 451 dive and snorkel sites across all three Cayman Islands. Seven shark species, Caribbean reef shark (*Carcharhinus perezi*), nurse shark (*Ginglymostoma cirratum*), hammerhead shark species (*Sphyrna* spp.), tiger shark (*Galeocerdo cuvier*) blacktip shark (*C. limbatus*), lemon shark (*Negaprion brevirostris*) and whale shark (*Rhincodon typus*) were recorded. Over the whole year, mean total shark sighting rates were significantly higher on Little Cayman (0.237 sharks/dive) than on Grand Cayman (0.183) or Cayman Brac (0.175). C. perezi (0.11 sharks/dive) was the most frequently encountered species, followed by *G. cirratum* (0.076), *Sphyrna* spp. (0.003), *C. limbatus* and *N. brevirostris* (0.0004), *G. cuvier* (0.0002) and *R. typus* (0.0001). Sighting rates of the more abundant species also showed significant differences between islands and between different parts of each island. In addition *C. perezi* encounter rates showed significant differences between months. The data collected by the Sharklogger programme has supported results from our scientific surveys (using BRUVS and scientific long-lining), and will, we anticipate, continue to provide information for monitoring of shark abundance during periods when dedicated research is not being funded.

Keywords: population assessment, long-term monitoring, dive survey, coastal sharks, survey tool.

An illusive safety net: A review of conservation and management of vulnerable elasmobranchs under the Species at Risk Act and the Fisheries Act in Atlantic Canada

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Canada enacted the Species at Risk Act (SARA) in 2002 to prevent wildlife species from becoming extirpated or extinct; provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity; and to manage species of special concern to prevent them from becoming endangered or threatened. Since its enactment, SARA implementation has encountered inadvertent and intentional bottlenecks. This presentation will review these issues as they apply to elasmobranchs. SARA charged the Committee on the State of Endangered Wildlife in Canada (COSEWIC) with assessing the conservation status of species and advising the Minister on whether protection under SARA is warranted. In the last 16 years, COSEWIC has assessed 15 populations representing 10 species of sharks and rays in the Atlantic. Five populations (4 species) met the criteria for endangered; five populations (5 species) were found to be species of special concern; and five populations (3 species) were either not at risk or non-active. So far, only White shark (*Carcharodon carcharias*) has been listed in 2011. But despite the listing, the full suite of conservation measures mandated by the legislation has not been adopted. The presentation will review SARA obligations and compare them to what is in place for White shark. Porbeagle shark (*Lamna nasus*) and two populations of Winter skate (*Leucoraja ocellata*), assessed as endangered and recommended for listing by COSEWIC, were rejected by the Minister on the grounds of high socio-economic costs and the adequacy of the Fisheries Act to address the threats. A review of the conservation measures adopted under the Integrated Fisheries Management Plans demonstrates limited actions despite available options. The 6 populations (5 species) recommended for listing by COSEWIC that are now under review by the Minister also fall under the Fisheries Act jurisdiction and therefore encounter similar problems. This presentation will conclude with recommendations to improve the chances of recovery of vulnerable elasmobranchs in Atlantic Canada such as amendments to SARA and the Fisheries Act to prevent unnecessary delays and improve recovery measures as well as mechanisms for engagement with the U.S. and the Regional Fisheries Management Organizations with respect to shared species.

Keywords: law, endangered species, fisheries management.

Global genetic inventory of the silky shark (*Carcharhinus falciformis*), the shark finning industry, and DNA fingerprinting

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Silky sharks (*Carcharhinus falciformis*) occur in all oceans and are subject to the second highest elasmobranch harvest on the planet. Their habitat overlaps with commercial tuna fisheries, and they account for over 90% of the shark bycatch in tropical purse seines of the western and central Pacific. Silky sharks are also one of the most abundant species in the shark fin trade. As a result, this formerly abundant species has declined by more than 85% in the last 20 years and is now listed as Near-Threatened and Declining by IUCN. Despite this dramatic decline, there is little information on genetic stock structure to identify the basic units of wildlife management. This project provides a global genetic inventory with 657 specimens from 12 globally distributed locations. Using restriction site-associated DNA polymorphisms (ezRAD) in whole genome scans, 16,000 single nucleotide polymorphisms (SNPs) were identified to calculate population structure. We show distinct genetic differences between Indo-Pacific, Red Sea, and Atlantic populations and low levels of population structure between Atlantic regions. A comparison of the maternally inherited mitochondrial genome to the nuclear genome demonstrates female philopatry and male mediated genetic dispersal across ocean basins. Finally, we are using this global genetic inventory as a baseline to identify the origins of Silky sharks in the fin markets. Over 1000 specimens from the fin market in Hong Kong, China will be compared to our global baseline. Given that traditional extraction monitoring of shark fins is not available, our assessment of stock harvest will happen at the end point of the market supply chain. This will allow the identification of sharks in the fin trade to both the species-level and oceanic region of origin, providing a much-needed scientific foundation for management plans.

Keywords: silky shark, population genetics, RAD-seq, shark fins, forensic.

Low genetic diversity and reduced population connectivity in a highly mobile coastal shark, the smooth hammerhead shark *Sphyrna zygaena*

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The smooth hammerhead shark (*Sphyrna zygaena*), in South Africa, is vulnerable due to overfishing and decimation of their natural habitat required for feeding and maturation. The rise in the number of neonate and juvenile hammerheads in the inshore area during the summer months increases the risk of localized stock depletion. With a low fecundity and a long generation time of up to 20 years, potential for population recovery is minimal. In this study, 750bp of the ND2 mtDNA gene (n=55) and seven microsatellite markers (n=95) were used to assess levels of genetic diversity within and between populations of Mossel Bay, Port Elizabeth, and the KwaZulu Natal region. The microsatellite data indicated a subdivision between the southern coast (Mossel Bay) and the Eastern Coast (Port Elizabeth and KZN), while the mitochondrial DNA revealed no divergence between sampling sites with one major haplotype shared amongst most individuals. Additionally, siblingship was determined from neonate and juvenile smooth hammerhead sharks in Mossel Bay over two seasons to determine the degree of relatedness as a precursor for investigating philopatry of smooth hammerheads in the future. The majority individuals displayed at least one order of relatedness through a half-sibling relationship with a few full-sibling relationships also present. A thorough assessment of the genetic diversity and population connectivity of this species will provide insights to how these sharks may respond to environmental and anthropegenic pressures associated with recent declines of related shark species.

Keywords: *Sphyrna zygaena*, sharks, population genetics, fisheries management, kinship.

Exploring the diversity of Chondrichthyes from Andaman waters, India

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Andaman & Nicobar Islands of India are surrounded by a variety of coastal habitats such as mangroves, seagrass beds and fringing reef ecosystems, supporting diverse flora and fauna, and providing a wide ranges of socio-economic services. Compared to the other parts of Indian EEZ, the coastal waters of these Island largely remains unexplored. Studies on chondrichthyans are scarce and limited data is available. Present study is an attempt to give a detailed account on diversity and richness of cartilaginous fishes (Sharks, Skates, Rays & Chimaeras). This study is based on the surveys conducted for two years (2014-2016) at various fish landing centers (single day/multi-day commercial fishing vessels), fish market and deep-sea oceanographic exploratory surveys (FORV SagarSampada)) around Andaman Islands. The present findings revealed a total of 16 species of chondrichthyans in exploratory surveys which includes chimaeras (2), sharks (10), rays (2), skates (2) and more than 30 species in commercial fishery as targeted and also as bycatch. Surveys provided an insight to unexplored diversity, with several new reports to region including *Proscyllium magnificum*, *Neoharriotta pinnata*, *Hexanchus griseus*, *Heptranchias perlo*, *Cephaloscyllium silasi* and *Echinorhinus brucus*. Findings also revealed two new records of ray are in press from the region, namely *Rhinoptera jayakari* and *Gymnura zonura*. Several unidentified specimens are also collected, belonging to Chimaeridae, Triakidae, Rajidae, which will further increase the diversity of region. An updated checklist was prepared from the region which consists of 80 chondrichthyans species recorded covering 10 orders and 30 families with Chimaeras (2), sharks (49), Skates (1), Rays (21), Sawfishes (3) and Guitar fishes (4). Diversity of chondrichthyans shows Carcharhiniformes as most diverse with 6 families followed by Myliobatiformes with 4 families and *Carcharhinus* were the most diverse genus. Bathymetrically, depth range 600-800m and spatially, latitude 12-13°N were the most diverse in comparison to other locations. An estimated 245 tonnes of chondrichthyans were recorded during 2014-15 in Andaman fishery and 158 tonnes during 2015-16. Outcomes from present study indicates rich diversity and unexplored areas in Indian EEZ, which require to study in detail to understand the status of chondrichthyans.

Keywords: Chondrichthyes, species composition, diversity, Andaman Islands, Indian EEZ.

Old devils – Age & growth of Indo-Pacific mobula rays

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Chondrichthyans (sharks, skates and rays) are vulnerable to overfishing due to highly conservative life-history characteristics. Mobulid rays, in particular, are at risk of overexploitation due to long gestation periods, reduced litter size and late maturity. They are landed as target and retained bycatch throughout most of their range, to be sold as low-value flesh consumed locally and high-value gills for exportation. In light of these threats, mobula rays were recently listed on Appendix II of CITES in an effort to regulate international trade and improve traceability (CoP17). Yet, important basic biological and ecological information is still lacking for the genus. Age and growth estimates are crucial to estimate life-history parameters and to understand how exploited populations are likely to respond to anthropogenic pressure. Poorly calcified vertebrae centra and difficult to access specimens has precluded age and growth estimation in mobula rays until a study in *Mobula japanica* revealed growth bands in the caudal vertebral region of this species. In order to test the feasibility of using this method to estimate the age of mobula rays from other species and regions, we collected vertebrae from *Mobula japanica*, *Mobula thurstoni*, and *Mobula tarapacana* landed in artisanal gillnet fisheries in Indonesia and from *Mobula kuhlii cf. eregoodootenkee* landed as bycatch in a shark control program in Eastern Australia. Mobula ray species showed different levels of calcification in the caudal vertebrae, with growth banding patterns visible in *Mobula japanica* and *Mobula thurstoni* but not in *M. tarapacana* and *M. kuhlii cf. eregoodootenkee*. A multi-model approach was chosen to estimate growth by selecting best-fit models using Akaike's information criterion with a bias correction for small sample size (AICc). Observed size at birth was available from the study location and was incorporated in two-parametric models. In *M. japanica* models were fitted to females and males separately to compare growth rates between sexes. Age and growth parameter estimates were compared with those of *M. japanica* from Mexico and with other elasmobranch species, highlighting high vulnerability of mobulids to exploitation.

Keywords: growth modeling, longevity, devil ray, mobulid, vertebral aging.

How do manta and mobula rays sense their world? Novel visual specialisations, electroreception & the lateral line

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Mobulid rays (manta and mobula rays) possess exceptionally large brains relative to body size, while brain morphology suggests they possess comparatively high capacity to process sensory information. The genus *Mobula* currently comprises eight species, unique among batoids as pelagic filter-feeders, encompassing drastic differences in morphology and behaviour among species. Smaller mobulid ray species tend to occur in epipelagic waters while extreme deep-diving has been recorded in larger species. These habitat differences are likely linked to key morphological adaptations that are species-specific - such as the presence of cranial retia mirabilia to maintain brain heat while at depth in the chilean devil ray and the oceanic manta ray, divergences in pre-branchial appendage morphologies, body size, shape and colouration. In order to gain insight into how manta and mobula rays sense their environ-ment, we are studying their sensory systems in a functional context, providing important insights into the evolution of filter-feeding elasmobranchs. We compare visual, electroreception and lateral line adaptations among species, hypothesising that specialisations differ as a function of behaviour. Results reveal unique specialisations of mobulids among vertebrates such as a naso-ventral area of high ganglion cell density in the retina, which confers increased acuity in the visual fields located above and behind them. Electroreception and lateral line system morphology suggests they play an important role in mobulid rays. Retinal transcriptomics underway reveal the visual pigments expressed by mobulids. We discuss findings in an ecological context. This information is highly relevant for bycatch reduction through sensory deterrents such as LED lights in non-selective fisheries.

Keywords: retinal topography, mobulid, elasmobranch, vision, sensory biology.

Transfer of heterologous microsatellites among species from the *Squalus* genus (Squaliformes: Squalidae)

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Microsatellites are powerful tools for the evaluation of a variety of genetic applications, although they are specific markers and the development of new microsatellites for Elasmobranchs is challenging. Thus, the application of heterologous microsatellites is an alternative approach. Recently, in 2016, a regional taxonomic revision of the *Squalus genus* (Chondrichthyes: Squaliformes: Squalidae) described four new species in the southwest Atlantic Ocean, including *Squalus albicaudus*. In this context, the feasibility of using heterologous microsatellite markers developed for *Squalus acanthias* on *Squalus albicaudus* was evaluated. *S. albicaudus* samples were collected off the coast of Rio de Janeiro, from November 2015 to October 2017. Tissue samples was removed from the back muscle tissue (dorsum) of each individual and stored in ethanol 80% in 2.0 ml micro-tubes. DNA was extracted through a protocol applying sodium chloride, quantified on a NanoDrop 2000c spectrophotometer and verified by agarose gel electrophoresis. Twelve microsatellite markers were analyzed on a thermocycler and PCRs were performed with according to the conditions established by the authors who developed the primers. Locus amplification was determined by agarose gel electrophoresis and the sizes of the allelic fragments were analyzed on an automated sequencer. The 12 heterologous primers functioned in *S. albicaudus* with a remarkable degree of polymorphism. These results indicate that the heterologous microsatellite markers developed for *S. acanthias* can be used in genetic studies on *S. albicaudus* with the creation of a specific protocol. This allows for one of the future objectives of our main study, which intends to determine the frequency of multiple paternities in this species.

Keywords: elasmobranch, genetic analysis, genetic markers, transferable markers.

Embryonic phase morphometry and sexual dimorphism of the Brazilian electric ray *Narcine brasiliensis* (Olfers, 1831)

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The Brazilian electric ray *Narcine brasiliensis* is distributed along the Southwestern Atlantic coastal waters and, despite being recorded in fish landings, this species is still poorly understood. This study aimed to morphologically compare individuals in the embryonic phase and neonates to identify the presence of sexual dimorphism at these early stages of development. Measurements taken from neonates and embryos were also analyzed, to verify the existence of diagnostic characters that could define embryonic stages. Based on 50 specimens provided by the Rio de Janeiro Marine Aquarium, 44 measurements were performed for the calculation of means, standard deviation, kurtosis, length variation and proportion in total length and symmetry, and the data were separated by sex and compared through Mann-Whitney'stest. The analysis allowed for the definition of five embryonic stages, based on the anatomy and color pattern of the specimens. The first stage is characterized by not yet externally visible gill filaments and not yet formed gill slits, an undeveloped electric organ and externally present yolk sac. The second stage is characterized by the incomplete formation of the gill slits. The third stage features the expected five gill slits, well developed, but the pectoral fin not yet fully fused to the head. Due to the curvature of the neonates, the left pelvic fin is more developed than the right one. The fourth stage features pectoral fins already fused to the head, developed pelvic fins and a not yet fully developed electric organ. Lastly, the fifth stage shows a developed electric organ, with the hexagonal electrocyte structures visible to the naked eye. While the first and second stages are characterized by a faint coloration, with few blotches of grayish areas, the third and fourth stages presented a much more defined color pattern, with dark gray long stripes upon a pale background, but with well-defined limits, a distinct character from stage five and adults, where the markings presented no clear boundaries over a pale body. The comparison of males and females showed sexual differences in eight of the determined measurements. This study also demonstrates the usefulness of breeding programs by marine aquariums and universities as a source of specimens in different development stages, rarely obtained in the natural environment. This partnership allows for research in several fields regardinglocal species that suffer from gaps in knowledge and paves the way for better management strategies for the protection of the Brazilian marine ecosystems.

Keywords: batoidea, embryonic development, ontogeny, torpediformes.

Silky shark *Carcharhinus falciformis* (Bribon, 1839) satellite tagging in the equatorial and southwestern Atlantic Ocean

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The silky shark, *Carcharhinus falciformis*, is a highly migratory apex predator and pelagic species distributed in tropical and equatorial waters of all oceans. In northeastern Brazil, it is particularly abundant in the vicinity of the Saint Peter and Saint Paul Archipelago (ASPSP). This work aimed at studying the movements of silky sharks in the equatorial and southwestern Atlantic Ocean, by three different types of satellite tags, from the ASPSP. From 2010 to 2014, a total of 10 silky sharks were tagged: 3 with PSAT, 5 with MiniPAT tags and 2 with SPOT tags. The time of monitoring of these sharks ranged from 6 to 248 days and from these tags, 6 reported data to the satellites as scheduled, 1 reported prematurely and 3 never reported. An inbuilt state-space model, the unscented Kalman filter- UKFsst, was then applied to the raw location estimates to correct anomalous positions, using SST data from Reynolds at 0.25° NOAA Optimum Interpolation. In general, the tagged sharks showed a preference for warm waters of the mixed layer, where they remained most of the time, during the day. The dive patterns indicated that *C. falciformis* remained largely at depths of up to 0- 70 meters and temperatures of 26 to 28°C, with a preferred depth between 1-10m, showing close relationship with the surface. However, it presents incursions to the Mesopelagic zone, with sporadic dips at depths of about 450m, mainly during the night period reaching temperatures of up to 8°C. In relation to the horizontal displacements the studies revealed a high association to ASPSP by the tagged silky sharks, but also used a wide area in the surroundings with no prolonged migration has been detected so far, confirming the behavior of this species to aggregate around oceanic islands, seamounts and Fish Aggregating Devices- FADs behavior found in other works of the species. So the present results, for the first time to our knowledge, an assessment of this species in the region, clearly show the importance of the conservation of silky sharks, particularly in the vicinity of oceanic islands and others, due to the strong association these sharks show to these structures.

Keywords: behavior, displacement, telemetry, conservation, Carcharhinidae.

Quaternary tiger sharks (*Galeocerdo cuvier*) from Rio de Janeiro – Brazil

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The cosmopolitan tiger shark (*Galeocerdo cuvier*) is particularly vulnerable to contaminants and was widely fished by prehistoric humans; sharks' teeth are frequently found in anthropogenic constructions called shell mounds. Shell mounds represent a record of intense prehistoric fishing activity, more than 2000 shell mounds have been recorded along more than 8000 km of the Brazilian coast. These archaeological sites date from 4800 to 780 cal BP and are accumulations of mollusk shells, bones, teeth and fish vertebrae, as well as other animal remains and human burials. They were used in funerary rituals or simply as a discard area. Sharks are top predators in marine assemblages and they are particularly vulnerable to bioaccumulation of contaminants, such as Hg. Bioaccumulation of contaminants via food web is defined as biomagnification. Mercury accumulation in predatory fish is approximately ten times that of non-predatory fish, and sharks in particular exhibit high levels of Hg in their tissues. The Usiminas shell mounds (2 kcal BP) of SE Brazil are influenced by seasonal coastal upwellings. The derived paleontemperature for the Cabo Frio coastal zone based on isotope analyses of tiger shark ($\delta18O$-PO4) range between 21.8 to 28.3ºC, in agreement with paleoceanographic data. In order to evaluate prehistoric bioaccumulation of mercury, we determined total Hg concentrations in tiger shark teeth and in shells of the gastropod *Astraea sp.* taken from the shell mounds. Total Hg concentrations in shells (0.56 – 9.94 ng/g of dry sample) were similar to background values of sediments from the SE Brazilian shelf, whereas concentrations in black soil (15.32 – 52.40 ng/g of dry sample) and shark teeth (87.69 – 31.01 ng/g of dry sample) were higher. Considering the affinity of Hg for organic matter, the increased soil concentration may be due to Hg release during decomposition of tissue. Considering that these shell mounds are anthropogenic constructions formed primarily by the accumulation of the remains of marine fauna consumed by humans, our results can be considered the earliest evidence of bioaccumulation of Hg in humans. The high Hg concentrations in shark teeth suggest biomagnification in the SE Brazilian paleofauna.

Keywords: Holocene, Anthropocene, paleofauna, bioaccumulation, biomagnification.

Freshwater stingrays (Potamotrygonidae) of South America

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In the framework of the Annual Operational Plan (2016) of the Institute of Research of Biological Resources Alexander von Humboldt-IAvH, the project "Freshwater Stingrays (Potamotrygonidae) of South America Part II: Colombia, Brazil, Peru, Bolivia, Paraguay, Uruguay Argentina" was undertaken. This editorial project was led by the IAvH and three universities: Universidade Federal da Paraiba, Universidade Estadual Paulista-UNESP and Universidade de São Paulo. It counted with the participation of 64 researchers, from 32 organizations (universities, NGOs, fisheries authorities, among others) from seven countries. This study and recent updates recognize 34 species of rays: *Heliotrygon* (2 sp.), *Paratrygon* (1 sp.), *Plesiotrygon* (2 sp.) and *Potamotrygon* (29 sp.). Two marine species of the new genus *Styracura,* Carvalho, Loboda and Silva 2016, have recently been included in the family Potamotrygonidae. Preliminary data show that Brazil is the country with the highest species richness (26 sp.), followed by Colombia (11 sp.), Peru (10 sp.), Argentina and Paraguay (6 sp.) Bolivia, Venezuela and Ecuador (5 sp. each), Uruguay and Suriname (3 sp.) and finally the Guianas (Guyana and French Guiana), with two species each. The basin with the greatest diversity is the Amazon (24 sp.), followed by Paraguay (7 sp.), Paraná (6 sp.), Orinoco (5 sp.), Parnaiba (3 sp.) Uruguay and Essequibo (2 sp.) and Suriname, Mearin, Maracaibo, Corantin, Inini, Maroni, Oyapoc, Tampoc, Magdalena, Atrato, with one species each. Recent results of research projects on conservation (population censuses), biology and ecology (movements) and molecular systematics (*Potamotrygon* gr *orbignyi*) are also included.

Keywords: *Heliotrygon, Paratrygon, Plesiotrygon, Potamotrygon,* fisheries resources.

New records of the longnose caribbean chimera Neoharriotta carri (HOLOCEPHALI, Chimaeriformes) in the Caribbean Sea.

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The cartilaginous fish known as chimeras (SubClass HOLOCEPHALI), comprise a one Order, 3 families and 51 species, 22 have been described in the last 25 years. This situation is due to offshore exploration and mining operations and to the new deep-sea fishing areas of all oceans. The chimera Neoharriotta carri is a species of deep waters of continental slope of Panama, Colombia and Venezuela. It was known only by the Type Series (17 specimens), and other 8 specimens captured later in Panama and Colombia (1968-2010). In Venezuela, it was known only by two specimens (no Type Series) captured in exploratory trawl fishing (R/V Oregon) realized in the continental slope of the Northwestern region (1963). In this work, these specimens are examined and its registered by the second time for Venezuela, 48 years later (2011), by a new specimen captured artisanal fishing fleet in the continental slope of the central coast (Vargas State). Additional, is included a new records of a captured specimen and five observed in January 2011, in the continental slope of Honduras (South of Islas del Cisne) in the Northwestern Caribbean, during the Research Cruise of the Spanish Research Vessel B/O Miguel Oliver and a specimen observed (November 2013) with ROV Hercules, in the insular slope of Grenada (volcano Kick-'Em-Jenny), Southwest of the Caribbean, during the Research Cruise E/V Nautilus. The examined specimens present distinctive characteristics of the species as: separate anal fin, second dorsal fin base terminates immediately above to anal fin origin, plane of snout in lateral view, extending forward well below eye, pectoral tip well past pelvic fin base and angular canal loop symmetrically bilobate at anterior end. With 1,220 mm of TL, the specimen captured in Venezuela, is the new record size of the species (maximum size recorded previously 975 mm TL). According to our results and that found by other authors, this species lives in rocky and soft bottoms of the platform and continental slope, between 90 and 600 m deep. Although its abundance is very low, since only about 30 specimens were known between 1962 and 2010, in January 2011, 59 specimens were captured in the continental slope of Panama (552 to 556 m) (56 of them only in one station), indicative of some reproductive event. Due to his restricted distribution, endemic of the Caribbean sea, we propose the alternative common name longnose caribbean chimera.

Keywords: *Neoharriotta carri*, Chimaeriformes, Venezuela, Honduras, Grenada, Caribbean Sea.

What is the global status of pelagic sharks and rays?

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Previous studies suggest that up to 90% of large predatory fishes, such as tunas and sharks, have been lost since the 1950s and 16% of all shark species are threatened with extinction. Declines in the populations of these top predators have led to cascading consequences throughout the food web, resulting in decreases in diversity and productivity, loss of ecosystem services and, in some instances, ecosystem collapse. Their populations must be monitored and adequately managed given their ecologically significant role as top predators. There are 21 pelagic sharks and rays species and 75% classified as Threatened or Near Threatened in 2008, many of which are found off the waters of South America. The management and conservation of these species is hampered by their tendency to range across vast areas of the high seas, outside countries' Exclusive Economic Zones and therefore, beyond the remit of national jurisdictions where they are threatened with overexploitation and bycaught in high seas fisheries. Furthermore, they exhibit life history traits (e.g. slow intrinsic rate of population growth and slow to mature) that make them particularly vulnerable to exploitation. Regional fisheries management Organisations are primarily responsible for managing these species but are unable to undertake full stock assessments due to data deficiencies, and the status of these species is not well known. Here, we assess the current global status of pelagic sharks and rays with a particular focus on regional variations within species through gathering population time-series in published literature. Data is analyzed through the Living Planet Index approach, applying the generalised additive modelling framework to determine the underlying trends of each time-series. The findings will contribute to the IUCN reassessment of pelagic sharks and rays and can provide an indication of the conservation management needs at both regional and national levels.

Keywords: pelagic sharks, rays, global assessment, living planet index.

Halos of fear: the impact of predation threat on feeding behaviour of mesopredatory fishes around patch reefs

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Fishing is rapidly removing sharks and other large predators from coral reefs, but at present we lack a complete understanding of the ecological role of these predators in such environments. It is known that sharks are likely to exert strong ecological effects on their prey either directly through consumption, or indirectly by inducing antipredator-or "risk effects"- behaviours, however direct experimental evidence of such behaviours are rare. Using life-size models of threatening (reef sharks) and non-threatening (turtles, small fishes) taxa, we examined the impact of perceived predation threat on the feeding behaviour and spatial use by mesopredatory reef fishes in a coral reef environment. Preliminary results show that the presence of a model reef shark increased the time taken for mesopredatory species to consume prey items and suppressed feeding at larger distances from the reef edge. A model coral trout did not increase the time taken for mesopredatory reef fishes to consume all available prey items compared to a negative control (no model). The use of life-size models has provided some of the first evidence for the existence of risk effects caused by large, high-order predators on mesopredatory fishes in coral reef environments.

Keywords: coral reef, risk effects, predator-prey interactions, non-consumptive effects.

Elasmobranchs of the Banc d'Arguin: conservation and ecological importance

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Globally, elasmobranchs (i.e. sharks and rays) are targeted for their fins and meat, of which the fins are mainly destined for international markets. In addition, in West-Africa sharks and rays are also targeted for meat, for which there is a regional market. The decline of these vulnerable species and the lack of data from West-Africa highlights the importance of research studies focusing on elasmobranchs within this region. The present study focused on the targeted catch and bycatch of sharks and rays within the Banc d'Arguin National Park (BdA) in Mauritania. Local fishing communities have been targeting elasmobranchs within the BdA since the 1970s, when the demand for fins increased in West-Africa. This study reviewed the current status of sharks and rays within the park by interviewing the local community and analysis of landings of elasmobranchs within the park. Furthermore, previous and current management plans were reviewed to determine management priorities for sharks and rays within this West African national park. Since 2003 the targeted catch of elasmobranchs (except the smooth-hound *Mustelus mustelus* and barbeled houndshark *Leptocharias smithii*) in Mauritania is prohibited. However, local communities continued to catch elasmobranchs and remain to have an agreement with the park management to be allowed to catch sharks for two months per annum. The majority of the catches consists of milk sharks (*Rhizoprionodon acutus*) and Lusitanian cownose rays (*Rhinoptera marginata*). Furthermore, hammerhead sharks (*Sphyrna* spp.) and guitarfishes (*Rhinobatos* spp.) make up the third and fourth largest proportion of the elasmobranchs landed respectively. Indicators resulting from the interviews, analysis of fishery-dependent data and from reviewing current and previous management were used to analyze management effectiveness. Positive indicators for management effectiveness included the development of 5-year management plans with evaluation components, the proposals for a zonation plans and agreements with the local communities on nets and fishing seasons. Main indicators of a gap in management effectiveness include the unclear definition of targeted catch and bycatch, lack of implementation of the zonation plan and the large scale deployment of nets with illegal mesh sizes within the park to target rays. Future management efforts should prioritize on implementation of a zonation plan to prohibit large mesh sizes within the intertidal areas. Furthermore, more research should be directed towards the assessment of vulnerability of the species caught in the fishery and connectivity of populations along the West African coastline.

Keywords: Mauritania, intertidal, artisanal, West Africa, subsistence fishing.

Spatiotemporal distribution of two reef-associated shark species: an integrative approach

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Since September 2015 the Exclusive Economic Zone of Saba (Dutch Windward Islands) is designated as a marine mammal and shark sanctuary. To ensure effective conservation measures for elasmobranchs within this area a baseline survey was needed. Between 2012 and 2016 three complementary methods to study the diversity and distribution of sharks around the island of Saba were deployed: stereo-Baited Remote Underwater Video (BRUV), acoustic telemetry and a citizen science program. Stereo-Baited Remote Underwater Video systems were deployed on shallow (15 m), intermediate (50 m) and deep (100 m) reefs. In total five different shark species were recorded, of which the Caribbean reef shark (*Carcharhinus perezi*) and nurse shark (*Ginglymostoma cirratum*) were the most common around the island. The mean catch-per-unit-effort (CPUE) for those two species was 0.25 ± 0.48 sharks/hour (mean ± s.d.) for Caribbean reef sharks and 0.20 ± 0.45 sharks/hour for nurse sharks. All observed individuals of these two species were immature based on fork length. Of those two species, 8 Caribbean reef sharks and 4 nurse sharks were tagged with acoustic transmitters and their movements were tracked for a year. Detection indices (days detected over the total study duration) ranged from 0.01 to almost 1.00 for Caribbean reef sharks and 0.17 to 0.92 for nurse sharks. Overall results prove high intraspecific variation in spatial behavior and detection patterns, especially for Caribbean reef sharks. Diel detection patterns for this species suggests different behavioral patterns associated with twilight hours for some individuals. Detection patterns of nurse sharks corresponded with a nocturnal change in behavior. The last method, a citizen science program, gathered data on more than 5,200 dives over a timespan of four years. The results of the citizen science program also showed a high year-round CPUE for the two most common species, suggesting high residency of both species around Saba. The highest CPUE values based on the citizen science program were recorded around pinnacles and seamounts on the west side of the island. Significantly lower presence of Caribbean reef sharks during the period January-April coincided with the parturition period known of this species. The present study shows how these three methods can be used in a complementary manner to provide a baseline study on the diversity and distribution of reef-associated sharks. The combined results of these three methods highlight priorities for local management of elasmobranch species.

Keywords: diel activity, site fidelity, residency, acoustic telemetry, Caribbean Netherlands.

Heavy metals in sharks that are frequently consumed by the population in Todos Santos, Baja California Sur, Mexico

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In recent decades, the urbanization and industrialization of the world's coastal zones have resulted in an ecological imbalance in the marine ecosystems. Heavy metals are considered as the potential hazard agents for marine organisms due to their persistence in the environment, and for their ecological risks. Besides the occupational exposure, fish consumption is considered the main pathway of exposition of metals in humans as Cu,Cd, Pb, Cr,Ni and As. Among the marine species that accumulate concentrations of these metals in their body are the sharks. They are top predator of large size and long-lived life that constitute an important fishing resource in Mexico, mainly in Baja California Sur where shark fishing is one of the principal economic activities.The purpose of this study was to evaluate the metals concentrations in sharks to know if they exceed the permissible limits. In October 2017 we sampled a total of 25 organisms of the silky shark *Carcharhinus falciformis* of which 16 females (11 adults and 5 juveniles) and 9 males (6 adults and 3 juveniles). We sampled stomach, muscle, liver and kidney to determine the concentrations in dry weight of Pb, Cd, Cr, Ni, Cu, As and Se. ICP-OES 8300 Perkin Elmer was used to and validate the method of metals determination in shark samples.The highest concentrations of Pb were found in liver and muscle (0.12 ± 0.12 mg / kg), while Cd (62.56 ± 26.60 mg / kg), Cu (15.86 ± 8.99 mg / kg) and As (84.79 ± 25.35 mg / kg) in liver, Cr (17.87 ± 24.11 mg / kg) and Ni (6.50 ± 7.75 mg / kg) in stomach, and Se in kidney (29.86 ± 33.36 mg / kg). The females had higher concentrations of Pb (0.12 ± 0.12 mg / kg), and As (93.03 ± 20.23 mg / kg) in liver tissue than males. However, males have higher concentrations of Cd than females (67.31 ± 12.61 mg / kg), Cu (15.86 ± 5.24 mg / kg) and Se (17.73 ± 0.75 mg / kg) in liver. We found that the concentrations of Cd exceeded the maximum permissible limit of 0.5 mg / kg established by NOM-242-SSA-2009, also the concentrations of Cr were greater than 13 mg / kg in stomach and kidney and exceed the limit of by WHO. In general, we found that the concentrations of the heavy metals studied in sharks exceed maximum permissible limits.

Keywords: fish consumption, human health, *Carcharhinus falciformis*.

Correlation of steroid hormones with the gonadal morphology of the Cururu stingray *Potamotrygon wallacei* (Chondrichthyes-Potamotryonidae), during the flood period of the Rio Negro river

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Potamotrygon wallacei (Carvalho, Rosa & Araújo, 2016) is the smallest species of Potamotrygonid. This freshwater batoid, exhibits as reproductive mode matrotrophy viviparity with lipid histotrophy. The flood pulse of Negro river influences the reproductive cycle. This study aimed to correlate the plasma profile of steroid hormones in *P. wallacei* adult males and females with the gonadal morphology in different phases of the reproductive cycle. A total of 75 adult rays were captured in the middle Negro river, during the flood period (between January and May 2017). There are 3 main flood sub-periods as follows: 1) beginning rising waters (January-February) with 25 males and 19 females; 2) in rising waters (March-April) with 15 males and 13 females; 3) beginning of the high waters (May) with 1 male and 2 females. Each stingray was measured, sexed and classified according to the maturational state for elasmobranchs. The changes in the females follicles development and the spermatogenic activity in the males were associated with the gonad macroscopic characteristics to validate the maturation stages. The morphological data were also compared with the levels of steroid hormones. Plasma concentrations of the steroid hormones progesterone (P4), testosterone (T) and 17β-estradiol (E2) were determined with experiments of enzyme-linked immunosorbent (ELISA) of the DRG®. In females, the P4 has a positive correlation with T concentrations showing its precursor function. In March during the rising water, the growing and follicular development corresponded to T and E2 increasing concentration until ovulation period, at the beginning of the high water in May. P4 elevate levels occurred in all development stages, with the highest peak observed at the beginning of pregnancy in May. In males, the T peak occurred in April-May. This time, males in reproductive activity were captured. The concentrations of E2 was associated with maximum spermatogenic development in testis. P4 concentrations in male were high compared to females. The greatest concentrations were in reproductive activity males. In this study, the behavior of the steroid hormones in *P. wallacei* coincides with the hormonal profile observed in other species of viviparous elasmobranchs during the reproductive period. The P4 levels are considerably higher, probably as a response mechanism to the preparation of a new reproductive period when favorable conditions arise. These observations demonstrate the obvious correlation of the temporal gonads development with the changes in the steroid hormone concentrations. It corroborates the cururu reproductive period synchronization with the hydrological cycle of the river.

Keywords: elasmobranch, *Potamotrygon*, spermatogenesis, vitellogenesis, steroids.

Artisanal fishing of Elasmobranchii in Southeastern Brazil (Tropical Western Atlantic)

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Elasmobranchs are essential elements in marine food webs, playing an important role controlling populations, avoiding side effects as the trophic cascade. Elasmobranchs exhibit low growth and reproductive rates, making them more vulnerable to anthropogenic actions. In many Brazilian regions, fishing is uncontrolled and their fins and head are removed (remaining the carcass) before landing, making difficult their identification and representing important threat to this group. Thus, monitoring landing data and fishing gears is extremely important to management and conservation actions. Our aim was to describe the biomass captured by different fishing gears and in different months in southeastern Brazil (Tropical Western Atlantic). Data were obtained from landing registers and landing interviews by the joint Program in Fishery Statistics of the Brazilian Fishery and Aquaculture Ministry and Federal University of Espírito Santo. Data were collected on a daily basis, 40h/week, between April/2011 and March/2012, in 15 fishing ports between 18°35' to 21°06'S. During this period, 571,819 kg of elasmobranchs were captured, mainly represented by sharks (80.5% of total biomass) which mostly comprised carcasses (64.6% of total). Among identified sharks, Carcharhinidae showed highest biomass (90.6% of total) and was composed by blue-shark, *Prionace glauca* (99.8% of the family) and tiger-shark, *Galeocerdo cuvier*. Other families captured were Lamnidae (*Isurus oxyrinchus*, 1.1%,), Sphyrnidae (*Sphyrna* spp., 0.2%), Ginglymostomatidae (*Ginglymostoma cirratum*, 0.2%) and others. Rays were mainly represented by Rhinobathidae (*Pseudobatus* spp., 56%) and other non-identified individuals. Carcasses were obtained by surface longline (43.2%), followed by gill nets (39.4%) and multiple gears (15.1%). Most (87.5%) of Carcharhinidae's biomass was caught by surface longline, followed by multiple gears (11.4%). Other rays were mostly caught by bottom longline (48.6%), surface longline (19.5%) and multiple gears (17%). Most of total captures occurred between April and August. Carcass biomass was higher in May (15.4%) but it was almost equally distributed throughout the year, while August (30.9%) and April (20.6%) showed highest biomass of Carcharhinidae. Non-identified rays and Rhinobatidae were also equally distributed throughout the year, however May (representing 12.7% and 25.8%, respectively) and August (12.4% and 18.8%) were months with highest values. Vulnerability to uncontrolled fishing activity and lack of knowledge of elasmobranchs were identified and requires urgent management measures, since most of the captured animals might belong to endangered species. Surface longlines (sharks, carcasses, and rays) and bottom longlines (rays) shall be regulated and the uncontrolled fishing was equally observed throughout the year.

Keywords: fishery statistics, shark, fisheries management, Espírito Santo.

Spatial and temporal distribution of elasmobranchs captured along the coast of Espírito Santo – Brazil

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The fishing activity of elasmobranchs presents high economic, social and political importance along the Brazilian coast. In recent years, fishing activities which targeted this group has increased, mainly due to the great appreciation in the market, besides to great acceptance in the national and international market. In this sense, the present study evaluated the spatial-temporal distribution of elasmobranchs catches in fishing landings along the coast of Espírito Santo. Data were collected on a daily basis at fishing landing ports in Espírito Santo, through the Fisheries Statistics Program of Espírito Santo. From March 2011 to April 2012, a total of 12,349 tons were estimated fishery production, composede by Osteichthyes (71,97%), Invertebrate (23,43%) e Elasmobranchii (4,60%). The elasmobranchs, a total of 568,006 kg regarding the groups: Sharks (65,04%), Rays (17,84%), *Prionace glauca* (14,42%), *Isurus oxyrinchus* (1,09%), *Pseudobatos* spp. (1,16%), *Ginglymostoma cirratum* (0,18%), *Sphyrna* spp. (0,24%) and *Galeocerdo cuvier* (0,03%). The cities of Santa Cruz, Conceição da Barra and Guarapari were the regions with the largest parcels of these catches, representing 31.5%, 13.3% and 11.8%, respectively, totaling around 60% of the catches of this group. The most productive months per groups were: sharks in April (48,851 kg) and May (56,714 kg); *Prionace glauca* in August (25,366 kg); and Rays in May (12,585 kg) and November (12,791 kg). sharks were among the 10 main fishing resources landed in the ports of Espírito Santo, which highlights the need of studies to identify landing stations and landed volumes for the development of management measures, since some of these species are overexploited by fishing.

Keywords: fishery statistics, shark, fisheries management, Espírito Santo.

Shark distribution patterns and species-habitat associations in the Revillagigedo Archipelago

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Determining shark distribution patterns and species-specific habitat associations in response to geographic and environmental drivers is critical to assessing risk of exposure to fishing, habitat degradation, and the effects of climate change. This study examined shark distribution patterns and species-habitat associations with baited remote underwater video stations (BRUVS) within the Revillagigedo National Park for over 4 years' period. Nine species of sharks from three families were recorded. The most abundant species recorded were the juvenile and sub-adult Galapagos shark, *Carcharhinus galapagensis* (MaxN 3.07 ± SD 1.8, furcal length of 1005.81mm ± SD 351.6 mm) and whitetip reef sharks, *Triaenodon obesus* (MaxN 2.9285 ± SD 1.49, furcal length, 1091.4 mm ± 273.25mm). Evidence of nursery areas for silvertip *C. albimarginatus* (MaxN 1.88 ± OD 0.78, furcal length, 771.44mm ± 145.86mm) and tiger sharks *Galeocerdo cuvier* (MaxN 1.5 ± SD 0.7, furcal length, 2409mm ± 707.11mm) were found in the shallow rocky reefs and sand areas, respectively, of San Benedicto Island. In the Canyon of San Benedicto, sharks hammer *Sphyrna lewini* was recorded (MaxN 1.8 ± SD 1.5, furcal length 1188mm ± 351.60mm). Multivariate analyses showed that differences between pelagic/benthic BRUVS, current exposure and substrates produced the primary split separating shark species. In addition to sharks, the giant manta *Mobula birostris*, the Pacific Bottlenose dolphin *Tursiops truncatus*, and yellowfin tuna *Thunnus albacares* were recorded. Therefore, knowing the population structure and habitat use of each species is key to creating effective protection strategies and determine priority conservation areas.

Keywords: Distribution patterns, habitat-association, BRUVS, management, Revillagigedo.

Evidences of shark connectivity and long distance movements in the Eastern Tropical Pacific

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The long-distance movements of sharks within and between marine protected areas (MPAs) pose substantial challenges for resource managers in multiple jurisdictions. Shark movements between the MPAs of the Eastern Tropical Pacific (ETP) (Revillagigedo, Cocos, Malpelo and Galapagos) have been studied for several years, however little is known about the possibility of connectivity between these sites, or of the existence of marine corridors or "swimways" linking them. Here we provide evidence of the occurrence of Whitenose shark (*Nasolamia velox*) at the Revillagigedo Archipelago, Mexico, using acoustic telemetry, recording movements from a coastal location (National Park Cabo Pulmo) to Revillagigedo Archipelago, supporting the idea of the potential connectivity of sharks between the Gulf of California and the Revillagigedo Archipelago. We also used the extensive MigraMar ultrasonic telemetry dataset to assess how Galapagos sharks (*Carcharhinus galapagensis*) and silky sharks (*Carcharhinus falciformis*) use MPAs as stepping-stones during their migrations across the ETP. The frequency of movements was compared with the distance travelled by each species. A silky shark tagged in the anchorage at Wolf Island, Galapagos, travelled to Clipperton Atoll (2,200 km to the north) in two different years. A Galapagos shark tagged in Socorro Island, Revillagigedo, was detected at Clipperton Atoll (959 km south of the tagging site) and one year later was recorded in the receivers of Darwin Island, Galapagos (2,200 km to the south), in fact, this is one of the longest movements ever recorded for this species. Although long-distance dispersion was not common (only 9.5% were inter-insular and less than 1% moved between MPAs), our results highlight the need for international co-operation between jurisdictions to ensure adequate protection for sharks.

Keywords: connectivity, swimways, long distance movements, whitenose shark, Galapagos shark, silky shark, Eastern Tropical Pacific.

Predictors of white shark *Carcharodon carcharias* presence at two recreational beaches in a major metropole

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The occurrence of white sharks *Carcharodon carcharias* in the False Bay, South Africa follows a clear seasonal cycle. In the austral winter months, white sharks aggregate around Seal Island, but move to inshore areas in summer. However, the drivers of this inshore movement remain a subject of debate. Previous research identified that inshore shark sightings were higher when the water was warmer and during new moon, which led to the prediction that these conditions favour prey availability. In this study, we expand on previous research and investigate a number of environmental and biological variables, including prey availability on shark sightings at two recreational beaches in Cape Town, South Africa. A total of 1209 white shark sightings were recorded from 1 January 2006 – 31 December 2015 at the beaches of Muizenberg and Fish Hoek. We confirmed that shark sightings were clearly seasonal and sightings peaked between 17.49 - 18.57°C. Fish presence revealed a similar peak at 17.94°C. Randomization tests indicate shark sightings were 66% (p < 0.001) more likely when prey fish were present, which supports the prediction of a prey mediated cue. Shark sightings were also influenced by ENSO with more sightings during weak negative ENSO values. These reflect weak La Niña events, which supports previous findings. In addition to providing a better understanding of the ecology of white sharks in False Bay, our results can also be used in shark safety and education programs to reduce shark-human conflict.

Keywords: white shark, inshore beaches, seasonality, temperature, prey mediated cue.

Ecotoxicology as a tool for the conservation of southeastern Brazilian marine species: Ecological implications of metallothionein levels in *Narcine brasiliensis*

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The electric ray *Narcine brasiliensis* (Olfers, 1831) is known as being able to generate electric charges through a specific electric organ and for being the smallest Torpediniformes species. It is the most recurrent species of its order along the Brazilian coast, characterized by benthic habits in shallow waters, and its diet is composed mainly of polychaetes and crustaceans. This species exhibits a high ecological relevance, due its participation in trophic marine webs through its predatory habits. However, ecology studies on *N. brasiliensis* are still insufficient. Due to the importance of this species in coastal environmental health, this study aimed to quantify metallothionein (MT) levels, a thermoresistant protein responsible for metal detoxification, recognized as a metal exposure biomarker. MT were determined in the liver, muscle tissue, electric organ and gills of 4 adult females collected at Itaipu Beach, Niterói (Rio de Janeiro, Brazil), adjacent to one of the most polluted areas in Brazil, Guabanara Bay, and acclimatized at the Rio de Janeiro Marine Aquarium for 3 months. The same was carried out for 6 neonates from these females. MT were purified by thermal extraction after centrifugation in a Tris-HCl buffer containing anti-proteolytic and anti-oxidant agents. Determinations were performed by spectrophotometry at 412 nm. Correlations between MT in adult and neonates organs were assessed by the Spearman correlation test, due to data non-normality. Differences between organ MT levels of each group were evaluated by the Mann-Whitney test. MT accumulation in the analyzed tissues suggests environmental metal exposure. In adults, as expected, levels were higher in the liver, as this is the body's main detoxification organ, indicating induction by metals. Correlations between liver and muscle MT in adults were observed, indicating probable metal bioaccumulation processes. In neonates, MT levels were lower than in adults, and showed differences between development stages. MT induction in the adults is probably due to the species feeding habits, since *N. brasiliensis* prey accumulate high metal levels, due to their filter-feeding habits and the high metal contamination at Itaipu. Future investigations will determine metals levels in these specimens, to confirm the data presented herein, which indicates that coastal environments and their marine fauna suffer in a large scale with anthropic actions. The restricted distribution of *N. brasiliensis* throughout the coasts of the American continent underscores the importance of further investigations on its conservation status, physiological implications of contamination and how these processes affect marine ecosystems.

Keywords: Bioaccumulation, *Narcine brasiliensis*, metallothionein assay, elasmobranch conservation.

A scientometric analysis on the metallothionein metal-detoxification biochemistry pathway in Elasmobranchs: Ecotoxicological implications for conservation measures.

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Elasmobranchs are long-lived apex predators, threatened with extinction and particularly vulnerable to environmental contamination, especially pollutants that may bioaccumulate and biomagnify, throughout the trophic web, such as metals. In this regard, ecotoxicological analyses are valuable tools concerning sublethal pollutant biochemical outcome information, allowing for decision-making aiming at mitigating harmful pollutant effects. However, Elasmobranch management and conservation plans are challenging and this group is often neglected regarding ecotoxicological analyses, particularly concerning metal detoxification mechanisms. In this context, this study aimed to investigate literature regarding the metallothionein (MT) mediated metal detoxification biochemistry pathway in Elasmobranchs. A scientometric analysis was conducted at the Web of Science, Pubmed and Scopus (Elsevier) scientific databases, between February 23rd and 24th, 2018. The terms "Elasmobran or Sharks or Stingrays or Chondrichthyes and metallothionein" were used for the search, and only results in the "article" category, in English, were considered. Fourteen published articles were obtained and manually screened. Three were removed, since no MT data was reported, leaving 11 studies. This low number of publications indicates how scarce data regarding MT-mediated detoxification mechanisms are for this group. Publications ranged from 1986 to 2015,

four from the 80s, 3 from the 90s and four from the 2000s, all on sharks, with no data on stingrays reported. Only four studies evaluated MT levels in sharks captured from the environment (Ireland/ UK, Florida, Italy), while the others performed *in vivo* laboratory exposures. The most representative species was *Scyliorhinus canicula*, predominantly in laboratory exposure studies, which mostly evaluated Cd exposure effects. One study exposed animals to Ni, Cd, Pb, Cu, Ag, and another, to equimolar Cd, Cu and Zn concentrations and Zn alone. Most studies analyzed only liver, though data for other tissues were reported (three studies). Although MT were characterized by spectrophotometry, electrophoresis, western blotting, polarography and SEC-HPLC, this was mostly after laboratory metal exposure. Data, thus, seems very fragmented regarding the MT metal-detoxification biochemistry pathway in sharks, especially in environmental contamination scenarios, and no data is available for stingrays. This points out the urgent need for further studies, since (i) metal pollution has greatly increased in the last decades, (ii) Elasmobranchs are highly threatened with extinction, (iii) scarce information for this group is available on which metals bind to MT for subsequent excretion in environmental contamination scenarios, and (iii) no indications of minimal MT induction thresholds in environmental contamination scenarios for this group are available.

Keywords: metallothionein, metals, elasmobranchs, scientometric analysis.

Possible female philopatry and juvenile seasonal residency of the smooth hammerhead shark, *Sphyrna zygaena*, revealed by genetic structure patterns

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Migratory species can show complex migration or population structure patterns depending on their characteristics (e.g., site fidelity, sex segregation, philopatry, etc.). Some species of the Sphyrnidae shark family have shown spatial genetic structure patterns consistent with female philopatry, characterized by the return of females to particular areas for various reasons (breeding, gestation, etc.). Sphyrnids exhibit seasonal residency or site fidelity in some ontogenetic life stages. The smooth hammerhead (*Sphyrna zygaena*) is one of the two most abundant and important Sphyrnids to commercial fisheries in the Mexican Pacific; it is a semipelagic shark found throughout tropical and temperate waters worldwide. Their life history traits (slow growth, late age at maturity, low fecundity) make it vulnerable to over-exploitation via fishing. Currently, *S. zygaena* is listed as Vulnerable on the IUCN Red List and in CITES Appendix II. Given the need for information regarding this species, we assessed the spatial pattern of mtDNA genetic structure of *S. zygaena* in 10 localities from the Northern Mexican Pacific. A total of 35 haplotypes were identified in 129 sequences of the mtDNA Control Region. The results showed slight but significant genetic structure among localities (ΦST= 0.08, p< 0.001). In addition, the localities with highest number of juveniles were genetically different (ΦST=0.083, p=0.011), which may be representative of nursery areas. The genetic differentiation pattern can be associated to female philopatry and preference for particular birthing sites. On the other hand, all localities exhibit high gene flow which is consistent with the high migration potential of the species. Finally, historical demography shows that *S. zygaena* populations showed sudden rapid growth after a bottleneck that occurred between 60,000 – 532,000 years ago during glacial events in the Late Pleistocene.

Keywords: mtDNA, smooth hammerhead shark, Northern Mexican Pacific.

Juvenile white shark nursery behavior and habitat use in southern California

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Juvenile white shark (*Carcharodon carcharias*) sightings in nearshore (<500m) waters and along popular beaches throughout southern California have increased over the last 10 years. Coastal areas in southern California and central Baja California are known nursery areas for white sharks in the Northeast Pacific, yet little is known about how or why juveniles (1.2 – 3m TL) select particular beach and lagoon habitats. Four hotspots in the northern part of the Southern California Bight have been identified as key nursery habitats based on historic fisheries and telemetry tracking data. Passive acoustic tracking and aerial observation data of juvenile white sharks indicate loose aggregations of individuals showing high fidelity to beaches for periods up to 100 days, with sharks using shallow habitats (<3m) along the shoreline during both day and night hours. Satellite telemetry tracking has indicated coastal seasonal migration southward when water temperatures decline below 14°C; however, ENSO events appear to change migratory behavior, resulting in young of the year sharks remaining in southern California throughout winter months. New surveying and tracking methods including Remote Underwater Video Systems (RUVs), drone and aerial surveys, Smart tags, Autonomous Underwater Vehicle surveys and eDNA are being used to characterize juvenile white shark beach use, distribution patterns and annual fidelity. In addition, lifeguard agencies have begun to keep sighting and beach closure records to correlate shark activity with human recreational activity.

Keywords: movements, temperature, humans, nursery habitat.

Trophic ecology of the narrow-mouth catshark *Schroederichthys bivius* (Chondrichthyes, Scyliorhinidae) in the northern Argentinean continental shelf

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The narrow-mouth catshark, *Schroederichthys bivius*, is an oviparous species endemic of South America. This species is frequently caught as by-catch by bottom-trawl nets in Argentine fisheries. It is catalogued as 'Data Deficient' species by the International Union for Conservation of Nature (IUCN). Currently, little is known about the trophic ecology of this shark. The main objective of the present work is to studying the diet of *S. bivius* by analyzing the stomach content on the northern Argentinean continental shelf (between 35°S y 41°S). Specimens were captured during spring 2016 on board a research cruise carried out by National Institute of Research and Development (INIDEP) in Argentina. Stomachs were analyzed at the laboratory. Prey items were identified to the lowest possible taxonomic level, counted and weighted. In order to quantify the diet of *S. bivius*, the frequency of occurrence (%F), the percentage of number (%N) and the percentage of weight (%Mi) and the percentage of the index of relative importance (%IRI) were estimated. Preliminary results indicate that from 143 stomachs of *S. bivius* analyzed, 100% contained food. The Narrow-mouth Catshark, *S. bivius* is a benthic feeder. The diet consists mainly in crustaceans (56.6 %IRI), followed by polychaetes (18.65 %IRI) and fish (18.09 %IRI). Among crustaceans, the most important identified prey was euphausiids *Eupahusia* spp. (25.77 %IRI), the red crab *Libidoclaea granaria* (12.65 %IRI), and the hyperiid amphipod *Themisto gaudichaudii* (5.38 %IRI). The most important fish in the diet of *S. bivius* was the Nototheniid *Patagonotothen ramsayi* (6.61 %IRI). Variations in the diet were evaluated by fitting generalized linear models (GLM). The narrow-mouth catshark, *S. bivius* is a mesopredator species with trophic level of 3.6.

Keywords: Diet, trophic level, shark, mesopredator.

Case report of dystocia in captive cownose ray (*Rhinoptera bonasus*)

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The species *Rhinoptera bonasus*, also widely known as cownose ray, resides in Brazil from the North coast to the Southeast region. The objective of the present study is to contribute with reproductive data on *Rhinoptera bonasus* in captive breeding through visual morphological analysis and its behavior. The monitoring was carried out by the Biology team in the ocean tank of the Marine Aquarium of Rio de Janeiro. This tank has 3.5 million liters of salt water with a great diversity of species, life support system (SSV) with mechanical, chemical and biological filtration and water quality parameters measured daily. It was observed a courting behavior between the eagle rays in the fourth quarter of 2016, but the copula was not evidenced. In January 2017, signs of pregnancy was observed and it was verified due to the significant increase of the belly that was being constantly monitored by the team. Approximately 11 months after the first evidence, with the objective of a better evaluation of the clinical picture, the specimen was transferred to the quarantine and conditioned in a circular tank of 8,000 liters of salt water, with an individual filtration system and daily monitoring of the parameters and water quality. In addition to this procedure, a biometry of the individual was performed presenting a total length (CT) of 136.0 cm, disk width (LD) of 105.0 cm and weight of 27.0 kg. As a complementary exam for gestational diagnosis, an ultrasonographic examination was carried out to evaluate the gestation conditions and the fetus stage of development. A B mode (Esaote Mylab) and a linear transducer were used. The procedure was performed in a short period of time with the animal outside of the water in the ventral decubitus, conditioned on its own stretcher and monitored by the medical team. The transducer position was dorsal ventral where a fetus compatible with a final third of gestation was observed, but with no heartbeat. After two days of detailed examination, the abortion of the fetus spontaneously occurred, a male with a total length of 108.2 cm, a Disc Width of 56.7 cm and a weight of 2.465 kg. It is stipulated that this dystocic birth occurred from maternal origin due to the nervous and hormonal factors, since the confined animal showed signs of stress during its quarantine stay where it presented altered behavior, lack of appetite and agitated swimming.

Keywords: cownose ray, reproduction, aquarium.

Report of a morphological abnormality in the *Dasyatis hypostigma* (Myliobatiformes: Dasyatidae) from the Marine Aquarium of Rio de Janeiro - AquaRio, Brazil

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Morphological abnormalities are widely found in elasmobranchs and have been reported in the last decades. In sharks, these malformations are found in the cephalic region and in the axial skeleton. In rays, the most commonly abnormality encountered entails the lack of fusion of the pectoral fins to the cephalic region, while maintaining a V-shaped aperture. Dasyatidae family is characterized by marine and estuarine rays that have emanated from a long tail resembling a whip. This family is composed of eight genus, including *Dasyatis*, which accounts for about forty species. The described morphological abnormalities for this genus are the ones already reported for rays. The objective of this work is to describe a morphological abnormality yet not reported for *Dasyatis hypostigma*. The malformed specimen (female) was born in Aquário Marinho do Rio de Janeiro - AquaRio in September of 2017 along with three siblings, morphologically normal. After birth, the four animals were transferred to a 1.000 L tank exclusive to them, where they received the standard care and feeding. The malformation was characterized, as expected, by a lack of fusion from the pectoral fins to the front of the head; however, its left pectoral fin had two great recesses, dividing the same in a strip. It was observed that the malformed specimen had difficulty in swimming, but still managed to feed by it self. Nevertheless, this individual did not obtain expected growth and fattening, reaching a maximum disc width of 15.7 cm and a total weight of 77.8 g (dying in December 2017). Its three siblings reached a mean disc width of 17.4 ± 0.3 cm and mean weight of 150.9 ± 7.5 g at the same period. It is believed that this type of anomaly is mostly unreported due to the fact that these individuals do not survive the first days of their lifetime in wild nature. The difficulty of swimming and the consequent inability to protect themselves from predation are key factors involved in this survival. Thus, the study of animals created and reproduced in a captive environment may increase knowledgement regarding the species and their environment, relying as a complementary tool to obtain information that may help in the awareness of environmental conservation field.

Keywords: rays, anatomy, groovebelly stingray.

Impaired intrauterine development of round stingray (*Urobatis halleri*) embryos to legacy environmental PCB exposure

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Despite widespread evidence of negative reproductive effects in most other vertebrate taxa from organic contaminant exposure, similar studies in elasmobranchs are limited. We used the Round Stingray as a model species to investigate potential impacts to female fecundity and offspring quality in two populations of stingrays exposed to differential levels of environmental PCB contaminants in southern California (USA). No differences were found between sites for female measures of reproductive success used in this study. In contrast, we did find significant site differences in embryo quality, indicating a negative effect of PCB exposure in utero. While stingrays from the contaminant-exposed site ovulated earlier, embryo growth was slower than stingrays from the reference site. When corrected for ovulation time, reference stingray embryos were relatively heavier than their contaminant-exposed counterparts. We also found some evidence that PCB exposure had an interactive effect with sex, as males from the reference site were proportionally heavier when compared to females whereas no sex-related differences were found at the contaminant-exposed site. While male embryos from the contaminated site were smaller, they had relatively larger livers than reference males suggesting that maternal resources were not being efficiently used towards growth in exposed male embryos. Our study demonstrates that PCBs can elicit negative physiological responses in utero, and may have future implications later in life.

Keywords: organic contaminants, reproduction, growth, offspring.

DNA barcoding southwestern Atlantic skates: assessing its effectiveness for species identification and highlighting cryptic species

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Skates are a common component of the demersal fish community along the South American continental shelf and slope, and have become a concern because of the considerable and increasing catches in recent decades due to international demand. The skate fauna in the Southwest Atlantic (34°-55°S) is represented by ~30 species grouped in two families, Arhynchobatidae and Rajidae. Several species share external characters, especially when juvenile, that may lead to misidentification and therefore fishery statistics may be error-prone or deficient. In this sense, molecular approach may be a complementary useful tool for helping in both, species identification and flagging of potential cryptic species. In this study, we explore on the use of DNA barcoding to discriminate skates species from the Southwest Atlantic (SWA) Ocean. We also compile our results placing them into a comparative framework with other studies to provide a comprehensive review of available barcodes for SWA skates. A total of 208 specimens belonging to 22 different species from families Arhynchobatidae and Rajidae were successfully barcoded in our survey. The Kimura 2-parameter genetic distances averaged 0.19% within species and 3.65% within genera. Nearly all species exhibit unique barcodes or clusters of closely related haplotypes, showing a strong concordance between morphological identification and COI sequences clustering. The only exception were samples of *Psammobatis normani* and *P. rudis*, which sequences could not be separated each other. However, the use of nucleotic diagnostic character (NDC) allowed us to discriminate them. Character-based analysis also showed that species were clustered in two main clades corresponding to the families Arhynchobatidae and Rajidae according to current classification scheme. Compiling our results with available data on the Barcode of Life Data System, about 27 species inhabiting SWA have barcodes, representing 90 % of the species occurring in the area. Some species exhibited low interspecific divergence, which is reflected in the Barcode Index Number analysis: a conservative approach that clusters sequences data into Operational Taxonomic Units called BINs. Indeed, some species were assigned to the same BIN. However, these species do not shared haplotypes and presented unique NDC that allow to differentiate them. Finally, the presence of two different BINs for the same nominal species, highlights a potential cryptic skate in the SWA.

Keywords: Rajiformes, molecular identification, BINs, Southwest Atlantic, hidden diversity.

A multidisciplinary approach in assessing molecular ecology and biology of smoothhound sharks (genus *Mustelus*) with reference to species from southern Africa

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Multidisciplinary approaches have previously offered some alternative innovative ways of addressing classical ecological questions while providing novel insights into behaviour and biology of elasmobranch species. The species-rich shark genus *Mustelus*, or smoothhounds, is one of the most bio-economically important group of elasmobranchs in the world's oceans. Despite the commercial value of *Mustelu*s, its systematics remains largely unresolved and the knowledge on the copulating and dispersal strategies of species of *Mustelus* remains poorly understood. Here, a multidisciplinary approach – molecular, morphology and histology – with different spatial scales and methods of analysis was used. First, this study investigated the evolutionary origin of the shark genus *Mustelus* in southern Africa using molecular phylogenetic and statistical biogeography approaches. Second, molecular screening tools and a dermal denticle identification key guide was developed to assist with the identification of southern African species including *M. mosis, M. mustelus, M. palumbes, Galeorhinus galeus, Scylliogaleus quecketti* and *Triakis megalopterus* commonly mis-identfied in the region. Third, a comparative population genetics approach was used to gain insight into spatial genetic structure and dispersal patterns in species of *Mustelus* (*M. mustelus* and *M. palumbes*) and other co-distributed demersal sharks (*Galeorhinus galeus* and *Triakis megalopterus*) characterised by assorted life histories, habitat preferences, and dispersal behaviour. Last, the current study investigates several aspects of the reproductive biology (sperm storage and mating strategies) of species of *Mustelus* in South Africa using molecular and histological approaches. Overall, the results of this study provide insights into the conservation biogeography of *Mustelus*, resolving species identification issues and, ecology of dispersal and mating behaviours in *Mustelus* with potential implications for management and conservation.

Keywords: *Mustelus*, smoothhound, genetic identification, multiple paternity, sperm storage, population structure, biogeography, phylogeny.

Genetic diversity and population connectivity of the longfin-mako shark (*Isurus paucus*) in the Equatorial Atlantic Ocean

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The longfin-mako, *Isurus paucus*, is a widely distributed but only occasionally encountered oceanic tropical shark. This species is caught mainly as bycatch in tropical pelagic longline fisheries, which operate throughout its distribution range, but at much lower ratios than its congener shortfin-mako, *I. oxyrinchus*. Their catches are inadequately monitored and possibly underestimated due to misidentification among species of the *Isurus* genus. This is a species of conservation concern due to its apparent rarity, and life history traits such as high longevity and slow growth, late sexual maturity and low fecundity. Currently, *I. paucus* is listed as "Vulnerable" on the Red List of the International Union for Conservation of Nature and Natural Resources (IUCN). In the present study we analyzed 939 base pairs of the mitochondrial control region sequenced from 104 individuals. From those, 12 haplotypes were identified, with one shared by 35.57% of the individuals. The haplotype and nucleotide diversities showed moderate values, respectively 0.783 and 0.00239. The AMOVA (analysis of molecular variance) revealed the absence of genetic population structure (ϕst = -0.03239) and therefore, the genetic variation distribution of the species is probably homogeneously composing a single population unit. Such genetic traits can be explained by the high migratory capacity of *I. paucus* and absence of barriers to gene flow in the sampled region. The moderate genetic diversity indexes found is similar to most species of pelagic sharks evaluated until now. The loss of genetic diversity can impact the species adaptation due to environmental changes and inbreeding depression. Thus, the identification and maintenance of differentiated genetic stocks are fundamental priorities for the elaboration of conservation measures. Our results describe the first scenario of genetic variability and its distribution for the longfin mako shark in one important area of its distribution in the Atlantic Ocean. We now plan expand the geographical range of these assessments and to generate historical series of continued genetic monitoring.

Keywords: Oceanic tropical shark, conservation genetics, continued genetic monitoring molecular marker.

Trophic ecology of an endemic Andean river stingray *Potamotrygon magdalenae* (Chondrichthyes: Potamotrygonidae) from stomach contents and isotopic analyses

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Understanding the ecological role of species within an ecosystem depends largely on knowledge of its trophic relationships. Such relations within a food web are a central step in understanding the structure and dynamics of the communities. Thus, the composition of diet plays an important part in shaping the ecological roles of individuals, species and functional groups. The batoids comprises a diverse group, which can develop different functions in the food webs of the benthic and demersal aquatic realms, mainly transferring energy between diverse trophic levels. The knowledge on the diet of the South American freshwater stingrays has increased considerably over the last years, but still, little is known about their ecological role. Thereby, the aim of this research was evaluate the feeding habits and the trophic ecology of the endemic stingray *Potamotrygon magdalenae*, using approaches, of stomach content and isotopic analyses (^{13}C and ^{15}N).

The samples were collected in the middle Magdalena river basin, Colombia, between 2015 and 2016, in two contrasting hydrological periods: high and low waters, during artisanal fishing operations. The stomach content analysis indicated that *P. magdalenae* is a specialist predator that feeds on insects, mainly Diptera in larval stages, such as Chironomidae larvae. By contrast, the main contribution of Coleoptera and Epehemeroptera in the diet were supported by the SIAR mixing model. No significant differences of δ^{13}C and δ^{15}N were observed in the muscle of the species between sex and hydrological periods, and the isotopic niche was intermediate. Stomach content and stable isotope analyses classify *P. magdalenae* as a predator of intermediate trophic position. These results provide a starting point for further ecological studies about the South American freshwater stingray species, in order to assess their role in the ecosystem.

Keywords: Batoidea, diet, feeding sources, food webs, δ^{13}C and δ^{15}N.

Historical analysis of the shark fisheries in Campeche, Mexico

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Campeche is characterized for its long fishing tradition and shark diversity distributed along its coast. Consumption of shark products had been common practice locally, but demand for shark fins increased once the industry opened to international markets. This study aims to analyze the shark fisheries in Campeche using scientific and grey literature to describe changes in catch composition, price, fishing areas and fishing gear. The first official shark industry in Mexico developed between 1936 through 1939 focusing on the extraction of liver oil. After the development of synthetic vitamin A, this industry fell into decay. In the 1950s there was a renewed interest in shark fisheries when the federal government built shark experimental plants, but it was not until the 1980s that the federal government focused in developing these fisheries by giving loans to buy boats, motors and fishing gear. This in turn was reflected in the increased landings all through that decade and the beginning of the next one. But by the end of the 1990s there was a 35% decline in shark captures. In 1981 there were only 9 shark species reported for Campeche, but by 1997, the number had increased to 18. However, species like *Carcharhinus obscurus* have not been reported recently, and species like *Negaprion brevirostris* have become rarer. *Sphyrna tiburo* and *Rhizoprionodon terraenovae* have been captured constantly since the beginning of the fisheries, but there has been an important decline in the *S. tiburo* captures which used to represent up to 60% of the total captures, a percentage that does not correspond to their current landings. There have also been important changes in prices. Sharks had been sought after their liver, skin and meat. However, their fins currently play a bigger role: Species like *Sphyrna mokarran*, *Sphyrna lewini*, which are listed in Appendix II of CITES, as well as *Carcharhinus leucas* are part of the international market. Meanwhile, small species like *Carcharhinus acronotus*, *R. terraenovae* and *S. tiburo* are consumed at local level. It's important to note that technological advances have allowed fishermen to increase their fishing areas. This study is an initial step to analyze the shark fisheries in Campeche by taking into account the area's historical context.

Keywords: catch records, populations decline, shark markets, Gulf of Mexico.

Growth type of *Potamotrygon magdalenae* (Potamotrygonidae: Myliobatiformes) (Dúmeril, 1865) in lagoon environments within the area of two cascade reservoirs in a Neotropical basin

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Potamotrygon magdalenae is one of the 34 freshwater stingrays described, and the only species reported at Magdalena-Cauca basin, categorized as Near Threatened (LibroRojo de peces Colombia), Least concern (IUCN) and also III CITES appendix, which presents an information void in its upper portion. The objective of this study was to describe the growth type of *P. magdalenae*, in two artificial lagoons, located in the lotic stretch among Betania and El Quimbo cascade reservoirs system (Huila, Colombia). 18 samplings were carried out, between April (2016) and December (2017) with fixed bottom nets, cast and trawl nets, around of 1 km in diameter, during 2 hours. 54 organisms were captured with sizes between 45 and 375 mm of disk width (DW), the latter being the largest reported size for the upper Magdalena, with weights between 7.37 and 590 gr. The growth coefficient value shows an isometric trend (b: 2.79), which coincides with other reports for the basin. The species inhabits floodable environments, with depth and average transparency of 3.68 m and 0.49 m, respectively, with substrates composed of sludge and decomposing organic matter. The water temperature was between 23.2 and 28ºC, the conductivity between 79.2 and 129.6 µS/cm, the dissolved oxygen between 3.6 and 7.65 mg / l, the pH between 6.3 and 7, 96 and the saturation percentage between 46.2% and 103.2%. Despite the transformation due to the presence of cascading reservoirs, the conditions found in the study area may favor the presence and *P. magdalenae* catches neither have no recorded in other environments at the same region. This work is a first contribution to the knowledge of the biology of this species, necessary to elaborate and implement management strategies of Colombian freshwater stingrays, especially in endemic basins such as Magdalena river. This study is part of the contracts CEQ-612 and 8400111970 among EMGESA S.A E.S.P and Universidad Surcolombiana, executing Proyecto ÍcticoPesquero del Alto Magdalena, III and IV phases.

Keywords: freshwater stingray, growth type, water quality.

Batoid nurseries: definition, use and importance

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Nursery areas are crucial for many elasmobranch species, providing benefits that increase fitness and survival. Shark nurseries are well studied and our knowledge of their function and importance has expanded over the past few decades. However, little attention has been given to batoid nurseries, with studies covering less than 6% of the 663 currently described species. Threats of extinction faced by batoids reinforce the importance of defining these critical habitats. This review synthesises current knowledge of batoid nursery areas to provide a better understanding of their ecological roles and importance. Historically, different criteria have been used to define viviparous and oviparous batoid nurseries, causing confusion that could lead to failure of conservation and management strategies by under- or over-estimating the importance of areas and delaying effective action. We suggest the criteria used to identify shark nurseries be applied to juvenile batoids, standardizing this nursery definition for all elasmobranchs, but also advocate for a second set of criteria that identifies egg case nurseries. Regarding ecological aspects, batoids are thought to play three main roles in nursery areas: energetic links, bioturbators and mesopredators. Biotic and abiotic features affect abundance and distribution of batoids within nurseries and likely play a key role in their habitat use. However, analysis of batoid ecological roles in nursery areas is limited by the lack of research on their early life history stages. Thus, identification of areas that support sensitive life stages and an improved understanding of early life history are crucial for the efficient management and conservation of batoid species and their nurseries.

Keywords: sawfish, skate, stingray, guitarfish, habitat use, ecological role.

Fetal mummification in scalloped hammerhead shark *Sphyrna lewini*

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Fetal mummification occurs when autolysis of a dead embryo is restrained, impairing its decomposition process within the uterus. It can be a result of environmental or maternal conditions, such as hypoxia, dryness, genetic or anatomical causes. Due to the lack of oxygen and microorganisms, the embryo is not reabsorbed or macerated and the uterine fluids are quickly reabsorbed. Such process was mostly described for domestic mammals, but a few occurrences were already reported for elasmobranchs. For this reason, the aim of this study was to describe the occurrence of fetal mummification in the scalloped hammerhead shark *Sphyrna lewini*, based on a pregnant 310 cm total length female caught by the artisanal fisheries, in Praia Grande city, São Paulo state, southeastern Brazil. Uterine fecundity was 14 embryos (seven by uterus), already in the placentatrophy stage of embryo nourishment. Embryos' total length (TL) and total wet weight (TW) ranged from 46 to 49 cm and 480 to 584 g in the right uterus and from 17 to 49 cm and 10 to 582 g in the left uterus. Two mummified male embryos in different development stages were observed in the left uterus. The embryo #1 had a TL of 17 cm and TW of 10 g and the embryo #2 had a TL of 35.2 cm and TW of 90 g. Embryo #1 was covered by a brownish mucoid substance/fluid, being characterized as a hematic mummification. Embryo #2, however, was dry and presented a leathery aspect, yet it was not possible to verify if the process of fetal mummification because the embryo was in a more advanced stage and dryness might occur as a function of time. Fetal mummification is observed in several placental mammals, and, in most cases, this condition affects the whole offspring. In this study, however, only two of 14 embryos presented this condition, suggesting that some physiological/physic barrier might occur, protecting the rest of the offspring from the conditions favoring fetal mummification. Besides, this process occurs mostly due to hypoxia/anoxia conditions, as well as the absence of microorganisms in uterus. Since *S. lewini* presents uterine compartments, these structures might be acting as a barrier and creating a microenvironment for each embryo to develop. In the present study it is postulated that maternal conditions might be associated to this event, since only two embryos were affected and the rest remained apparently macroscopically intact.

Keywords: embryo, hematic mummification, reproduction, Sphyrnidae.

Population structure of the Brazilian blind electric ray *Benthobatis kreffti*

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The Brazilian blind electric ray *Benthobatis kreffti* is a small benthic deep sea elasmobranch endemic to the Southwest Atlantic, occurring in southern and southeastern Brazil, about 400-600 m depth. Despite the restricted known geographical range, its biology is poorly understood, remarkably in the northern extreme of its distribution. Thus, the present research intends to study aspects of the population structure of *B. kreffti* off São Paulo State continental slope, southeasthern Brazil, western South Atlantic, considering the catch and size composition, sex ratio and length-weight relationships. Individuals were captured by bottom trawl scientific cruises from 31th July to 2nd August 2003 at 492-501 m depth between Santos and Cananéia cities. Total length (TL, mm), total weight (TW, g) and sex were recorded. Maturity stages were classified into immature, developing and mature. Length-frequency was based in 10 mm length classes and sexual differences were tested with the Kolmogorov-Smirnov test. Differences from the expected 1:1 sex ratio were tested with a chi-squared test. Finally, length-weight relationships were calculated for males and females and an analysis of covariance was performed to detect sexual differences between the regressions. Chondrichthyes represented 3.23 % (28.65 kg) of the total catch and were represented by *B. kreffti* (72%), followed by *Gurgesiella dorsalifera*, *Hydrolagus matallanasi*, *Tetronarce puelcha* and *Dipturus* sp. Size structure was different between sexes (D=0.452; p<0.05), with females presenting larger TLs (118-299 mm) than males (96-256 mm). All maturity stages were observed (35 immature, 51 developing and 178 mature) and total sex ratio was different from1:1 ($x^2(1)$=5.470; p=0.019, n=264) towards females, as well as for adult individuals ($x^2(1)$=7.2809; p=0.007, n=178). At immature and developing stages no differences were observed. Length-weight relationships were different between sexes ($F(1,179)$=6.930; p=0.009) with females attaining larger TL and TW. Sexual differences for size and weight might occur due to different reproductive costs associated with maternity and vitellogenesis, usually observed for viviparous elasmobranchs. Based on the catch composition, *B. kreffti* seems to be an important component in the elasmobranch fauna due to its high frequency among other species. In addition, the high frequency of all maturity stages considered suggests that this species uses the studied area during its life cycle. The results herein presented highlight the importance of knowing biological and demographic aspects of this species, especially due to its restricted geographical and longitudinal distribution.

Keywords: deep-water, length-weight relationships, sex ratio, size structure, Southwest Atlantic.

Where do they come from and where do they go? An integrated approach to assess pupping areas and female migration in a Conservation Dependent shark

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Knowledge about reproductive strategies and habitat use is important for conservation planning, particularly in highly mobile species. School shark (*Galeorhinus galeus*) are distributed globally in discrete populations, including in Australia where they are listed as Conservation Dependent due to historical overfishing and stock collapse. A long-running debate around the location of the pupping grounds of these wide ranging meso-predators has taken on greater significance with efforts to rebuild their population. The current management model assumes obligate female migration to pupping areas in south-eastern Australia (Tasmania), however anecdotal evidence suggests that pupping occurs in other areas up to 1,500 km away from these sites, suggesting a more complex model of reproduction and female migration. This study integrates the use of natural tags (vertebral elemental signatures) with archival tagging of pregnant females to address this knowledge gap. Vertebral elemental signatures formed just after birth were assayed in three cohorts of juveniles and sub-adults from two regions (South Australia and Bass Strait) using laser ablation ICP-MS. Signatures differed between regions for two cohorts but were similar in another, suggesting that different pupping areas contribute to these populations, although similar or shared pupping areas may be used in some years. Pregnant females were tagged in South Australia over two sampling years with pop-up satellite archival tags. In the first year, no females (n=8) migrated to the south-eastern nurseries as predicted by the current management model; remaining at least 1,100 km away in South Australia. In the second year (n=6) three migrated to Tasmania and one to New Zealand to pup. Our results indicate that reproductive strategies and habitat use are more plastic than previously assumed and that the current recovery management model is based on inaccurate assumptions of only one pupping region in the southeast part of the species range. Increased scientific effort to locate other pupping areas and to further understand drivers behind female migrations may allow us to predict female movements and mitigate exposure to potential threats such as fishing pressure.

How to do environmental education about sharks and rays in a participative and integrative way

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Although there has been much discussion on the importance of environmental education (EE) for the sharks and rays conservation, few effective actions have been performed. In Brazil, EE is regulated by law no. 9795/1999, which establishes that EE must integrate formal education in all its modalities in a transversal way. The school "Colégio Estuadual do Campo Felipe Valentim", located in Ilha do Mel, Parana state, southern Brazil, is part of the National Field Education Program, where in addition to EE, the local reality and biodiversity need to be taught in the classroom. Due the school demand and the opportunity to integrate knowledge about elasmobranch conservation in the formal education, between May and November 2017, the "RAIAr da eduCAÇÃO" project planned, enabled and performed EE actions in a participative way in schools, using the Research Action methodology. As part of the previous diagnosis, a meeting with the school's administrative staff and teachers was realized, in which was discussed about the project action mode, the school's pedagogical policy framework and the teachers' participation in planning and conduction of the activities. Several knowledge areas were included in the activities, which were incorporated in the Work Plan of each participating teacher. In the Artistic Expression area, students made hats in the shape of sharks and rays with recyclable materials, with space for reflection on the potential problems generated by the trash in the environment, both for local community and for sharks and rays. In the areas of Natural and Social Sciences and Language, a field trip was carried out where themes including ecosystems, geology, stories, legends and environmental problems related to sharks, rays and the community were studied. Also, practical class was offered, to look at zooplankton organisms, fish, mollusks and other prey of sharks and rays. In the Exact Sciences area, it was elucidated how to structure and analyze data, using species data as natural characteristics and degree of risk of extinction. In corporal expression area, an integrative gymkhana was performed with the elasmobranchs theme, like the games including manta breaching, ray eggs race and sharks/rays quizzes. Considering that the EE process is continuous, we provide a guide for EE activities of sharks and rays, with the conservation perspective "know to preserve" that can be incorporated into school teaching practices and be a guiding example for other initiatives.

Keywords: elasmobranchs, research action, school education.

Fishermen perception about elasmobranchs of the Paranaguá Estuarine Complex, Southern Brazil

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Fishers, accumulate years of empirical knowledge which can facilitate environmental studies. In order to examine fishers perception of elasmobranchs in the Paranaguá Estuarine Complex, Paraná, Brazil, eight individuals from the village of Ilha das Peças, were interviewed in October and November of 2017, as part of the actions of the "RAIAr da eduCAÇÃO" project. Semi structured questionnaires were carried out, with questions related to occurrence, abundance, uses and legends. In addition, it was questioned: What should be done for sharks and rays to brought out of the extinction risk list, with actions which do not have an adverse effect on artisanal fishing? The elasmobranch species of the estuary include seven species of rays (*Manta birostris*, *Rhinoptera* spp., *Mobula* spp., *Aetobatus narinari*, *Bathytoshia centroura*, *Hypanus say*, *Gymnura altavela*) and 4 shark species (*Sphyrna* spp., *Galeocerdo cuvier*, *Carcharhinus limbatus*, *Carcharias taurus*). Sharks occur mainly around the Ilha das Palmas located in the northern mouth of the estuary and the rays inhabiting the whole estuary. All species occur mainly in the summer and early fall, with some rays such as of genus *Hypanus*, *Bathytoshia*, *Rhinoptera* and *Gymnura* occurring in spring and fall as well. The shark's meat has been reported as tasty and marketed as "cacao" and the majority of ray meat reported as unpalatable, however some are palatable and consumed including *Rhinoptera* spp. and *G. altavela*. Legends have been reported e.g. "If you point the finger at a manta ray breaching, it does not breach again". It was cited that abundance of all species is reduced, mainly after the beginning of industrial fishing in the region and the use of nylon nets and motor boats. It has been reported that all species of sharks and rays, as well the fishes of the region, have declined. *C. taurus* was reported as the most reduced in abundance, considered practically extinct and *M. birostris* the most reduced in abundance even though it is not a target species. One fisher reported not catching a shark for 3 years ago. The opinion of most fishers is that industrial fishing is the major culprit of the decrease in the sharks and rays abundance and artisanal fisheries catches, due to the indiscriminate capture which leads to a decline in fish resources. Urgent actions should be taken to reduce the impact of industrial fishing, in order to prevent the risk of fish stocks to collapse and perhaps local extinctions.

Keywords: sharks and rays, empirical knowledge, fisheries crisis, fisheries impacts, estuary.

Diel movements and fine-scale activity patterns of California horn sharks (*Heterodontus francisci*) in response to environmental temperature

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Ectothermic sharks such as demersal, nocturnal California horn sharks (*Heterodontus francisci*) are physiologically and behaviorally influenced by environmental temperature, affecting their net energetic gain; however, how horn sharks regulate movements and activity patterns in response to changing temperatures is not yet understood. Active acoustic telemetry and accelerometer data loggers (ADLs) were used to quantify diel movements and fine-scale activity rates of horn sharks as they move through a heterogeneous thermal environment. Twenty horn sharks (1.8 – 4.3 kg) were fitted with custom 1st dorsal fin tag packages that included an acoustic transmitter (Vemco, V9-6L) and an ADL (Cefas and TechnoSmart), which records 3D body acceleration, depth, and temperature (at 25 Hz). Each shark was continuously tracked for 24 – 48 hrs. During the day, horn sharks were largely inactive and used an average (±SD) area of 5.4 ± 6.4 km^2, while nocturnal space use was 99.3 ± 92.4 km^2. The maximum linear distance a shark travelled during nighttime activity was 13.4 km. Horn sharks spent 89.9 ± 5.62% of their daytime periods resting, and only 50.8 ± 6.99% of their nighttime periods resting. While nocturnally active, horn sharks travelled through temperatures ranging 9.9 – 23.8°C and depths ranging 0.25 – 112 m. As sharks were resting during the day, ambient water temperature changed 3.5 ± 2.2°C, whereas during nighttime horn sharks averaged a change of 7.28 ± 2.47°C. Using these temperatures, standard metabolic rates were calculated for each shark to estimate minimum energetic costs of activity. Quantifying horn shark movements and activity across heterogeneous environments will allow us to quantify their energetic landscape and to predict how changing ocean temperatures may affect the distribution and behavior of this kelp forest associated species.

Keywords: horn shark, accelerometry, acoustic telemetry, temperature.

Demographic parameters of the cownose ray *Rhinoptera steindachneri* in the Bahia de la Paz, BCS, Mexico

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Rhinoptera steindachneri is one of the most common batoid species in the artisanal fishing with gillnets in the Gulf of California. The objective of this study was to estimate the demographic parameters of *R. steindachneri* females from Bahia de la Paz, BCS, Mexico, from previously generated life history parameters for the species in the same area (Pabón-Aldana et al. 2016; Ehemann et al. 2017; Burgos-Vázquez 2018). Survival at age was estimated from eight indirect methods used to estimate natural mortality. The mean survival varied between 0.67 in individuals of age 0 to 0.75 in individuals of age 11 and 12. Life tables and age-structured matrix models were developed, using a deterministic approach and assuming a closed population. The (Leslies) matrix model assumed a post-reproductive scheme and births by pulses (given its annual reproduction). The reproductive value and the stable stage distribution were determined and it´s elasticity analyzes were carried out. Parameters were similar between methods: net reproductive rate (Ro = 0.28 and 0.24), generation time (7.48 and 8.48 years) and the mean age of parents (4.52 and 4.5 years). Instantaneous rate of population increase (r = -0.171 years-1) and finite rate of population growth (λ = 0.483) values, indicate that the population may be decreasing. Individuals of age 0 represented 17.7% of the females, followed by individuals of ages 1 (14.2%) and 2 (11.7%); the ages up to 6 years counted for 75% of the total number of individuals in the population. The reproductive value was higher for ages 4 to 7, and the lowest for ages 11 and 12. Survival elasticities of individuals ≤4 years were the highest (11.2% in all cases). Fertility elasticities were lower than those of survival of juveniles (≤4) and adults (≥5 years), which were similar. The elasticity rate revealed that changes in survival at age 4 could have the greatest impact on the population growth of *R. steindachneri* in Bahia de la Paz. This preliminary demographic analysis indicates that *R. steindachneri* may not be adequately supporting the levels of fishing pressure to which it is subjected in Bahia de la Paz, and therefore could be at risk. However, migratory events of the species in the area must be considered, while they may or may not favor it, that is, if they migrate to reserve areas (where they might be protected), or to other fishing areas (where they might also be caught).

Keywords: Batoidea, life tables, matrix models, elasticity analysis, population growth rate.

Trading Card Games: pop culture for propaganda and environmental education related to conservation policies of Elasmobranchii

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The Elasmobranchii (sharks and rays) are a diverse group of fishes. They are ecologically and economically important for both marine and fresh water environments comprehending more than 950 species described. Species in the group are under pressure due to overexploitation, pollution and other human activities which is leading many of them to the helm of extinction. Thus, Elasmobranchii are in demanding of conservation and management strategies. The effectiveness of such policies is better reached when they are coupled with propaganda and environmental education plans. Many pop culture icons have been used in meeting these tasks as an example of cartoons, comics and movies characters. Collectible items such as Trading Card Games-TCG (a game in which players collect cards to duel with other players in matches) use many fictional creatures, which in some cases are inspired in real fauna an example of Yu-Gi-Oh! and Pokémon. Coupling the aims of aware public on conservation issues as well as the power of pop culture in gain attention of people, this work investigated the capacity of elementary school students in identifying characteristics of elasmobranchs in TCG cards, foreseeing the potential of these games in developing affectivity and awareness of children connected with Elasmobranchii. In approaching this aim, activities were carried out with seventh and ninth grades students of a public school in São Gonçalo (state of Rio de Janeiro, Brazil) using TCG. The activities were done with children divided into working groups (nine in total) each of them receiving fourteen different TCG cards from Yu-Gi-Oh!, Pokémon, Magic: The Gathering, Vanguard and Digimon. The students were challenged to find characteristics of the fictional creatures which could characterize them as Elasmobranchii. After the activity the participant answered a questionnaire on their opinions about the activity. As results, 63 students identified 25 different morphological and ecological characteristics of elasmobranchs, being ventral mouth (n = 38) and gill slits (n = 35) the most mentioned ones. Furthermore, almost all students (98.93%) rightly identified creatures from the TCG which were based on sharks or rays. All participants enjoyed the activity and 95.24% due to be linked with pop culture elements and 7.94% connect their answers with conservation issues. In conclusion, the use of TCG as educational tools linked to specific aims such as developing affectivity and awareness of children connected with Elasmobranchii was effective, portraying the potential of pop culture for propaganda and environmental education related to conservation policies.

Keywords: Magic: the gathering, pokémon, sharks, rays, teaching tools, Yu-Gi-Oh!

A baseline for marine elasmobranchs (Rio de Janeiro and São Paulo, Brazil) based on Holocene zoo-archaeological remains from sambaquis

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Baselines are one of the most important tools for the conservation and management of biodiversity, especially regarding endangered species. In the case of marine Elasmobranchii fauna (sharks and rays) which includes many intensively exploited species, the establishment of baselines is particularly important for both conservation and informed fisheries policies. However, accurate baselines should include not only current and historic but also prehistoric (fossil/sub-fossil) data. Abundant along the Brazilian coast are archaeological sites dating between 8,000 and 1,000 years before present called sambaquis, which were built by groups of prehistoric fishermen-gatherers-hunters. Sambaquis contain large number of faunal remains, including those from sharks and rays. Based on sambaquis' registers of marine Elasmobranchii, this work endowed to present an inventory of the biodiversity of sharks and rays for Rio de Janeiro (RJ) and São Paulo (SP) during the Holocene. Data were compiled from scientific articles, books, thesis, dissertations, monographs and technical reports. The species list was analyzed in terms of absolute and relative species richness and frequencies of occurrence. Furthermore, taxonomic, biogeographic, ecological and economic information on species were collected from the FishBase. A total of 37 species were registered for 39 sambaquis in the studied area. Sambaqui do Algodão in Angra dos Reis-RJ was the richest site with 28 inventoried species (relative species richness = 0.757). *Carcharias taurus* Rafinesque, 1810 and *Aetobatus narinari* (Euphrasen, 1790) had the highest frequencies of occurrence, being found in 26 (relative frequency = 0.667) and 24 (relative frequency = 0.615) of the sambaquis, respectively. Most of the identified sambaquis' elasmobranchs are circumtropically distributed (32.43%) and inhabit estuarine environments (45.83%). Moreover, most species have a pelagic habit (48.65%), oceanic migratory behaviour (54.05%) and carnivorous diet (91.89%). Lastly, all of them have some commercial value. Despite the limitations of sambaquis' data such as the difficulty in species identification due to the fragmentation of zoo-archaeological remains and the selectivity of fishermen-gatherers-hunters groups that underestimate the diversity of Holocene fauna, the species richness recorded in the sambaquis represents 33.94% of that found in the checklists of current Elasmobranchii fauna of RJ-SP, showing that an important number of the species present nowadays were already explored in prehistoric times. These results put the ecology and economic role of Elasmobranchii biodiversity in a historical perspective, giving to conservation and management measures an evolutionary perspective. Hopefully these informations can contribute to reduce the threats on marine elasmobranchs.

Keywords: conservation and management, fishermen-gatherers-hunters, inventory, sharks and rays, zooarchaeology.

What can fatty acid profiling tell us about chondrichthyan feeding ecology?

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Fatty acid (FA) analysis is being increasingly applied to studies elucidating the trophic ecology of marine and terrestrial species. Although FA analyses have traditionally been applied to simple food webs or organisms at low trophic levels, studies on high order marine predators including fish, marine mammals, and elasmobranchs are growing in number and complexity. Chondrichthyans, however, have unique physiologies that may influence the interpretation of results from FA studies, hindering the uptake of this method to investigate the feeding ecology of this group. Using the FA profiles from 104 chondrichthyan populations around the world, we compared the effects of trophic group, temperature, habitat, and phylogeny to elucidate the causes of variations in FA profiles and determine the reliability of using specific FA to assess dietary changes. FA profiles were significantly affected by all four factors, with habitat being the factor influencing FA profiles the most and FAs 18:0, 20:1w9, 20:4w6 and 22:6w3 driving the difference within habitats. Overall, FA profiles can be used to distinguish foraging temperature, trophic group, and habitat with specific FA tracers able to disentangling which factor is driving changes in FA profiles. Our global meta-analysis provides a novel understanding of the information that can be inferred from FA analysis, which could not be obtained from standard regional studies, and validates the use of FA profiles and tracers to investigate the trophic ecology of chondrichthyans.

Keywords: tracer, biochemical, trophic ecology, chondrichthyan, habitat.

Otlet – an online platform for sourcing biological samples

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Research teams collect more than 94 million biological samples annually, the majority of which are subsampled for targeted analysis. The remaining sample, often including a number of unused organs, is then able to be repurposed for additional studies by collaborators around the world. However, the absence of a systematic way to source these unused samples results in wasted tissues, organisms and opportunities for research as scientists undertake redundant sampling regimes. As such, 'Otlet', a global online database, was set up to overcome the challenges of sourcing scientific research samples from colleagues. The platform allows the users to 1) upload a record of their unused samples, 2) search the database of existing samples from other users and request them directly from the contributor and, 3) post a request for samples onto a searchable community board. The platform facilitates communication between research teams across different locations, taxa and expertise to foster novel collaborations while accelerating scientific output. Otlet's newly constructed platform is an important tool for biological scientists of all disciplines to efficiently communicate and source research material. Membership is freely available for scientific use by researchers from universities, government agencies, museums, private consulting and NGOs.

Keywords: database, collaboration, global.

Understanding and quantifying shark depredation in the Ningaloo Marine Park and Exmouth Gulf, Western Australia

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Shark depredation, where a hooked fish is consumed by a shark before it can be retrieved to a fishing vessel, causes extra mortality to target species, injury to sharks from fishing gear, and negatively impacts the recreational fishing experience. This research sought to quantify the spatial occurrence and frequency of shark depredation in a recreational fishery within the Ningaloo Marine Park and Exmouth Gulf, Western Australia, and identify the shark species causing depredation. A large-scale boat ramp survey collected data on depredation from 403 recreational fishing vessels at Ningaloo Marine Park and Exmouth Gulf boat ramps, from July 2015 - May 2016. The mean depredation rate was 13.65 ± 3.27% for demersal fishing in the Ningaloo Marine Park, compared to 11.48 ± 2.84% in Exmouth Gulf. The results of Generalised Additive Mixed Models (GAMMs) indicated that higher depredation rates occurred in areas which received greater fishing pressure, suggesting the formation of a behavioural association in the depredating sharks.

Additionally, depth and the number of vessels fishing in close proximity influenced depredation rates. A novel application of underwater video cameras identified five shark species responsible for depredation in this region, which varied depending on the depth and location of fishing. A wide range of behaviours were also observed in the video footage. Video analyses were used to construct a series of behavioural ethograms for each species, based on interactions where sharks either consumed bait or hooked fish. Overall, this research represents the first quantitative assessment of shark depredation in a recreational fishery globally, and provides new insights into the behaviour of sharks around fishing gear. This information is vital for fisheries management in this World Heritage listed Marine Park, and on a broader level, the knowledge of how sharks interact with fishing gear can benefit future research into designing measures for mitigating shark bycatch and depredation in both commercial and recreational fisheries.

Keywords: shark depredation, recreational fishing, fisheries management, Generalised Additive Mixed Models (GAMMs), shark behavior.

Population genetics of the bull ray (*Pteromylaeus bovinus*) along the east coast of South Africa

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Pteromylaeus bovinus or the bull ray is a chondrichthyan belonging to the family Myliobatidae with life history traits that make it particularly vulnerable to fishing, causing low population growth rates. The species is caught as bycatch in the KwaZulu-Natal Sharks Board (KZNSB) Bather Protection Program along the east coast of South Africa. However, there is limited knowledge on movement patterns and dispersal potential of this species along its entire range off the African coastline. This study analysed the cytochrome c oxidase subunit I (COI) and twelve exon-primed intron-crossing (EPIC) markers to investigate population genetics of the species along a small regional scale (~350 km) off the eastern coast of South Africa. Phylogenetic reconstruction using mtCOI data revealed that *P. bovinus* populations from South Africa are not genetically distinct from the Italian populations. The COI results revealed genetic homogeneity but high genetic diversity with a total of 22 haplotypes, and the sites within central Durban had highest haplotype diversity (h = 0.825±0.002) compared to the sites far north and south of Durban. The population from Central Durban were not only significantly different to samples collected from the sites far north (Fpt = 0.347, p < 0.008) and south of Durban (Fpt = 0.098, p < 0.05), but the most common or dominant lineage was confined to this area. The Bayesian skyline plot of population structure based on EPIC data recovered fine-scale genetic clusters, comprising two main overlapping populations clusters from the central Durban and far south coast. The bull ray caught in the KZNSB Bather Protection Program comprised two main interbreeding lineages, at least based on the nuclear EPIC markers. The results revealed population connectivity along regional scale of ~350 km coastline, however broader sampling coverage is needed to establish if recovered mitochondrial panmixia and nuclear clusters prevail across the entire species' range off the African coastline.

Keywords: dispersal potential, haplotype diversity, genetic homogeneity, population connectivity, interbreeding lineages.

Age, growth, and mortality of the little gulper *Centrophorus* cf. *uyato* in the Northern Gulf of Mexico

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Roughly half of all shark species occur below depths of 200 meters, yet very little is known about their basic life-histories. Deep-water sharks generally have much more conservative life histories than coastal and pelagic species, likely making them more susceptible to overexploitation. The little gulper shark, *Centrophorus* cf. *uyato*, is a cosmopolitan mid-sized deep-water species inhabiting temperate to tropical latitudes. *Centrophorus* cf. *uyato* is presumed to have very conservative life-history characteristics similar to those documented for congeneric species. Presently, numerous fisheries target deep-water stocks throughout the world, many of which have experienced significant declines in stocks. For example, *Centrophorus* cf. *uyato* and other congeners in New South Wales experienced a 99% population decline after 20 years of commercial fishing. In the northern Gulf of Mexico, no fisheries target deep-water-sharks and very few fisheries even encounter these species, making these stocks representative of healthy, unfished populations. It would be prudent to use these stocks to address critical information gaps in the life-history of *C.* cf. *uyato*, allowing for the proper management in active fisheries and pro-active regulations in areas where fisheries have not yet developed. This study provides the first descriptions of age, growth, and mortality for *C. cf. uyato* in the northern Gulf of Mexico. *C.* cf. *uyato* in the Gulf of Mexico lives to 70+ years, matures at 40-45 years (~85% of its maximum length), and has an instantaneous natural mortality rate of ~0.05. These results will inform demographic models for predicting population responses to fishing pressure throughout the range of this species.

Keywords: life history, deep-sea, fisheries, natural mortality, von Bertalanffy.

Age structure of the blue shark in the Southwest Atlantic

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In the Southwest Atlantic (SWA), blue sharks have been the most caught species of fish in longline fisheries for at least six decades. In spite of this, no consensus exists about its population status. Thus, the age structure of catches of *Prionace glauca* in the SWA was estimated from vertebrae collected in 2004-2008, aboard two commercial longline fishing vessels in southern Brazil and adjacent international waters, between the latitudes 23ºS and 38ºSº and between the longitudes 29ºW and 52ºW. Fork length (LF) of 2340 males (84-262cm) and 402 females (73-247cm) was measured along a line parallel to the body axis, rounded down to the nearest centimeter below the actual length, by using a wooden caliper 3.0 m long. Vertebral frontal plane sections for stereoscopic microscopy (SM) (0.75mm) were stained. Alizarin and silver nitrate improve band pair recognition, allowing us to define the growth marks (GMs) as the only point at which the pattern of calcification switches, from more calcified to less calcified. Vertebral sections were read twice. Ageing precision was analyzed through bias graphs and precision indexes both, for the entire sample and by age groups (D=8.07, APE=11.42). Marginal increment analysis for different life stages revealed that GMs are formed annually in winter. The maximum observed ages were 12.5 and 13.6 years old for females and males, respectively. VBGF was adequate to describe growth, with no differences between sexes (L∞=265,2, k=0,149, t0=-1,504). The age structure of catches in 2004-2008, consisted primarily of 4-5 yr-old subadult males, and 6 yr-old adult females. Small juveniles of 1 to 3 years old were found in spring, south of the Subtropical Convergence. The presence of all life stages in the study area, allows us to conclude that the age structure herein presented is useful as a reference point both, to describe the FL and age composition of longline landings and to monitor the stock assessment of *P. glauca* in the Southwest Atlantic.

Keywords: *Prionace glauca*, longline fisheries, population dynamics.

Are seamounts nursery areas for oceanic sharks in the Southwest Atlantic?

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Seamounts are underwater mountains that rise from the seafloor, with hundreds or thousands of meters tall. These isolated areas aggregate pelagic species and support assemblages that differ from the open ocean. In the Southwest Atlantic, there are two main seamounts formations: the Vitoria-Trindade Ridge (VTR) (20°S/29′W) and the Rio Grande Rise (RGR) (33°S/35°W). Both seamounts are located about 1200 km west of the Brazilian coast. Monitoring of catches on board commercial longline fishing boats has shown that small juveniles of oceanic whitetip shark (*Carcharhinus longimanus*), porbeagle shark (*Lamna nasus*) and blue shark (*Prionace glauca*) occur in nearby waters of these seamounts at certain seasons. Data were collected during twelve commercial fishing cruises performed by Brazilian longliners from 2004 to 2009. The twelve cruises together covered the area between the latitudes 23°S and 38°S. All months, except April and May are represented in the data. Fork length (FL) was measured as the distance between the tip of the snout and the fork of the tail, along a line parallel to the body axis, rounded down to the nearest centimeter below the actual length. Throughout the monitoring, whitetips were recorded only in summer at the VTR area. Ten whitetips were recorded, being all of them small juveniles, with FL from 70 to 86 cm. Porbeagles were found in spring at the RGR area. A total of 1217 porbeagles were recorded, being all of them small juveniles, too, with FL ranging from 69 to 111 cm. Blue sharks were always the most frequently species of fish in catches. Small juveniles were 6.7% of all blue sharks caught, and were found in winter at the continental slope of southern Brazil, and in spring at the RGR area, where they were most frequent. The occurrence of small juveniles of these oceanic species of sharks raises the question of whether these areas are oceanic nurseries, and therefore, the need for the establishment of international joint strategies for their conservation and management.

Keywords: blue shark, porbeagle shark, whitetip shark, small juveniles.

Citizen science and photo-identification of whitetip reef sharks (*Triaenodon obesus* Rüppell, 1837) in Gorgona Island National Natural Park, Colombian Pacific Ocean

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In Latin America, the support through of initiatives and projects which connect the biological conservation and the members of the society are highly relevant. With the objective to monitor the richness and distribution of elasmobranchs species in Colombia, the citizen science program PNAT (National Program of Sharks and Rays Sightings) has been implemented since 2003. To date, divers and researches submitted 396 photographs and 157 videos of whitetip reef sharks (*Triaenodon obesus*) in Gorgona Island. Using photo-identification techniques, 74 whitetip reef sharks individuals have been identified at 9 different diving locations around the island: 43 females (58.1%), 29 males (39.2%), and 2 unidentified. Furthermore, 21 individuals were present at least one re-sightings, and the longest period between re-sightings events was 10 years. 95.6% of the sightings correspond to adults well distributed around the island; however, the sightings of the juveniles are located at the east side over the coral reefs. The re-sightings occurred mostly at the same diving locations, which suggests a high philopatry in this area. The PNAT have received 510 sightings reports of *T. obesus* in all the months of the year. Therefore, the whitetip reef sharks have been listed as a resident species in Gorgona Island. Gravid females were present between July and January, which indicates that Gorgona Island is an important area for the reproduction and growth of whitetip reef shark populations. This long-term monitoring of *T. obesus* at Gorgona Island has been made possible through the citizen science project. In this respect, the constant support of the diving community is extremely important to further access information about this species in this area.

Keywords: philopatry, population structure, spatial and sex segregation.

Biological and ecological aspects of freshwater stingrays (Potamotrygonidae) in the area of influence of the municipality of Puerto Carreño (Vichada), Colombian Orinoco River Basin

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Surveys were conducted in the dry season from 2011 to 2016, to collect information on the composition, distribution and bioecological aspects of the stingrays in the Colombian Orinoco River Basin. 319 individuals were collected and four species of the genus *Potamotrygon* were recorded from the basin: Raya Tigrita (*Potamotrygon orbingnyi*), Raya Motora (*Potamotrygon motoro*), Guacamaya or Trébol Ray (*Potamotrygon schroederi*) and the Punta Diamante Ray (*Potamotrygon scobina*), as well as two new species assigned to this genus. In the case of the manta or apple ray (genus *Paratryon*), two new species were found identified here as *Paratrygon* sp1 and *Paratrygon* sp2, which are currently being described, and were previously referred to as a single species (*Paratrygon aiereba*). The most abundant species were *P. orbignyi* and *P. motoro*, found in all environments (main river, tributaries, floodplain) and water types (clear, black and white). *P. schroederi* and *Paratrygon* spp. were restricted to the main channel of the Orinoco River and larger tributaries of clear water and never penetrated the floodplain. Both species are found in both types of water (clear and white). Sizes larger than those previously reported for the basin in the literature were observed, with a female of *P. motoro* measuring 470 mm and 4.8 kg, as well as sexually-mature sizes smaller than those reported, with a mature female of only 209 mm. Also *P. schroederi* was observed with lower sizes at maturity, with mature females of 250 mm and 0.9 kg and a mature male of 34 cm and 2 kg. *Potamotrygon orbignyi* has continuous reproduction throughout the year. *P. motoro* and *P. schroederi* breed throughout the dry season and part of the first phase of the rainy season and rising water phase. Stingrays are mainly carnivorous, feeding a great variety of prey among which insects, shrimp and fish were found. Additionally, the consumption of earthworms (Haplatoxida) for *P.orbignyi* is reported for the first time. *Potamotrygon motoro* and *P. orbignyi* showed the greatest diversity in diet, probably related to the diversity of habitats they use to feed themselves. Progress has been made in generating information about this group, however, as more information is acquired, interesting results emerge, such as the capture of some rays of the genera *Potamotrygon* and *Paratrygon* that are not yet described, which confirm that the initial questions to be answered by this project, have not yet been answered in full.

Keywords: feeding, habitat, cartilaginous fishes, reproduction.

Vertical movements and temperature preference of the whale shark (*Rhincodon typus*) in the Galapagos Marine Reserve, through the use of SPOT satellite transmitters

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Whale shark *Rhincodon typus* has a wide range of distribution in temperate waters. This species can perform dives at more than 1000m and tolerate ambient temperatures between 5 and 30 °C. In order to determine the frequencies of occurrence in vertical and horizontal zones in this study analyzed the temperature and depth parameters recorded for 30 days in 17 sharks marked with satellite transmitters (SPOT) in The Galapagos Islands. A higher frequency of occurrence of individuals was obtained at depths between 5m and 15m and a higher temperature preference of 25 to 28 °C. The results show a line of tendency and behavior of the species towards these temperatures and depths during this period of time which could be related to the obtaining of food, reproduction or mating. This study is of great importance for conservation as it contributes to the knowledge of the behavior of this species inside and outside the Galapagos Marine Reserve allowing to establish long-term management measures.

Keywords: whale shark, spot, temperature, depth.

Biomass, connectivity and threats in remote islands: the case of the top predator *Carcharhinus galapagensis* in the Easter Island Ecoregion.

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Oceanic islands and seamounts usually gather high abundance of migratory species because they represent discrete habitats in a continuum of ocean water. These habitats usually are used as navigational reference points and feeding areas, facilitating the dispersion of migratory organisms and connecting populations among distant areas. Easter Island (EI) and Salas y Gomez Island (SG) are part of the Salas y Gómez Ridge. EI displays signs of historical overfishing with top predators becoming severely depleted. In contrast, top predator species account for about 40% of the fish biomass at SG. Nowadays, SG is part of the Motu Motiro Hiva Marine Park (MMHMP), a no-take area of 150.000 Km2; nonetheless, being in close proximity to MMHMP borders means that SG biodiversity is highly exposed to industrial fishing vessels. The Galapagos shark (*Carcharhinus galapagensis*) is a "near threatened" top predator that is abundant at SG and rare at EI. Little information currently exists on this species abundance, distribution and connectivity pattern around both islands. In order to determine abundance and distribution of the Galapagos shark around both islands, we used bated remote under water videos (BRUVS). Connec-tivity between the two islands was determined by tagging five juveniles with mini-PAT pop-up satellite tags near SG. In addition, tissue samples from 35 SG and 25 EI individuals were obtained for genetic analyses (SNP and mtDNA). Fishing pressure around both islands was assessed using Global Fishing Watch (GFW, www.globalfishingwatch.org). Our results showed high abundances of Galapagos sharks all around SG, and low abundance in a very restrict are of IE. Tagging analysis indicated high residency levels of juveniles around SG; however, all of then also travel far from the island and up to 90 km outside of the marine park. Genetic analyses are in progress; however, we expect to find higher migration trends from SG to EI, based on the latest knowledge about the direction of ocean currents and studies on other species of the area. GFW data showed a high occurrence of industrial vessel out-side the MMHMP boundaries. Our research findings will enable the determination of appropriate scales at which management strategies for this species should be implemented to prevent local extinctions of this species at EI and SG.

Keywords: Oceanic Island, migratory species, elasmobranchs, Motu Motiro Hiva Marine Park.

Vertical movements and residency of the scalloped hammerhead shark, *Sphyrna lewini* in San Benedicto and Roca Partida Islands, Mexican Pacific

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Scalloped hammerhead shark (SHS), *Sphyrna lewini* populations have declined globally due to overfishing and ecological changes, and are now considered an endangered species. Revillagigedo Archipelago (RA), represent an important habitat and a refuge for these marine predators. The aim of this study is to describe the residence index between climatic seasons and vertical movements of *S. lewini* in San Benedicto (SB) Island and Roca Partida (RP) Islet. A total of 23 hammerhead sharks were tagged externally with coded ultrasonic transmitters, 1 shark using satellite telemetry and a network of 13 acoustic receivers were installed around the RA islands at a depth of 20-40 m, which recorded time and date of detection of these tagged individuals. Data was analyzed using the Kruskal-Wallis one-way and Dunn a posteriori test to determine significant differences between sites and months. The residence index estimated the preference to know the amount of time spend at the sites between warm and cold seasons. Preliminary results (2013-2015) showed 58,145 acoustic detections from 11 SHS tagged, around SB Island without migrating to the other islands of the RA, which may indicate a high fidelity and aggregation site in the island. A high level of residence (73%) was obtained at 'Canyon' site southwest of SB, while in 'Cuevitas' only nine percent was obtained. More transmissions were recorded during the day phase (06-17 hrs.), indicating that SHS remains close to SB during this period and moving offshore to depth zone at night phase (18-05 hrs.) to feed. Seasonally, there was a decrease in the number of detections in April and May 2013, possibly related to the migration of females to the coast to give birth to their offspring. We recorded vertical movements of a SHS that was tracked with the satellite transmitter for 11 days in RP islet, and showed that it traveled a distance of 142 km from the point of tagged, indicated significant differences between the time spent at different depth ranges and the time of the day. Furthermore, evidence of interconnected movements between adjacent habitats is shown, SHS followed swimways from RP island and Bernoulli seamount possibly to maximize their feeding opportunities and as dispersion axes that use as a geographic reference for their migrations. The results of this research will provide important information about the movement patterns of SHS in order to recommend more efficient conservation and management measures for this species.

Keywords: *Sphyrna lewini*, Archipelago Revillagigedo, residence, patterns of movement, conservation.

A blank area on the map – Molecular identification and shark population dynamics: implications for conservation based on artisanal fishing on the coast of the Eastern Tropical Pacific.

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Trophic food webs from coastal ecosystems are highly affected by elevated fishing pressure, targeting a higher number of species in continental waters and being sharks and rays among the most disturbed and harvested species. The increasing demand for shark fins and meat in combination with by-catch captures has led shark populations all over the world to an alarming decline. The Eastern Tropical Pacific (ETP) represents an optimal opportunity to serve as a case study for shark conservation, carrying the potential for worldwide implications. However, fisheries data in coastal areas is scarce and nonspecific for elasmobranchs. Thus, the lack of information is still a key problem for the establishment of definitive conservation and management policies. The largest part of elasmobranchs landings from artisanal fisheries is juvenile sharks and captured sharks are landed decapitated, finless and ready to be processed. This, together with the lack of taxonomic knowledge from fisherman and fisheries control agents, make proper identification a challenging task. Therefore, the use of genetic tools for the identification of the shark species is crucial, due to the high observed abundance of juvenile sharks collected, the presence of cryptic species and important genetic population units that might probe essential for conservation and establishment of baselines for further shark research in the ETP. Here, we present barcoding results from the mitochondrial NADH2 gene used for the identification of 7 species from shark landings in the Northern Colombian Pacific region (ETP) during the years 2016-2017. Two species are listed under IUCN, *Sphyrna lewini* (30,5%) is considered Endangered, *Carcharhinus falciformis* (16,5%) is Vulnerable. *Mustelus lunulatus* (29,9%) and *M. henlei* (17,8%), despite being considered by the IUCN as Least Concern, are placed by the Colombian National red list assessment under regional vulnerable category due to the fishing pressure in the area. The results of this project will be the backbone for further research in the area aiming for understanding shark population dynamics, i.e. genetic diversity, connectivity between populations as well as the identification of nursery areas.

Keywords: ETP, shark identification, by-catch, conservation.

Age and growth of the Brazilian sharpnose shark *Rhizoprionodon lalandii* in southeastern Brazil

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The Brazilian sharpnose shark *Rhizoprionodon lalandii* is a small coastal shark distributed from Panama to Uruguay. In Brazilian waters it is an important resource in artisanal fisheries, remarkably in the Southeast coast, representing 60% of total shark landings. The science-based management requires understanding age and growth parameters of the species. The present study examined the life history of *R. lalandii* obtained from artisanal fisheries operating along the southeastern Brazil, between August 1996 and December 2003 and between May 2012 and April 2013. Vertebrae were collected and aged for 119 males and 119 females, ranging in total length (TL) from 17.5 to 70 cm and from 31.5 to 79 cm TL respectively. The edge analysis indicated a trend of annual banding deposition in the vertebrae. Maximum ages estimated for males and females were 4 and 8 years respectively. Four growth models were adjusted to the age and length data observed (three-parameter von Bertalanffy growth function: 3-VBGF, 2-VBGF using L_0 = 35 cm TL, Gompertz and Logistic). The Akaike's information criterion indicated that the 3-VBGF provided the best fit and the derived parameters are $L\infty$ = 66.16 cm (64.04; 68.95 CI), k = 1.16 y^{-1} (0.79; 1.75 CI), t_0 = -0.805 (-1.142; -0.548 CI) for males and $L\infty$ = 75.18 cm (72.16; 79.21 CI), k = 0.60 y^{-1} (0.41; 0.87 CI), t_0 = -1.378 (-1.910; -0.974 CI) for females. The $L\infty$ values for both sexes were smaller than the largest specimens in the sample possibly due to low sampling of adults. The estimated value for growth coefficients (k) was one of the highest of the literature, indicating that *R. lalandii* exhibits rapid growth, a common characteristic to the species of the genus. This value was higher than those estimated for *R. lalandii* in the equatorial coast of Brazil (k = 0.3) and closer to estimates obtained for Rhizoprionodon species (*R. taylori*, k = 1.34 - 1.01 and *R. acutus*, k = 0.94 – 0.63) in high latitudes from tropical areas of the Australia.

Keywords: vertebrae, longevity, growth parameters, life history.

The currently known interactions between elasmobranchs and plastic debris and efficiency of a digestion protocol of stingray *Gymnura altavela* stomach contents at Guanabara Bay, Rio de Janeiro, Brazil.

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Plastic materials are used worldwide since World War II, with their production growing exponentially since the 50s. Plastic polymers are extremely pollutant materials which leads to concern regarding the conservation of species and marine ecosystems. Elasmobranchs are often a neglected group when it comes to interactions between plastics, and the attention given to this group is lower than that given to other groups such as marine mammals, birds, turtles and teleostei fishes. This study has the main objective to investigate the currently known interactions between plastic materials and elasmobranchs, and to evaluate these interactions by testing a digestion method to isolate microplastics from stomach contents of the spiny butterfly ray, *Gymnura altavela*, at the Guanabara Bay estuary, Rio de Janeiro, Brazil, known as highly polluted. A scientometric analysis was conducted to collect the published data on these interactions at the Web of Science, Scopus (Elsevier) and Scielo scientific databases, between February 19th and 21th of 2018. The terms "Elasmobranch* OR Shark OR Stingray OR Chondrichthyes" were used in the search, and the results were refined using the words "Plastic OR Debris". To identify plastic interactions in *G. altavela*, stomachs were removed, dissected and dried in order to preserve stomach contents. The obtained contents were then submitted to a digestion process using NaClO and HNO3 to eliminate organic matter and leave only undigested plastic content, following the protocol developed by Collard. The digested contents were filtered through 0.45 µm cellulose acetate membranes and visually examined, comparing contents before and after the acid digestion. The review resulted in 21 articles, indicating ingestion and entanglement interactions in 21 shark species and 2 stingray species, with a high concentration of studies carried out in the Mediterranean Sea, and pointing out the need for further studies related to plastic debris interactions in elasmobranchs. The preliminary results of the NaClO digestion protocol did not lead to adequate results, as they were not totally efficient, resulting in non-digested particles obstructing the cellulose acetate membranes. Subsequent analyses will be performed testing KOH, which is known to be very efficient regarding acid digestion, following the protocol developed by Foekema.

Keywords: microplastics, ingestion, entanglement, marine pollution, plastic particles.

Improving the efficiency of back-calculation in elasmobranch age and growth studies

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Back-calculation techniques are used as a proxy for chronological observations of size-at-age for individual fish. For almost a century, back calculation techniques have been used to generate life histories for fish and compensate for the lack of juveniles in a sample. The application of back-calculation techniques to each vertebrae or otolith can be a tedious process. To date, all the studies that have incorporated back-calculation techniques have assumed that all the individuals in a sample are required to be back-calculated to produce biologically relevant parameters, and no study has investigated the minimum required number of samples for back-calculation. Datasets of six species of shark - blue (*Prionace glauca*), oceanic whitetip (*Carcharhinus longimanus*), silky (*C. falciformis*), whitecheek (*C. coatesi*), big eyed thresher (*Alopias superciliosus*), and pelagic thresher (*A. pelagicus*) - were used to investigate the number of individuals required to be back-calculated from the sample to produce biologically realistic growth estimates. Each individual from the back-calculated dataset were fit to a multi-model approach, incorporating Akaike's Information Criterion and three candidate models i.e. von Bertalanffy, Logistic and Gompertz growth functions. This was repeated 100 times, each time randomly selecting individuals to add to the dataset and producing model parameters for each iteration and each additional data point. A planned comparisons one-way ANOVA and Fisher LSD post hoc test were performed to compare the asymptotic length ($L\infty$), length at birth (L_0) and growth coefficient (k, gLog, gGom) model parameter estimates generated for increasing number of data points to the estimates generated from all individuals in the sample. Results for blue shark revealed that sample sizes from 10 (Logistic) to 50 (VBGF) provided estimates that did not significantly differ from the full data set, depending on the growth function used. Analysis for the other species will also be presented. Results from this study will help optimizing back-calculation efforts for elasmobranch life history studies.

Keywords: fisheries, pelagic sharks, life history, Papua New Guinea.

The scaling of area use in sharks and rays

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Movement is a key aspect of marine vertebrate behavior and important information for the effective management of species. Over the past few decades movement in sharks and rays has received increasing attention as tracking technologies have evolved, from mark-recapture to acoustic telemetry and satellite tags. While we have increased our knowledge of the degree of movement in many species, and have gained more knowledge about key aspects of area use – such as home range size, dispersal distance, and migratory behavior – a key next step is to develop a mechanistic understanding of what drives variation in an individual's patterns of area use. Patterns of area use, specifically home range size, are strongly determined by energy availability in relation to an individual's metabolic requirements. To develop a mechanistic understanding we will need to identify and investigate the strength of intrinsic biological characteristics (e.g. body size, breeding biology, metabolic rate) and ecological covariates (e.g. habitat type, ecological lifestyle, trophic ecology). Here we derive the scaling of shark and ray movements, including daily home range size and dispersal distances, and examine them in relation to morphology, ecology, and life history. We explain the variation in home range and movement attributes from 76 species from the IMOS database and from published studies.

Keywords: home range, dispersal, telemetry.

Angelshark monitoring in the Canary Islands: Acoustic telemetry, photo -identification, and genetic– and trophic assessment

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Recently, there are growing concerns about the conservation status of the angelshark *Squatina squatina* in the Canary Islands, which is presumed to be the last stronghold of a once very broad distribution. Implementation of an effective species management highly depends on the understanding and monitoring of its biology and ecology. In the absence of reliable historic data, this requires long-term in-situ research, creating datasets that can reveal scientific base knowledge and population shifts. For these purposes our study uses an integrated approach combining visual census, photo-identification, acoustic telemetry, and genetic –and trophic assessment. Visual census and photo-identification, with minimum research impact, are used to describe the activities, behavior, population structure, habitat use, growth and longevity of the sharks, as well as to identify critical habitats and potential threats. Field work and tissue sampling is gradually extending over the complete archipelago to address the inter-island genetic connectivity of the seven main islands from the Canarian Archipelago. To better understand the patterns that drive habitat selection, residency and movements, a pilot study using an acoustic receiver network is implemented in one of the detected critical areas. Genetic (ongoing) and isotopic assessment of the tissue samples, and quantification of changes in population metrics will further help to inform species management and future changes in it. These outcomes will also be used to inform citizens and stakeholders about the sharks' behavior, focusing the use of best practices with the aim to reduce possible impacts to *S. squatina* populations in the Canary Islands.

Keywords: Angelote, *Squatina squatina*, long-term monitoring, critical habitats, connectivity.

Habitat use and connectivity of *Hypanus americanus* in San Andres island, Colombian Caribbean, and their relationships with the touristic activity

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Hypanus americanus is a species of tourist interest in the Island of San Andres, Colombian Caribbean, specifically in the area known as "The Aquarium", where the stingrays are fed, manipulated and sighted. In order to study the movements of *H. americanus* individuals around this area and its connectivity with other areas of San Andres Island, 9 VR2W acoustic receivers (R) were installed and 22 individuals (17 females and 5 males) were ventrally tagged with V13 acoustic tags. Between November 2014 and November 2015, 655,786 detections were registered. The residence analysis indicated that the greater permanence of the stingrays occurred in the area where the tourist activity is carried out (R2) and in a very shallow channel located between two cays (R6) 600 m away from R2. The males presented greater residence in the deep zone of R2, while most of females presented greater residence in R6. The zones bordering the navigation channel (R1 and R3) and the mangrove zones (R4 and R5) were considered as passing or short stay of the animals. The absence of records of individuals tagged in the Aquarium in 3 receivers far from R2 suggests preliminarily that this population group does not move to other sectors of the Island. The diel analysis of the number of detections in each receiver indicated that R1, R3, R4, R5 are visited mainly during the day, R2 in the evenings and R6 at night. This pattern was corroborated with the analysis of variance, finding significant differences in the number of detections among four-day periods in 5 of the 9 receivers (except in R1, R7, R8 and R9). The largest residence in the Aquarium (R2) in the afternoon hours and between the Keys (R6) at night, suggests that the habitat use of the species is directly related to the tourist and feeding activity developed in this zone of the Island, and with the displacement to a safer area for the survival of the individuals, respectively.

Keywords: stingrays, habitat use, acoustic telemetry, Seaflower.

Understanding what we cannot see: a genetic approach to the mating system of the southern lanternshark, *Etmopterus granulosus*

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A variety of mating strategies are utilized by different individuals with the ultimate goal of increasing fitness while minimizing the costs associated with mating. Observations are useful to categorize mating behavior, however, observations may not always provide an accurate depiction of a mating system (e.g. socially mogonamous, but sexually promiscuous species). The use of genetic techniques is therefore necessary to help elucidate what cannot be observed and allows for behavioral inferences, especially when compared to other life history characteristics. The Southern Lanternshark, *Etmopterus granulosus*, is a deep-sea shark commonly found throughout the southern oceans, is frequently caught as bycatch in deep-sea Orange Roughy (*Hoplostethus atlanticus*) and Alfonsino (*Beryx decadactylus*) fisheries, but has little known about its life history and reproductive biology despite its common occurrence. With the goal of better understanding the mating system of *E. granulosus*, this study used paternity analysis in conjunction with other reproductive and biological factors as a proxy for mating behavior. Eighteen litters were opportunistically collected as bycatch along the Madagascar Ridge, Walter's Shoal, and Southern Indian Ocean Ridge. Ten novel microsatellite markers were used to test for presence and frequency of multiple paternity. Multiple paternity was found in 33% of litters. No clear relationships between litter size and polyandry as they relate to female size was found. Lower than expected frequency of heterozygosity and observed internal relatedness could be indicators of mating behavior or fishing pressure. Baseline information on reproductive and population genetics may be useful for future monitoring of this bycaught species.

Keywords: deep-sea, multiple paternity, bycatch.

Telomere length as a metric for longevity? Preliminary results from *Etmopterus granulosus*

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Age and growth studies of elasmobranchs have tried various techniques to enhance band pair visualization, while limited by available ageing structures. Though several studies successfully found treatments to process centra and spines for better band visibility, few have verified and validated band deposition. Evaluations of elasmobranch age are thus estimates, based on the best available data. Additionally, ageing studies focus on discrete counts in years for age, while longevity is a more functionally based measurement of organismal age. Therefore, in an attempt to seek alternative methods to determine age and longevity estimates, this study investigated telomere length in a deep-sea shark *Etmopterus granulosus*, the Southern Lantern Shark. Telomeres were successfully amplified with a standard deutoerstome primer set. Analysis via qPCR demonstrated telomere length was longer in shark pups than adults, indicating shortening with ageing. If similar to other vertebrates, telomere dynamics could have important roles in understanding longevity and reproductive fitness. Further analysis is necessary to understand the potential role of genetic age and longevity in elasmobranch research.

Keywords: fisheries, ageing, qPCR.

Age and growth of *Urotrygon microphthalmum* from Brazil

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The *Urotrygon microphthalmum* occurs in shallow and coastal waters of the Tropical West Atlantic Ocean at depths up to about 50 m. It is small ray that reaches 30 cm in total length. Its occurrence was registered in Venezuela, Suriname, French Guiana and in Brazil there are records from Amapá to Pernambuco. The age and growth of *Urotrygon microphthalmum* were studied through specimens collected between March 2010 and March 2012 as by-catch of shrimp trawling off the coast of the state of Pernambuco, Brazil (08°11'43"S/ 034°54'13"W; 08°38'44"S/ 035°01'24"W). We took 5-6 vertebrae from 161 males (81.6 - 249.55 mm TL) and 186 females (86.15 and 298.1 mm TL). The vertebrae were processed to a cut with a thickness of approximately 0.3 mm. Two independent readings were performed and the index of average percent error (APE) was used to evaluate the accuracy and error between the readings. To evaluate the periodicity of ring formation, the marginal increment ratio (MIR) was used. Data were fitted to the von Bertalanffy model (VBGM). IAPE ranged from 0.71% to 4.33% in the vertebrae of specimens with 1 and 6 pairs of bands, respectively. When analyzing MIR, significant differences were observed between May and September, and between May and October (p = 0.0223 and p = 0.0187, respectively) indicating the formation of rings in May. There were significant differences in growth parameters (p = 0.009) between male and female. Males reached faster growth rate and shorter theoretical asymptotic length than females. The maturity age for males and females was 1.52 and 2.02 years, respectively, and the maximum age observed was 5.5 and 8.5 years, respectively.

Keywords: Elasmobranch, Myliobatiforms, batoids, longevity.

Movement ecology of the Soupfin Shark (*Galeorhinus galeus*) in the Eastern North Pacific

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The movement ecology of Soupfin Sharks (*Galeorhinus galeus*) was investigated off California, USA using a combination of conventional, acoustic, and satellite tagging. Thirty-three sharks (all mature females) were captured in shallow water (< 5 m) off La Jolla, California in June – November of 2013 – 2017. Each shark was surgically implanted with a Vemco V16 coded pinger and tagged with a spaghetti identification tag. Acoustic receivers off La Jolla detected these sharks sporadically over periods averaging 81 days (range: 1 – 214 days) post-tagging. Eight of these were also equipped with a Microwave Telemetry X-Tag with deployments averaging 84 days (range: 59 – 90 days). High resolution pressure data captured a sinusoidal diel vertical migration pattern between approximately 2 m (middle of night) and 10 m depth (middle of day) with maximum depths of 65.9 – 161.0 m. After leaving La Jolla in Autumn, two-thirds of these sharks were detected throughout the Northern Channel Islands; 2 of these were also detected in the San Francisco Bay area and another off Washington State. Only 8 sharks (24%) ever returned to La Jolla, after absences of 1 – 3 years. These findings, along with distant recaptures in Grays Harbor, Washington, USA (n = 1) and Bahía Sebastián Vizcaíno, Mexico (n = 3), suggest this species is highly mobile along the western coast of North America with weak interannual site fidelity; however, the Channel Islands are apparently important. The biology underlying these movements is considered along with the geography and seasonality of historical catch records.

Keywords: diel migration, site fidelity, sexual segregation, satellite tracking, acoustic telemetry.

Morphological variation in rostral teeth of the extinct sawfish *Atlanticopristis equatorialis* Pereira & Medeiros, 2008 (Batoidea) from the Cretaceous of northeastern Brazil

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Sclerorhynchid sawfishes (Batoidea) are part of a monophyletic extinct group that is well recorded in the Cretaceous. They had peculiar morphological features: the dorsal fins more caudally located, and the rostral teeth attached in a different way when compared to extant sawfishes. Sclerorhynchids and pristids are not phylogenetically closed related. They evolved independently but exhibit similar adaptative features, remarkably the sword shaped rostrum used for defense, hunting and sensory functions. In order to evaluate the intraspecific morphological variation of a Cretaceous sclerorhynchid, rostral teeth referred to *Atlanticopristis equatorialis* Pereira & Medeiros, 2008 were analysed and their morphological characters measured and compared. The specimens were collected in the Alcântara Formation (Cretaceous, Cenomanian), Alcântara, Maranhão, Northeastern Brazil. Twenty rostral teeth (complete or incomplete) were studied. Principal Component Analysis (PCA) revealed that the anteroposterior basal lenght of the peduncle is the most varying character (78,8% of the total variation). The crown of the rostral teeth exhibits multibarbed anterior and posterior margins (two - five barbs on each margin). In some specimens tiny protuberances close to the base might be considered a 6th vestigial barb. Extensive enameloid ribbing are seen on the dorsal and ventral surfaces of the crown; centralized ribs are parallel and confined to the more proximal portion of the crown, with peripheral ribs forming progressively wider angles in relation to the longitudinal axis of the tooth, resulting in a fan-like appearance. A variation from seven to 13 ribs have been observed. The variation seen in the peduncle is the less useful regarding taxonomic importance since it serves as a "root" to the teeth and many different patterns of rugose surfaces are able to be attached by ligaments. The variation of the crown features is more useful for taxonomic distinction. They exhibit a more discrete variation and may be related to the size, position and ontogeny. Thus, we consider all the material studied as consistently referable to just one species. This study may be useful to guide future comparisons of rostral teeth belonging to the genus *Atlanticopristis*, in the case of other species be found, since it defines the variation of rostral teeth into the species *A. equatorialis*.

Keywords: Chondrichthyes, Elasmobranch, Sclerorhynchidae, Alcântara Formation.

Differences in elasmobranch density and abundance in the Bay Islands of Honduras

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Populations of elasmobranchs are declining globally as a direct result of targeted overexploitation and/or fisheries bycatch, with few fine-resolution data available on populations and diversity in most tropical countries. In Honduras, the status of elasmobranchs and the role of marine protected areas (MPAs) and legislation on their protection is unknown, despite the declaration of a country-wide ban on shark fishing in 2011 and the significant ecological and economic value these species provide. The Bay Islands of Honduras vary in size, population and levels of protection and enforcement. Roatán is the largest island, followed by Guanaja and Utila. Although they all have designated no take zones only Roatán currently has an ongoing enforcement program. This study examined the status of elasmobranchs using two methods: Baited Remote Underwater Video (BRUV), and in water Distance Sampling (DS). Surveys were conducted in all islands at fixed stations from 2015-2017. Stations were randomly positioned at evenly-spaced locations throughout three habitat types, forereef, backreef, and lagoon, and within and outside MPAs. Data analyses included MaxN and frequency of occurrence for BRUVs, and population size and density estimates from DS data.

The results of the monitoring indicate that Guanaja, despite being the island with the least control and surveillance efforts, had the highest frequency of occurrence of elasmobranchs and the highest density of sharks of the three islands. Roatán presented the highest density of rays of the three islands, mainly within the Sandy Bay-West End Exclusive Zone. Our results suggest that Exclusive Zones have little impact on shark occurrence and abundance in the Bay Islands, as more sharks were observed at stations outside Exclusive Zones than within them. Additional monitoring on the Island Roatán, reveals low abundances on BRUVs (%FO<11) and diversity (5 elasmobranch species recorded) across all surveys, with the majority of records falling outside of the West End and Sandy Bay MPA no-take zones. Results have catalyzed the Government of Honduras, in partnership with protected area managers and fishers, to include both sharks and rays in the recently revised management plan and policies as priority species for management and conservation and adopt the monitoring methods used as standards for Honduras. Additionally the patrol program has expanded to the eastern side of the island of Roatán, were most elasmobranchs were sighted.

Keywords: Mesoamerican reef, baseline monitoring, BRUVs, shark, ray, Shark sanctuary.

Characterizing an Artisanal Elasmobranch Fishery in the Remote Miskito Cays of Honduras

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In 2011 Honduras declared its EEZ a Shark Sanctuary, prohibiting shark fishing and the commercialization of any derivatives. In 2016, the ban was partially repealed to allow captures and commercialization of sharks specifically captured in the Moskitia Region, the most remote and diverse region of the country and home to several indigenous groups. As a result, an artisanal longline and gillnet fishery has emerged in the Miskito Cays. Consequently, in 2016 a pilot study was conducted to characterize the fishery and quantify landings. Bycatch from gillnet fisheries was dominated by Atlantic guitarfish (*Pseudobatus lentiginosus*), which were used to bait nets and longlines to target larger, more lucrative elasmobranch species, including endangered hammerheads and other large-bodied Carcharhinids. A total of 9 species from 4 families were identified in the landings from the Moskitia region. Shark fisheries are focused during the first quarter of the year leading up to the Easter week, to satisfy local, national and regional demand for dried fish during Lent. This is an unregulated and unreported fishery, with limited information on landings, bycatch and volume of the species captured. Expansion of this pilot project will complement an ongoing fisheries-independent baseline study at multiple stations in the Miskito Cays, including known shark fishing sites. Laying the groundwork for long term community-based monitoring of elasmobranchs, this project will provide key insights into the status of elasmobranchs, their importance to local economies and their commercialization and trade flows both nationally and regionally.

Keywords: Honduras, artisanal fisheries, baseline monitoring, shark, ray.

Streak fish fauna in the estuarine region of the rivers sergipe and vaza barris (Brazil, Sergipe): biology and economical exploration

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The estuaries constitute important and complex ecosystems, functioning as areas of reproduction, development and feeding for many coast marine species. However, a great part of the estuaries occurs next to the cities in development, with great and fast urban expansion. This very paper had as its objective to characterize the streak fish fauna of the estuaries of the rivers Sergipe and Vaza Barris. In the field, the specimens were identified concerning the specie and the gender and all of them were measured related to total length and width of the disc (streak fishes) and weight. Five species were registered: *Pseudobatos percellens* (estuaries Sergipe and Vaza Barris), *Narcine bancrofti* (estuaries Sergipe and Vaza Barris), *Aetobatus narinari* (estuary Vaza Barris), *Hypanus guttatus* (estuaries Sergipe and Vaza Barris) and *Rhinoptera bonasus* (estuary Sergipe). Pregnant females of *Hypanus guttatus*, with disc width varying within 737 and 1077 mm, are captured in the estuary of the river Sergipe, by vessels that operate with longlines, having its meat commercialized in the local community. The species Narcine bancrofti and *Pseudobatos percellens*, are frequently captured, but they do not have commercial value. The species *Aetobatus narinari* and *Rhinoptera bonasus* were represented by an exemplar, each one. Despite the great biological importance of the estuarine regions for the elasmobranches, little is known of the species that attend these environments, and how they use, being recommended more complex studies, in order to evaluate the impact of the anthropic activity in these populations.

Keywords: estuaries, streak fish, marine fauna.

Note about tiger sharks (*Galeocerdo cuvier*) captured on the coast side of Sergipe, Brazil

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Registered in practically all the oceans, the tiger shark (*Galeocerdo cuvier*) is found mainly on the coast region, and occasionally in ocean zones or around islands. In Brazil, it occurs along all the coast side, being more frequent in the North and Northeast regions. This study had the objective to generate information on the biology of the species *Galeocerdo cuvier*, based in six individuals captured on the coast side of the state of Sergipe within the months from December 2005 to July 2006, by the vessel Maradona, in spots from 8 to 18 meters deep, utilizing longlines (05 exemplars) and gill net (01 exemplar). Among the specimens, five were juvenile females measuring from 1.70 to 3.20 meters long and an adult male measuring 3.40 meters long. Five of them were captured in July (winter). In the analysis of the stomach content, it was possible to identify an elasmobranch (*Hypanus guttatus*) and teleostians (familes Tetraodontidae and Fistulariidae). The tiger shark (*Galeocerdo cuvier*) is a species captured accidentally by the artisanal fleet of small scale (canoe) on the coast side of Sergipe, and researches about the biology, distribution and abundance of the species are recommended, focusing on the status of the threat of this species characterized as near threatened by the International Union for Conservation of Nature.

Key-words: *Galeocerdo*, biology, Northeast.

Trophic ecology of the blotched stingray, *Urotrygon chilensis* (Elasmobranchii: Myliobatiformes: *Urotrygonidae*), in three areas of the Mexican Pacific

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There is a current global consensus that to achieve a sustainable use of fisheries resources, management of every organism subject to exploitation is required rather than only those targeted directly by the fisheries. Further understanding the feeding habits of the species in the ecosystem as well as the predator–prey relationships and their trophic levels is crucial. Batoids occupy an important ecological niche as benthic predators in estuaries and bays. There is no directed fishery for the blotched stingray, *Urotrygon chilensis*, but it is commonly caught incidentally by trawl and bottom gillnets fisheries subsequently diminishing its population. Recently, artisanal fisheries in Mexico have become focused on batoid species due to the depletion of shark catches, although there are few studies on its biology and ecology. We analyzed the trophic ecology of the blotched stingray in two main areas from the Mexican Central Pacific to understand the species diet and detect possible differences throughout fishing areas using stomach content analysis, and the overlap in diets between areas and the trophic level at each area. We analyzed 423 specimens and found 15 prey groups. Representatives of the two crustacean higher taxa –Cladocera and Peracarida– were the most important food items in the north area, while the crustacean family Penaeidae was the most important in the south area, having no significant overlap between areas (Cλ = 0.33). The estimated trophic position for the blotched stingray was 3.51–3.56 in both areas, and according to the Levin's index, the range of the trophic niche breadth for the blotched stingray was 0.059 and 0.039, which indicates that it is a specialist predator that can adapt to different prey depending on which organisms are present in the ecosystem. It is necessary to continue with these types of studies for species inhabiting the area, in addition to monitoring fisheries landings, fishing effort, and variations in biotic and abiotic factors in the area over a long period. However, this study outlines an approach for reaching the ultimate goal of sustainable exploitation of marine resources on an ecosystem level.

Keywords: stomach content analysis, stable isotopes analysis, trophic position, small scale fisheries.

Reproductive aspects of the scalloped bonnethead shark, *Sphyrna corona*, in the Colombian Pacific coast

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Sphyrna corona is a commercial species captured in industrial and artisanal fishing operations in the Colombian Pacific coast. This species is categorized as Near Threatened by IUCN and has a Medium Importance in the National Plan of Action of Chondrichthyes, NPOA-Colombia. Nevertheless, reproductive aspects of this species have not been evaluated. In order to contribute with relevant information on life history of the species, we estimated reproductive parameters of females and males from 283 individuals, previously sexed, measured (Total length - LT, cm) and eviscerated. Each gonadal structure was measured, weighted and its maturity analyzed. Inner clasper length (LC, cm) was measured and its calcification degree was defined for males. Embryos were counted, sexed, weighed and measured. Size at birth and onset of maturity were established. Differences in size and weight between sexes were tested, as well as differences between right and left measurements of each reproductive structure. Median size at maturity (Lt50) was calculated for each sex considering all the structures together, and each reproductive structure independently. Females reached sizes and weights greater (119.5 cm LT, 0.94 kg, n = 156) than males (111.5 cm LT, 0.68 kg, n = 114). Females presented a simple functional ovary (right), while the left one was vestigial or absent. For males, only differences were found in the width of the left and right testes. Females and males reach maturity at 46.4% and 51.8% of the maximum LT. Lt50 was estimated at 56.9 cm for females, considering all gonadal structures, similar value to those obtained from the uterus, oviducal gland and ovary (57.4 cm LT). Lt50 in males was estimated at 57.6 cm with all structures, and was also similar to those obtained with the other structures. Preliminary analyses showed us that fertilization and beginning of pregnancy occurs in the first months of the year and births at the end of the year. Gestation period was estimated in 8 to 10 months, fecundity varied between 8 and 27 embryos per female, and size at birth was defined between 22 and 23 cm LT. The results of this study, the first for the species, indicate that *S. corona* presents intermediate life history characteristics in the continuum r-K.

Keywords: Sphyrnidae, size at maturity, size at birth, fecundity.

Angelshark Telemetry: Acoustic telemetry network for long-term angelshark monitoring in the Canary Islands

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The angelshark *Squatina squatina* is a common benthic elasmobranch from coastal waters off the Canary Islands that was a fisheries resource in this region until 2009. Yet, its conservation status remains unconfirmed and the information that can help in the evaluation of its population is incomplete. Certain critical areas for the species coincide with existing protecting frameworks, such as the marine Special Areas of Conservation (SACs) of the European Natura 2000 network. However, these do not have specific management plans in place and their effectiveness is yet to be addressed. To this end, the project ANGELSHARK TELEMETRY aims to better understand the role of the coastal areas and SACs in the Canary Islands in the life cycle of *S. squatina* and their conservation potential by employing acoustic telemetry. As a pilot study, a receiver array will be implemented in the SAC Costa de Sardina del Norte (northern area of the island Gran Canaria). The permanent monitoring of tagged individuals will provide new knowledge about their habitat use, and movement –and residence patterns. Methodology evaluation will guide future expansion of the array, and to implement it in other areas from the NATURA 2000 network and in other species. The divulgation activities of this project aim to raise citizen awareness about the presence and importance of *S. squatina* in the SAC. These research actions are complementary to others from ElasmoCan related to angelsharks in the Canary Islands as part of an integrated approach for their long-term monitoring.

Keywords: angelote, *Squatina squatina*, critical areas, special areas of conservation (SACs), NATURA 2000.

Hammerhead shark research: Knowledge from the populations in the Canary Islands

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Hammerhead shark research is a project that studies hammerhead sharks *Sphyrna* spp in the Canary Islands with the aim to contribute scientific base knowledge of these species in an understudied distribution. Knowledge of hammerhead sharks in this distribution is limited to the presence of the scalloped hammerhead shark *S. lewini* and the smooth hammerhead shark *S. zygaena*, isolated records about behavior, and scant sighting reports by citizens in social media. Research efforts focus on juveniles, using tagging and tissue sampling combined with biological and fisheries data collection. This made it possible to confirm the presence of juvenile *S. zygaena* in the islands of Gran Canaria and Lanzarote.

In addition, two individuals were provided with a tow archival tag (PSAT). Future use of satellite telemetry, including fin-mounted tags (SPOT), will be used to better understand the role of the coastal areas in the Canary Islands in the life cycle of these sharks and their potential for conservation. The professional and recreational fishing communities are actively involved in the study, and are together with citizens encouraged to report sightings of tagged and untagged individuals. Future data collection and subsequent analysis is required to document the first local knowledge that can help in effective decision making for the species.

Keywords: Cornudas, *Sphyrna zygaena*, Satellite telemetry, tagging.

The diversity and abundance of a benthic elasmobranch community in relation to management and habitat in a warm-temperate bay ecosystem

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Overfishing has reduced shark abundance globally, but to assess the ecosystem consequences of over-fishing, we need information on shark ecology and how shark populations respond to management. The abundance and distribution of sharks, rays, and skates are influenced by interactions between habitat, prey distribution and fisheries management techniques, such as marine protected areas (MPAs). Walker Bay is a warm-temperate ecosystem in the Western Cape, South Africa with a history of heavy line fishing, but it now has diverse management paradigms in place to protect its diversity of habitats and species. Walker Bay's sandy bottom, rocky reefs, and kelp forests are home to a range of elasmobranch species, including catsharks (*Poroderma* spp.), shysharks (*Haploblepharus* spp.), sevengill sharks (*Notorynchus cepedianus*), and skates. A whale sanctuary limits boat traffic in parts of the bay from July to December each year. In addition, Mudge Point and Betty's Bay form nearby MPAs with moratoriums on boat-based fishing year-round. Baited remote underwater videos (BRUVs) were placed at 80 sites in Walker Bay (40 in the whale sanctuary, 40 outside) and at 56 sites in Betty's Bay to evaluate the regional distribution, diversity, and relative abundance of shark species in relation to habitat, depth, and management paradigm. Sharks, rays, and skates were widespread across habitats and management zones, but were most abundant in kelp habitats and within protected areas. Different habitat types showed distinct communities, with rays and skates preferring sandy habitat within the whale sanctuary and smaller catsharks preferring kelp habitat within MPAs. Batoids had seasonally higher abundance on sandy habitats within Walker Bay, with five species seen at approximately 50% of sites, compared to Betty's Bay, with only a few sighting each of two species. Sharks showed higher abundance within marine protected areas (seen at > 90% of all sites in Betty's Bay compare to <50% in Walker Bay), particularly in kelp. However, species richness did not vary greatly between sites, from 12 in the unrestricted zone to 15 within the MPA. The diversity and abundance of large sharks was low, potentially indicative of a historical loss of upper level predators. In contrast, the abundance of smaller mesopredatory sharks was higher. Overall, habitat is a more important driver of diversity and abundance than management across these small management areas, even for relatively sedentary, small, benthic elasmobranchs.

Keywords: BRUV, shyshark, catshark, sevengill shark, marine protected area.

SHARKS INTERNATIONAL

Analysis of the trophic ecology of rays and stingrays caught by trawling of pink shrimp in the Southern Brazil

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The knowledge of the feeding habit of a species contributes to the clarification of the trophic structure of a community, helping to understand its ecology. The rays and stingrays were obtained from trawl-dove-with-ports, directed to the pink shrimp that was landed in Guarujá, São Paulo, Brazil. Due to the large number of ray species registered in the Brazilian coast, the objective was to identify their food overlaps. Samples of 18 species from two vessels were collected from June 2012 to December 2016. A total of 356 exemplars were incidentally caught by fishing boats. The following species were identified: *Atlantoraja castelnaui* (77), *A. cyclophora* (119), *A. platana* (13), *Dasyatis hypostigma* (17), *Hypanus americanus* (four), *Pteroplatytrygon violacea* (three), *Rioraja agassizi* (79), *Sympterygia bonapartii* (one), *Myliobatis goodei* (one), *M. freminvilleii* (15), *Gymnura altavela* (four), *G. micrura* (three), *Pseudobatos percellens* (two), *P. horkelii* (nine), *Rhinoptera bonasus* (one), *Torpedo marmorata* (one), *Zapteryx brevirostris* (two), *Bathytoshia centroura* (five). Identification of stomach contents of the rays and stingrays and com-plementary bibliographic review were performed. A multivariate analysis was also performed with the Vegan package in the R Project software for the classification dendogram of the species similiarity, and the overlap calculation using the EcoSim package, where the closer to 0 is the result of the index, the greater is the food aggregation, and the greater is the number, the greater is the segregation. From 202 itens, four presented higher occurrence frequency, as follows: *Dactylopterus volitans*, present in eigth species (*A. castelnaui, A. cyclophora, A. platana, D. hypostigma, H. americanus, P. violacea, M. goodei* e *G. micrura*); specimens of the family Squillidae present in six species (*A. castelnaui, A. cyclophora, D. hypostigma, P. violacea, R. agassizi* e *S. bonaparteii*); exemplars of the family Penaeidae in five species (*A. castelnaui, A. cyclophora, D. hypostigma, Bathytoshia centroura*) and *Porichthys porosissimus*, presente in five species (*A. castelnaui, A. cyclophora, A. platana, D. hypostigma* e *R. agassizi*). Although some species share the same resource, the statistical analysis states that due to the great diversity of food there is no food overlap.

Keywords: elasmobranchii, foodweb, trophic ecology, stomach contents, South Atlantic.

Quantification of liver steatosis in Lesser-guitarfish, *Zapteryx brevirostris* submitted to different feeding cycles

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The Lesser guitarfish, *Zapteryx brevirostris* (Müller and Henle, 1841) is a benthic species that feeds mainly on crustaceans and polychaetes. In spite of the vast knowledge about feeding in the species, nothing is known about the physiopathological alterations upon mimicking starvation as occurs in its natural habitat. The objective of this study was to stereologically quantify the fat storage in the liver of animals submitted to different periods of restriction and refeeding. In a water recirculation system, 18 guitarfishes were divided into three groups: control (n=6), fed every day; W1 (n=6), with one week of restriction and two of refeeding and W2 (n=6), with two weeks of restriction and two of refeeding. A combination of 70% of frigate tuna (*Auxis thazard*) in cubes and 30% of headed Atlantic seabob shrimp (*Xiphopenaeus kroyeri*) was supplied once a day in the morning. After 76 days, the animals were euthanized by immersion in eugenol solution (168 mgL^{-1}). Liver samples were collected and prepared for further analysis. Data were evaluated using one-way ANOVA and post-hoc Tukey with a 95% confidence interval. The area occupied by fat in the liver of control group was 507.09 ± 536.06 μm 2, higher than that found in the groups with feeding restriction - W1 (340.39 ± 351.39 μm 2) and W2 (306.22 ± 282.96 μm 2) ($p < 0.001$). These results pointed to physiological adaptations during fasting periods, through the use of reserves stored in the liver. Similarly to teleost fish, there was a consumption of lipid reserves while enhancing the gluconeogenesis during fasting. This is the first report of liver steatosis in an elasmobranch and the results will serve as base for the improvement of feeding protocols, thus ensuring welfare and general health of animals held in captivity.

Keywords: elasmobranchs, water recirculation system, stereology, fasting.

Preliminary analysis of the reproductive parameters of bonnethead, *Sphyrna tiburo* (Linnaeus, 1758), in the southern Gulf of Mexico

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Bonnethead shark (*Sphyrna tiburo*) is distributed from North Carolina, E.U to southern Brazil, including the Gulf of Mexico (GoM) and the Caribbean Sea. In the south of the GoM this specie is exploited for commercial purposes, by the small-scale fleet, and ranks second place in terms of frequency of shark catch. The lack of information about their reproductive biology, as the strong exploitation rate in the region, make it necessary to generate information about their reproductive parameters, such as, the duration of sexual maturity, the length of the reproductive cycle, the rate of fertility and the sex ratio- by size groups. A total of 1,131 specimens of commercial shark catches were sampled at 10 landing ports in the States of Campeche and Tabasco during the period from November 1993 to December 1994. The sex ratio (H: M) was 1.4: 1 and of 1: 2.2 in embryos and adults, respectively. The total length interval (TL) in the males was 28.0 to 93.0 cm and in the females 28.0 to 121.0 cm. 67% of the commercial catches of *S. tiburo* corresponded to juvenile individuals. 353 of the females, 195 were adult, and 118 were pregnant, with a higher frequency in the months of June and July. For females, a length of maturity (L50%) of 86.2 cm LT was estimated. Fecundity varied from one to nineteen embryos (average = 9.5). Apparently the LT of first sexual maturity on the females of *S. tiburo* in the south of the GoM is different between the population of the north GoM and the western Atlantic of E.U. These differences in reproductive parameters are very important to understand the state of populations, and estimate their productivity and potential for resistance through the analysis of Productivity and Susceptibility and demographic models.

Keywords: reproduction, elasmobranchs, Sphyrnidae, fishery.

Bioaccumulation and biomagnification of trace elements in whale shark's tissue (*Rhincodon typus*) of the Gulf of California, Mexico.

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Anthropogenic activities and geological events increase the levels of potentially toxic trace elements (TE) such as mercury (Hg), cadmium (Cd), lead (Pb), arsenic (As), copper (Cu), zinc (Zn) and selenium (Se) in the aquatic environment. Marine organisms can absorb these elements by concentrating them in their tissues (bioaccumulation). Because of trophic position, top predators, such as sharks, tend to accumulate a greater amount of these TE throughout their lifetime (biomagnification). However, knowledge of bioaccumulation in filtering sharks is limited. For this work, the levels of Hg, Cd, Pb, As, Cu, Zn and Se were analyzed in 70 whale shark biopsies (*Rhincodon typus*) and in zooplankton collected in two feeding areas of the Gulf of California: Bahia de La Paz (LAP) and Bahia de Los Ángeles (BLA), Mexico in 2016 and 2017. In the biopsies (epidermis) from BLA, mean values of ng/g of dry weight (dw) of TE were found in the following quantities: Hg (67.35), Zn (2.14), Se (1.7), As (0.9), Cu (0.34), Pb (0.05) and Cd (0.03). In the biopsies from LAP, values of ng/g of dry weight (dw) of TE were found in the order: Hg (40.61), Zn (6.85), Se (2.81), Cu (2.75), As (1.8), Pb (0.14) and Cd (0.04). Hg, Zn, Se, As and Cu showed significant differences (p <0.05) between the study areas. Sex was not significant for any element, except Cd and Zn in LAP (p <0.05). Hg showed negative correlation with total length in males and positive correlation in females, which could indicate differences in the type of feeding. Molar relation between Hg and Se indicated that the levels of Se are not high enough to detoxicate mercury which could indicate, according with other studies on different sharks' species, that the epidermis is not the main tissue to store the Se. The mean values of TE in the mixed zooplankton from LAP (n=13) was: Zn (29.57), Hg (25.53), Se (11.21), Cu (3.78), As (2.13), Pb (1.03), Cd (0.74) ng / g (dw). Copepods (n=2) were identified as the main source of Pb and Cd, and Chaetognatha (n=3) as the main sources of Zn, Hg, As and Cu. Biomagnification has been detected in the animals from LAP through mixed zooplankton for Hg and Cu only. Future analisis of the zooplanckton from BLA will provide further comparisons between study areas.

Keywords: whale shark, zooplankton, ecotoxicology, trace elements, Gulf of California.

Natural history and taxonomy of the smooth butterfly ray (Myliobatiformes: Gymnuridae) reveals cryptic species in the Western North Atlantic

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Some of the most threatened and poorly understood chondrichthyan species worldwide include large-bodied batoids that are predominantly distributed in coastal regions, where increased vulnerability to intense fishing pressure and habitat degradation have been shown to impact the stability of populations that typically display conservative life-history characteristics. Further affecting the conservation of batoid populations is the misidentification of species based on morphological descriptions that do not account for sexual dimorphism and variations during ontogeny. Taxonomic re-evaluations and species-specific population assessments are therefore needed to improve our understanding of chondrichthyan biodiversity and to evaluate the stability of batoid populations. The smooth butterfly ray *Gymnura micrura* (Bloch & Schneider 1801) is a barbless, medium-sized batoid distributed throughout the Atlantic Ocean, where its conservation status remains largely unknown despite being commonly caught in demersal trawl fisheries as bycatch. Comparative biological, morphological and molecular analyses of preserved museum (n = 110) and freshly collected (n = 143) specimens revealed multiple species of *Gymnura* that are closely related to *G. micrura*: the recently named *G. lessae* (Yokota & de Carvalho 2017), and *G. micrura* in the Western North Atlantic, and *Gymnura* n. sp. in the Gulf. The present study highlights the need for accurate, species-specific information to assess and monitor batoid populations, and demonstrates the essential link between taxonomic research, fisheries science and improved understanding of the diversity of marine fauna.

Keywords: Batoidea, taxonomy, morphology, population genetics.

Embryonic development of the shortnose guitarfish, *Zapteryx brevirostris* (Müller & Henle, 1841) (Chondrichthyes, Trygonorrhinidae), from southeastern Brazil, western South Atlantic.

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The embryonic development of the guitarfish *Zapteryx brevirostris* was studied based on 378 embryos (between 14,5 to 141,3 mm TL), from 181 pregnant females (85 with uterine eggs and 96 with visible embryos) caught by bottom pair trawlers off the coast of São Paulo, Brazil, from September 2007 to August 2009. There was a slight relationship between the female TL with the size of offspring, but not with embryos TL. All embryos from the same female presented the same stage of development. The sex ratio of the embryos was not regarded significantly different from 1:1. Linear regression of the length-weight relationship showed no difference between sexes. All embryos removed from the same female had the same degree of development. The embryos were categorized into 10 stages of development considering the major morphological changes that occur during embryonic development. The seasonality of the sampled embryo presented certain asynchrony, mainly related to asynchrony in the species sexual cycle. Near-term embryos were collected in the summer of 2009. Of nine morphometric variables analyzed for relative growth of embryos, only 4 revealed differences between males and females, as follows: tail length, mouth width, length of pectoral fin and disc width. Females have higher growth rates than males.

Keywords: embryo, skate, morphology.

Reproductive biology of the shortnose guitarfish *Zapteryx brevirostris* (Müller & Henle, 1841) (Chondrichthyes, Trygonorrhinidae), from southeastern Brazil, western South Atlantic

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The reproductive biology of the guitarfish *Zapteryx brevirostris* was studied from 797 specimens caught by bottom pair trawlers off the coast of São Paulo, Brazil, between 10 and 50 m from September 2007 to August 2009. The sex ratio did not differ significantly for the total sample. There was no difference between the total length (LT) and total mass (MT) relationship for males and females. The mean ovarian fecundity was six oocytes (1-17) and the uterine fecundity ranged from 1 to 7 eggs or embryos. The LT50 of sexually mature specimens was 384 mm for males and 395 mm for females. Clasper growth was allometric and showed three distinct phases. 50% of males presented calcified claspers with 411,72mm LT. Larger females had slightly higher litter sizes and larger embryos; the size-at-birth was found between 140 and 160 mm LT. The hepatossomatic index showed little seasonal variation for females and lower values in winter for males; the gonadossomatic index showed higher values in autumn seasons for females and males. The species has asynchronicity in the sexual cycle, which probably lasts more than two years without superimposing the ovulation and pregnancy process. The parturition is estimated to occur in the summer season for the specie, in the São Paulo state coast.

Keywords: reproduction, skate, elasmobranchii.

Assessing patterns of introgressive hybridisation between *Carcharhinus galapagensis* and *Carcharhinus obscurus* in the east Pacific Region

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With a single documented case of hybridisation in cartilaginous fish to date, shark hybridisation remains poorly investigated. Small amounts of admixture have been previously detected between *Carcharhinus galapagensis* (Galapagos shark) and *Carcharhinus obscurus* (dusky shark), raising the hypothesis of ongoing hybridisation. We sampled a large number of individuals from areas both species co-occur, or contact zones, across the Pacific Ocean, and used a combination of mitochondrial and nuclear genome-wide markers to examine genetic admixture and introgression between the Galapagos and dusky sharks. Using empirical analytical approaches and simulations, we first developed a set of 1,873 highly informative and reliable SNPs for these two species to evaluate the degree of admixture between them. Overall, results indicate a high discriminatory power of nuclear SNPs ($F_{ST}=0.47$, $p<0.05$) between the two species, unlike mitochondrial DNA ($\Phi_{ST} = 0.00$ $p>0.05$), which failed to differentiate between the two species. We identified four hybrid individuals (~1%) and detected bi-directional introgression between *C. galapagensis* and *C. obscurus* in the Gulf of California along the east Pacific coast of the Americas. Importantly, four cases of misidentification were also detected between our target species and two other *Carcharhinus* species (*C. falciformis* and *C. brachyurus*), using the mitochondrial control region. Given the morphological similarities between these four species, we emphasize the importance of including a combination of mtDNA and genome-wide diagnostic markers to assess taxonomic identification, detect patterns of hybridisation, and better inform management and conservation of these sharks.

Keywords: genomics, hybrids, Galapagos sharks, Dusky sharks, East Pacific.

Movement patterns and social structure of reef manta rays (*Mobula alfredi*) in the Amirantes Island Group, Seychelles; implications for conservation.

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Telemetry can reveal both movement patterns and social linkages among individuals within groups of animals and provide critical insights into the effective design of marine conservation strategies. Here, we used acoustic telemetry to examine the movement patterns and potential social structure of reef manta rays (*Mobula alfredi*) in the remote Amirantes Island Group of Seychelles in the Western Indian Ocean. *M. alfredi* are known to aggregate in small groups (2 – 15 individuals) on coral reefs at this location, predictably visiting cleaning stations and feeding sites that are removed from the anthropogenic pressures associated with the populated Inner Islands located 150 km to the north-east. We externally tagged 25 *M. alfredi* with VEMCO V16 acoustic tags at D'Arros Island and retrieved location data from 70 VR2W receivers placed throughout the Amirantes Island Group for periods of up to 2 years. Movement patterns of *M. alfredi* were described at two spatial scales: at a large spatial scale around the reef and island chains of the Amirantes Island Group (10-100 km) and at a small spatial scale around the reef and lagoon areas of D'Arros Island and St Joseph Atoll (1 – 10 km). Tagged individuals travelled widely within the Amirantes Group and the majority of detections (59%) were recorded around D'Arros Island and St Joseph Atoll, highlighting the importance of these locations to the life history of *M. alfredi*. The repeated visitation – over 30,000 detections during this study - of *M. alfredi* to a known cleaning station to the north of D'Arros Island also facilitated the first analysis of social structure and leader-follower relationships in this species. Association rates among individuals were calculated using social network analysis techniques that considered both the sex and maturity status of each animal, before leader-follower relationships were investigated through examination of the timing of all detection events recorded at the cleaning station receiver.

Keywords: reef manta ray, acoustic telemetry, movement ecology, social networks, Seychelles.

Hot Brains: The Effect of Temperature on Brain Development in the Little Skate (*Leucoraja erinacea*)

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Cartilaginous fishes experience indeterminate growth, where both brain and body grow continually throughout their lives. This characteristic suggests that environmental conditions may impact overall development of the brain. Since neural growth has been linked with life history traits such as life span, reproductive output, mate selection, ability to avoid predators and find prey, changes in brain size and/or brain organization can have functional implications on the fitness consequences of environmental change in these species. The effects of increased rearing temperature were studied on brain development in the little skate (*Leucoraja erinacea*). Eggs cases were collected from a breeding stock of *L. erinacea* and placed into either ambient or 5° above ambient seawater conditions, and neonates were placed into a nursery tank at the same rearing temperature after hatching. To better understand how brain size and organization may be affected after exposure to increased temperatures, brains were imaged using magnetic resonance imaging (MRI) and brain region volumes were compared between the two treatment groups. Trends indicate differences in brain size between treatment groups, and are particularly localized to the telencephalon. Results from behavioral studies of neonate *L. erinacea* were combined with neuroanatomical data to study the possible connection between increased rearing temperature and behavioral abnormalities in these skates. Determining the effects of increased temperature on neural phenotype and behavior aids in understanding the consequences of environmental stressors on brain development in this species and will indicate how they may fare in a changing climate.

Keywords: brain evolution, comparative neuroanatomy, climate change, brain size, little skate.

Are oceanic manta rays exposed to the threat of plastic pollution?

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The oceanic manta rays, *Mobula birostris*, filter big volumes of water while feeding on zooplankton. Thus, they are potentially exposed to the growing threat of plastic pollution. Ingested plastics can leach adsorbed toxic pollutants and plastic additives (e.g. phthalates, used as indicators of plastic contamination in animal tissues) that are recognized as endocrine disruptors and toxic for many species. The oceanic manta ray populations of the Gulf of California have been drastically reduced in recent decades, making the Revillagigedo Archipelago and Banderas Bay its last refuge and aggregation areas in the Mexican Pacific Ocean. Samples have been collected from the sea surface using a manta net: floating plastics were found in both areas, we determined the size and polymer composition of the plastic debris through Fourier transform infrared spectroscopy (FT-IR). Small tissue samples (skin and muscle biopsies) of manta rays have been collected during scuba and freediving using a spear pole and will undergo chemical extraction and subsequent analysis to measure the concentration of phthalates. Chemical analysis of these plastics collected in the area has been carried on to quantify polychlorinated biphenyls, pesticides and polycyclic aromatic hydrocarbons that were adsorbed on the surface of plastic debris. Measuring phthalates in manta ray biopsies is a valid non-lethal method to investigate possible plastic ingestion occurrence in this species, that is considered vulnerable to extinction by IUCN and protected in Mexico. This research is a baseline study for plastic debris contamination in the area and for possible ingestion by oceanic manta rays.

Keywords: *M. birostris,* plastic pollution, Mexican Pacific Ocean, phthalates, non-lethal.

Use of satellite telemetry to depict migratory corridors for sharks and other pelagic species in the Eastern Tropical Pacific Ocean

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Spatial management through the implementation of marine protected areas is one strategy to limit the extraction and rebuilt the populations of sensitive marine species. With the creation of Marine Protected Areas (MPA), such as the Galapagos Marine Reserve (Ecuador), Isla del Coco National Park (Costa Rica), Malpelo Flora and Fauna Sanctuary (Colombia) and Coiba National Park (Panamá), functionality and ecological diversity of oceanic benthic ecosystems in the Eastern Tropical Pacific (ETP) has been largely preserved. However, a marked population decline of highly migratory species has been detected, such as sharks and sea turtles, that move between the territorial seas of the region. This transboundary mobility hinders the conservation efforts of highly sensitive migratory species when traversing non-MPA waters, even at moderate levels of fishing. To understand the spatial extent of sharks and other pelagic species distribution in the ETP, we assessed the habitat utilization distribution of 15 species tagged across the ETP. Up to 375 individuals have been tagged with argos- and geolocation-based satellite tags in seven continental and oceanic MPAs of the region. Our main findings show that while some sharks and tortoises are resident in MPAs for much of the year, others make long distance movements outside the protected waters and to other MPAs. The utilization distribution area overlay provides evidence of migratory corridors, or swimways, particularly between Coco and Galapagos, and Coiba and Malpelo. Habitat preferences of this species movements suggests an interesting association with seamounts, particularly between the Coco and Galapagos Swimway. While progress has been made towards protecting sharks within the MPAs, our results highlight the need for innovative, transboundary solutions to the conservation of these wide-ranging species in the ETP.

Keywords: marine protected areas, migrations, sharks, home range, marine corridor.

Quantification of THg in the Brazilian Whitetail dogfish, *Squalus albicaudus* (Squaliformes, Squalidae): the need to incorporate ecotoxicological aspects into conservation measures

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Since the 1980s, a significant increase in the exploitation of elasmobranchs has occurred. However, the preparation of management and conservation plans for this group has been challenging, since the complexity of their life cycles makes general plans impossible. Endangered species lists are used as a basis for the development of protective measures. However, these classifications are based largely on biological and ecological criteria, not adequately considering aspects that may influence the degree of threat, such as ecotoxicological parameters. Thus, this study aims to quantify the presence of mercury (THg) in Brazilian Whitetail dogfish *Squalus albicaudus* tissues captured in Rio de Janeiro, southeastern Brazil. This recently described species is a small demersal shark, occurring in waters from 100 to 300 meters in depth. It presents lecitotrophic viviparity by yolk sac and is captured by both commercial and amateur fishing. The muscle tissue, livers and gonads of 32 male and female individuals and the muscle tissue of 34 embryos were analyzed. The specimens were obtained by amateur fishermen, 50 miles from the coast, and donated to the Fisheries Biology and Technology Laboratory, where they were identified, measured, dissected and analyzed at the Eduardo Penna Franca Radioisotope Laboratory. The samples were freeze-dried and subsequently digested with acid in a water bath at 60°C. THg concentrations were determined by atomic absorption spectrometry with cold vapor generator (FIMS 400). Muscle tissue displayed the highest THg concentrations, ranging from 2.01 to 10.13 mg/kg(dry weight)-[1]. The second-highest concentrations were determined in livers, ranging from 0.04 and 19.85 mg/kg(dry weight)-1, with 81.3% of the samples exhibiting THg concentrations below 1.75 mg/kg(dry weight)-[1]. The gonads presented the lowest concentrations, with an average of 0.36 mg kg-[1]. Embryos ranged from 0.04 to 1.05 mg/kg(dry weight)-[1] THg, reaching 10.95% of maternal muscle concentrations. These results are alarming since viviparous species are particularly sensitive to fishing pressure, and more worrying still when considering the pollutant loads that the embryos receive before birth, with effects on neonate survival. The synergy between fishing and contamination is a threat to elasmobranchs, increasing mortality rates without, in most cases, being considered in the elaboration of management plans. This study points to the need to incorporate ecotoxicological aspects into conservation measures of long-lived and carnivorous species, such as many elasmobranchs, even those that appear to suffer no risk of contamination by pollutants of anthropic origin.

Keywords: conservation, ecotoxicology, elasmobranchs.

First approach to establish hematological parameters of the freshwater stingray *Potamotrygon magdalenae* in a captive environment

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This study aimed to characterize and compare hematologic and blood chemistry parameters of adult males and females of *Potamotrygon magdalenae*, an endemic freshwater stingray species and with high ornamental and commercial interest in Colombia. Blood was collected by branchial puncture from 11 captive stingrays, previously measured (Disc width, Dw) and weighted. Haemogram (males = 4, females = 6) included: erythrocyte count, hematocrit, hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin, thrombocyte count and differential leukocyte count. This last one included counts and percentages of leukocytes, heterophils, eosinophils, lymphocytes and monocytes. Blood chemistry (males = 5, females = 6) included the quantification of urea, triglycerides, plasma proteins, serum protein, glucose and cholesterol. Differences in all parameters between sexes were evaluated by a Mann-Whitney U test. Females were larger (20.3±1.29 cm Dw) and heavier (533.3±75.28 g) than males (15.3±0.57 cm Dw; 276±0.57 g). No differences were found between sexes in the evaluated variables, except for lymphocytes count, which was higher in males (p=0.042). Males had lower hematocrit values and higher leukocytes counts than females; however, one female showed the highest value of leukocytes count (10.140 leuko/ml), represented in a high count and percentage of heterophils (7503 hetero/ml; 74%). The same female had the lowest values of lymphocytes (2535 lympho/ml; 25%). Two other females showed high thrombocytes counts when compared with all females evaluated (11725 and 11760 thrombo/ml). One male presented high values of leukocytes count (10.140 leuko/ml), represented in a high count and percentage of lymphocytes (10221 lympho/ml; 88%). The absence of differences due to sex in hematological and chemical variables of the blood is a previously reported characteristic for several Potamotrygonid species. Further analyses are required in order to establish if some results were due to individual stress or health problems. The results obtained in this study constitute the first approach for the establishment of blood baselines of *P. magdalenae*, and will allow to evaluate its health status in captivity. However, it is necessary to increase the number of samples taken in captive animals, as well as to perform these analyzes on wildlife animals, in order to establish the normal reference values of the species and identify alterations in the blood physiology.

Keywords: elasmobranch, batoids, physiology, haemogram, blood chemistry, leukocytes.

Approach to animal welfare as an assessment tool for elasmobranchs

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Animal welfare assessment, which involves physical, physiological and ethological aspects of animals, presents an interdisciplinary option to establish the degree of vulnerability of species in their wild or captive environment. Although it is a highly developed science in other biological groups, we present it as an innovative and interesting option for assessments of wild and captive populations of elasmobranchs. The SQUALUS Foundation and the National University of Colombia (UNAL) had developed research focused on incorporating this concept as a tool in the assessment of captive populations, using *Potamotrygon magdalenae* as research model. This is a species of freshwater stingray endemic to Colombia with high commercial interest as ornamental fish and whose habitat is threatened by natural and anthropic processes. The research carried out with this species has focused on understanding the processes of acclimatization and adaptation to captivity, as well as the influence of this type of environment on their welfare. At the physical aspect, the animals were monitored in order to identify injuries and diseases that they could suffer during the captivity. A specific life support system for freshwater stingrays was designed and evaluated. Growth was evaluated at different temperatures but no significant differences in growth rates were found under these conditions. Successful reproduction in this species was achieved in captivity for the first time in Colombia. Nevertheless, the evaluation of the reproductive performance allowed to identify great opportunities, challenges and difficulties in the newborn animals. Hematology was used as an indicator of physiological status in order to initiate the establishment of baselines for the species in captivity, which can be used for monitoring individuals traded or kept in aquariums. This is a first step to establish differences between animals in wildlife and in captivity and to understand how captivity processes can influence the physiological status of the individuals. Ethological aspects were evaluated using real time video technology in both ethogram description and preference tests for substrate type, food and shelter. Preliminary results showed higher activity rates in males, and both sexes tended to bury themselves in the sand and preferred to eat red worms followed by a diet of shrimp and fish. In conclusion, the experience acquired with the study of *P. magdalenae* under this multidisciplinary approach to animal welfare, highlights the importance of further exploration of the concept, as a useful tool for the assessment of elasmobranch populations in captivity and wildlife scenarios.

Keywords: Freshwater stingray, Potamotrygonidae, ethology, physiology, captivity.

Comparative geographic distribution predictions of four stingrays of the genus *Hypanus* (Rafinesque, 1818) (Myliobatiformes, Dasyatidae) at the Brazilian coast

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Stingrays of the species *Hypanus americanus*, *H. guttatus*, *H. marianae*, and *H. say* are distributed along the Atlantic coast of the American continent. In the Brazilian coast, these species had their conservation status recently evaluated and, with the exception of *H. guttatus* (low concern), all of them were classified as 'data deficient' and thus a priority for studies. To make a priori inferences about genetic population connectivity and raise hypotheses concerning suitable habitats for these specimens, we made ecological niche models for each species. Occurrence records and environmental variables were obtained from online databases and the model was developed through the MaxEnt methodology in R software. *H. americanus* and *H. say* presented the most significant breaks in their distributions, suggesting interruption of gene flow; *H. marianae* and *H. guttatus* have almost continuous distributions along the coast, with *H. marianae* restricted to the Northeast of Brazil and *H. guttatus* having suitable habitats in South, Central, and North America even though it is currently absent in the Atlantic coast of the United States. The distance to shore is a very relevant environmental variable for the occurrence of *Hypanus americanus*, *H. guttatus*, and *H. say*, meaning these specimens prefer the closeness to coast rather than open ocean; this variable is also important for the habitat preference of *H. marianae*, however, these specimens are driven mostly by high temperature and salinity waters. Both *H. americanus* and *H. say* are also very influenced by the bathymetry; therefore, these stingrays are commonly found in shallow areas near the coast with high water temperatures. Two other relevant environmental variables for the occurrence of *H. guttatus* are silicate and phytoplankton. Given that these animals feed mostly on polychaetes and bivalves that recycle silicate and depend on phytoplankton, we can infer that their distribution is directed by the food web in which they are inserted. Therefore, the habitat preferences of these four *Hypanus* Brazilian stingrays are similar, implicating in area and resource partitioning amongst them. It is of utmost importance to identify the environmental characteristics that drive their distribution to help the conservation management based on their suitable areas of occurrence.

Keywords: ecological niche modeling, disjunct areas, habitat suitability.

Systematics and biogeography of the stingrays of the genus *Hypanus* Rafinesque, 1818 (Myliobatiformes: Dasyatidae) based on mitochondrial genomes

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The previously known genus of stingrays *Dasyatis* was recently revised based both on morphological and molecular data. The genus *Hypanus* Rafinesque, 1818 was resurrected, encompassing eight valid species distributed both in the Atlantic and Pacific oceans; however, the relationships amongst them was still not very clear. We sequenced the whole mitochondrial genomes of specimens belonging to the eight valid species using the gene capture methodology and made a Bayesian Inference using fossils to calibrate the molecular clock to evaluate their times of divergence and possible ways of dispersion. Based on these results, we noticed a break into two geographic lineages of *Hypanus americanus* (Hildebrand & Schroeder, 1928): one in South and another in North America; and a similar pattern for *H. guttatus* (Bloch & Schneider, 1801), with one in Central and another in South America. The four aforementioned lineages are monophyletic clades with posterior probabilities of 1. The South-American lineage of *Hypanus americanus* (Hildebrand & Schroeder, 1928) is closely related to the African *H. rudis* (Günther, 1870), and this clade forms a monophyletic group with *H. longus* (Garman, 1880) from the Pacific coast of the American continent. Therefore, the North-American lineage, including its type-locality, of *H. americanus* is not closely related to the putative South-American conspecific, suggesting the existence of two distinct species. This western-eastern Atlantic relationship could be a consequence of the final closure of the Isthmus of Panama during the Pliocene (5 to 3 Myr), which caused drastic changes in Atlantic ocean currents' circulation. At the beginning of the oceanic reorganization, there was a high energy period with an enhancement of the Atlantic Equatorial Undercurrent from Northeast Brazil to the Gulf of Guinea, during which some specimens could have crossed the mid-Atlantic barrier and colonized Africa. An endemic species to Northeastern Brazil, *H. marianae* (Gomes, Rosa & Gadig, 2000), whose phylogenetic relationships within the genus were until now undetermined, is a sister-group to the monophyletic clade composed by *H. americanus* complex, *H. rudis*, and *H. longus*. Another observed biogeographic pattern is the existence of two pairs of trans-isthmic species: *H. longus* in the Pacific coast and *H. americanus* species complex in the Atlantic, as well as *H. dipterurus* (Jordan & Gilbert, 1880) in the Pacific and *H. say* (Lesueur, 1817) in the Atlantic. Oceanic geophysical changes are consistent with the divergence times of lineages within this group of stingrays.

Keywords: evolution, Atlantic Ocean, Isthmus of Panama.

The science, politics and policies behind fin trade bans in the United States

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The demand for shark fins is a major driver of global shark mortality and has fueled the wasteful practice of shark finning. Though finning was initially outlawed in the United States by congressional action in 2000 and then further strengthened in 2010, the U.S. continues to import fins from countries that do not provide similar, or any, protections to their shark populations. In order to begin to tackle this problem, 12 U.S. states and 3 U.S. territories have banned the trade of shark fins and the U.S. Congress is currently considering a nationwide trade ban. While this federal legislation has been met with both praise and criticism from the scientific community, it has garnered broad bipartisan support in Congress. This talk will provide an overview of the history of shark fin trade bans both domestically and abroad, and then in hopes of shedding light on the opaque nature of passing a bill through the U.S. Congress, it will discuss the scientific background behind current U.S. legislation, and insights into the political realities of attempting to pass natural resource legislation in the United States. The talk will also discuss the balance that must be found between the political, scientific, and economic factors necessary for crafting meaningful legislation with a realistic chance of becoming law.

Keywords: conservation, policy, legislation, fin ban.

Looking back for the future: utilizing historic rostra to further sawfish conservation

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Sawfishes are considered the most threatened family of all sharks and rays, having suffered globally from declines in range and abundance over the past century due to by-catch in fisheries, direct exploitation, and habitat degradation. As a result, 'viable' populations of each of the five species are now confined to a small portion of their former geographic range. Populations that have suffered from drastic declines, such as those experienced by sawfishes, are typically at risk of having reduced, or low, levels of genetic diversity. Levels of genetic diversity have been assessed for contemporary populations of each of the species The International Union for Conservation of Nature Red List of Threatened Species classifies as Critically Endangered: largetooth sawfish *Pristis pristis*, green sawfish *P. zijsron*, and smalltooth sawfish *P. pectinata*, using mtDNA sequence and microsatellite data. However, due to a lack of baseline data for comparison, it remains unknown whether the observed levels of genetic diversity in contemporary sawfish populations are reduced from those of historic populations. To assess whether there have been severe losses of genetic diversity in these species over the past century, we are generating comparable genetic data for historic sawfish populations via tissue samples collected from old rostra. To date, we have collected tissue samples from historic sawfish rostra for 150 *P. pristis*, 31 *P. zijsron*, and 179 *P. pectinata*. Genetic data generated from these samples are being used to quantify any loss of genetic diversity in each species and assess their true 'viability'. If the levels of genetic diversity in contemporary populations are severely reduced from those of historic populations, protecting remaining genetic diversity within and between viable populations should be a priority in conservation plans.

Keywords: population genetics, genetic diversity.

Relation between red muscle volume and buoyancy of several deep-water sharks.

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In opposite with fishes, sharks do not possess swim-bladder. Their buoyancy is provided by two features: (i) their liver which is large and rich in low-density oil (hydrostatic lift) (ii) the shape of their body and fins which provide a resistive force of water drag (hydrodynamic lift). Despite these, Shallow-water sharks have a negative buoyancy pulling away energy consumption to stay in the same depth. Recent studies suggest that deep-water sharks could be neutral and even positively buoyant. Indeed, results show a larger liver than shallow-water counterparts, richer in oil content with a higher level of low-density lipids (squalene and DAGE) and low level of high-density lipid (TAG). Bone suggested that the red fibers volume in sharks can be correlated to their buoyancy. Several authors have suggested that if the shark is close to neutral buoyancy, we would observe less red fibers as these would take action only in the hydrodynamic lift and not in the hydrostatic lift. Several deep-water sharks perform the circadian vertical migration and a neutral buoyancy could allow them to conserve energy in their oligotrophic environment. Here we investigated the buoyancy of three deep-sea species (*Etmopterus molleri*, *Etmopterus spinax*, *Isistius brasiliensis*) and one shallow water counterpart (*Galeus melastomus*). We used Raman and MIR spectrophotometry to quantify the lipid composition of their liver. We also collected lipid composition data of several other deep-water sharks from the literature and red muscles distribution and volume of ten species were measured to bring in the light the possible correlation between buoyancy and red muscles volume.

Keywords: buoyancy, deep-sea sharks, red muscles, liver, Raman/Mir spectrophotometry.

Shark Sightings: seasonal monitoring of elasmobranchs in Dutch coastal waters

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The Wadden Sea is a temperate, coastal intertidal area with a multitude of transitional habitats such as tidal channels, sandy shoals, sea-grass meadows, mussel beds, sandbars, mudflats and salt marshes. From fisheries surveys, and recreational and commercial catch data it is known that migratory shark species, such as starry smoothhound (*Mustelus asterias*) and tope (*Galeorhinus galeus*) occur seasonally in the Wadden Sea. However, virtually nothing is known about the utilization of Dutch coastal waters by sharks and the potential importance of the area in the life cycle of these species. Following increasing records of neonate and large female tope in brown shrimp fisheries, it is hypothesized that Northeast Atlantic tope utilize the outer deltas and tidal channels between the Wadden Sea and North Sea as a parturition and possible nursery area in the summer. A research project studying habitat utilization and spatial ecology of sharks in Dutch coastal waters of the North Sea and Wadden Sea was recently started. The main challenge is obtaining data, due to the scarcity and seasonal occurrence of the animals and the challenging physical properties of the intertidal area. The project involves close collaboration with fishermen to retrieve information from both commercial and recreational catches and to obtain shark samples from their bycatch, as well as exploring possibilities for a telemetry study. In addition, species assemblages will be monitored with the deployment of a Baited Remote Underwater Video (BRUV) system. The objective is to enhance understanding of the spatial distribution and migration of tope in the North Sea, and identify the role of Dutch coastal waters in the life history of migratory sharks. This presentation reports on trials testing BRUV design parameters, image analysis and practical experimental designs in a cold-water low visibility environment, as well as preliminary results from collaboration with fishermen.

Keywords: Tope, Habitat utilization, BRUV, Telemetry.

Saving sawfishes from extinction: a five-year strategy focusing on 'Beacons of Hope'

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The sawfishes (family Pristidae) are among the world's most threatened marine fishes. All five species of these shark-like rays are classified as Critically Endangered or Endangered on the IUCN Red List of Threatened Species based on severely depleted populations and drastically reduced extents of occurrence globally. Sawfish are threatened primarily by incidental mortality in artisanal and commercial fisheries as well as inshore habitat loss. Pursuant to a 2014 Global Strategy, the IUCN Species Survival Commission's Shark Specialist Group (SSG) has been reviewing sawfish conservation progress worldwide and revising priorities using a regional approach. In the southeastern USA and northern Australia, viable sawfish populations and sufficient habitat are relatively well protected through a variety of policies and programs. As such, these countries are serving as "lifeboats" for the species. The SSG has identified four priority regions that still harbour significant yet seriously under-protected sawfish populations; these regions represent "beacons of hope" for conservation success if urgent actions are taken: the Western Central Atlantic and Caribbean (including the Bahamas), the Amazon outflow region of the Western Atlantic off of northern Brazil, the Western Indian Ocean, and the Western Central Pacific around Melanesia (particularly Papua New Guinea). Although threats and levels of management capacity vary across these regions, each has the potential, through coordinated conservation strategies, to evolve into additional strongholds for sawfishes, and thereby enhance the chances for their continued persistence and recovery.

Keywords: sawfish, Pristidae, species conservation, threatened species.

Hybridization between a cryptic species pair, *Sphyrna lewini* and *Sphyrna gilberti*, in the western North Atlantic

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Scalloped hammerheads (*Sphyrna lewini*) and Carolina hammerheads (*S. gilberti*) are cryptic species sympatrically distributed in the Atlantic Ocean off the southeastern United States. Currently the only morphological character used to differentiate between the species is the number of precaudal vertebrae. Therefore, we developed a panel of 1,490 diagnostic, nuclear-encoded single nucleotide polymorphisms (SNPs) that are fixed between the species. Individuals identified as *S. lewini* in the field were sequenced, 288 were confirmed to be *S. lewini* and 49 identified as *S. gilberti*. Visual inspection of fifteen ambiguous individuals revealed some individuals heterozygous at nearly all diagnostic loci, indicative of first generation (F1) hybrids, and some individuals with approximately 75% alleles from one species 25% from the other species, indicative of backcrossing. A 1,000 base-pair fragment of the mitochondrial control region (mtCR) was then amplified for 13 putative F1 hybrids and 2 putative backcrosses. All 13 F1 hybrids had mtDNA haplotypes consistent with *S. gilberti*, indicating hybridization between female *S. gilberti* and male *S. lewini*. In both backcrossed individuals it appeared that male hybrids had mated with a female *S. lewini*.

Keywords: hybrid, hammerhead shark, Next Generation Sequencing.

Social facilitation of foraging behaviour in juvenile Port Jackson sharks

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Learning from the observation or interaction with another individual can be a shortcut for acquiring locally adaptive information. Social learning is taxonomically widespread, yet has only been investigated in two elasmobranch species. Considering their basal position in the vertebrate tree and wide range of life-history traits and ecological niches, social learning studies in elasmobranchs can provide important insights into the cognitive mechanisms of social learning as well as its evolutionary origins. In addition, social behaviours and social information transfer are known to play a vital role in the establishment of migratory and foraging routes in some fish species, and thus have implications for movement ecology and population dynamics. Here we investigated social information use and social learning in juveniles of a benthic shark species, the Port Jackson shark (*Heterodontus portusjacksoni*), and examined the relationship between intensity of training, personality traits, and laterality with social learning ability. Naïve 'observer' sharks could observe and interact with either (1) 'demonstrator' sharks, trained to gain access to food through one of two arbitrary routes, or (2) 'sham demonstrators', with no previous experience in the task. After 10 days of social exposure, observer sharks were tested in isolation. Observer sharks from the demonstrator group and the sham demonstrator group learnt the task faster than singletons, suggesting that social facilitation enhanced learning abilities in both group conditions. The two groups took approximately the same number of days to reach learning criterion, and only a small proportion of sharks performed well when tested without demonstration, suggesting some form of release from conformity to the demonstrator's behaviour. Sharks from the lower training intensity schedule took fewer trials to reach learning criterion, and females performed better than males. The quality of demonstration also influenced learning ability. Observers paired with 'poor' demonstrators were faster in responding to the task, perhaps because well-trained demonstrators were too fast to be followed. Personality and laterality traits were not linked to any task performance measurements. Our results suggest that Port Jackson sharks can use social information to learn a foraging route, but the frequency and quality of demonstration are important factors.

Keywords: social learning, cognition, conformity, animal personality, benthic sharks.

Capture stress in *Zapteryx brevirostris* (Muller and Henle, 1841) (Elasmobranchii, Trygonorrhinidae) males during the reproductive period: nutritional and reproductive consequences and conservation impacts.

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Zapteryx brevirostris, known as the lesser guitarfish, is endemic to the South Atlantic, occurring from southern Brazil to northern Argentina. The species exhibit great representability in the bycatch of artisanal fishing and it is currently classified as "vulnerable" by the International Union for Conservation of Nature (IUCN). Despite not having significant commercial value and being commonly landed alive, there are no management plans and/or regulation in force for the species. The present study aimed to evaluate the influence of the reproductive period (i.e., copulation phase) on the post-capture survival capacity of males through the evaluation of morphological and physiological parameters. The animals were purchased at the disposal of artisanal fishing in Matinhos (PR). Three experimental groups were established: (a) control (21 live males captured outside the reproductive period - LORP), (b) stressful condition 1 (four live males captured during the reproductive period - LIRP) and (c) stressful condition 2 (24 males landed already dead during the reproductive period - DIRP). Morphological impairment, Fulton's condition factor (K), triglycerides, stress markers (K+, P3+, Na+, Cl-, urea and lactate), osmolality of plasma and semen were analyzed to determine the impacts of capture. High post-capture mortality (89%) was observed during the copulation phase of the reproductive period compared to the high survival reported outside the reproductive period (100%). Additionally, morphological alterations were more common during the copulation period (e.g., intestinal eversion and flaring). Significant alterations were observed for triglycerides (p <0.001), Fulton's condition factor (K) (P <0.001), K+, P3+, Na+ (p <0.001) and lactate (p <0.001) when comparing dead individuals with live animals in- and outside the reproductive period, indicating metabolic and osmotic disturbances, as expected for lethal stress. There was also a significant difference between plasma and semen osmolality (p <0.001), with semen being hyposmotic to plasma, indicating seminal unalteration. Together, these results indicate a great influence of the reproductive period on the survival capacity of males, with high mortality rates, morphological alterations and metabolic and homeostatic imbalance facing capture stress. In this way, management plans based on compensatory release can be impaired during the reproductive period, indication the need for seasonal adaptation (e.g., prohibition of capture during the copulation phase – July to September in the area of study contemplated here), thus ensuring population recovery and consequently conservation of this endemic and threatened species, not only in the coast of Paraná, but in all its areas of occurrence.

Keywords: elasmobranch, batoids, conservation physiology, fishing physiology.

Challenges in monitoring and sanitary control of elasmobranchs decharacterized by on-board processing in artisanal fisheries of Southern Brazil

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In Brazil, regulations for elasmobranch fishing are scarce, besides insufficient monitoring and management. The first Ordinance on catch regulation for the group was released in 1998 (IBAMA No. 121/98). In 2012, the legislation was updated, prohibiting landing of animals without the fins attached to the body (I.N. MPA/MMA 14/2012). Despite the prohibition, such legislation provides legal support for evisceration and beheading before/prior to landing. Such practices become particularly problematic in two distinct scenarios: (1) fisheries management in a conservationist perspective and (2) sanitary management based on consumption. In a four-year survey conducted off the Paraná Coast, landings of eviscerated and beheaded elasmobranchs showed a significant increase, with landing peaks during holidays seasons (December to February). Among the species regularly caught by artisanal fishermen between 2014 and 2018, *Rhizoprionodon* spp. and *Pseudobatos* spp. were landed eviscerated and/or beheaded in 70% of the observations. *Squatina* spp. were landed eviscerated, beheaded and skinned in all observations. For *Rhinoptera* spp., the landing of processed animals was less frequent (~ 3%). According to fishermen, on-board processing occurs specifically when few animals are caught (personal communication). However, landing of processed animals was observed particularly when the catch volume was observed for larger catch or for protected species. For example, landings of large volumes of *Sphyrna spp.* were composed of processed individuals while smaller catches were processed only subsequently to landing. From a conservationist perspective, such legal practices lead to circumvention of other national regulations that protects species of which morphological identification is based on cephalic characters (e.g., hammerhead sharks and guitarfishes) (I.N. No. 5/2004; No. 53/2005 and MMA Ordinance No. 445). Thus, precluding proper report of illegal catches and clearly demonstrating gaps and failures in the current legislation. From a sanitary perspective, on-board processing increases susceptibility of meat contamination in addition to inadequate sanitary conditions and improper cooling, leading to safety/health hazards in term of consumption. Therefore, reassessment of the current legislation and sanitary practices is warranted (i.e., mandatory landing of the entire animal), thus contributing to the synergy between existing legislation, to ensure correct identification and monitoring of endangered species along with sanitary control and food security.

Keywords: artisanal fishing, elasmobranch, evisceration, beheading, endangered species.

Stress physiology and post-release survivorship of scalloped and great hammerhead sharks from US Atlantic waters

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The scalloped hammerhead (*Sphyrna lewini*), and the great hammerhead (*Sphyrna mokarran*) are large, coastal to semi-oceanic shark species common to waters of the U.S. east coast and are regularly taken in commercial and recreational fisheries, particularly the bottom longline fishery, in this region. High rates of hooking mortality and low rates of population growth are believed to have caused severe declines in the U.S. Atlantic populations of these species. The objective of this study was to determine the physiological stress induced by bottom longline capture in both *S. lewini* and *S. mokarran*, and to assess the post-release survivorship of *S. lewini* using survivorship pop-off archival satellite tags (PSAT-LIFE, Lotek Wireless Inc.). Physiological stress was quantified using the blood biochemical indicators pH, lactate, pCO2, bicarbonate, potassium, glucose, and hematocrit, which have been demonstrated to indicate physiological stress in elasmobranchs. Each shark captured was assigned a condition factor, which was compared with the stress parameters and time on hook to quantify stress induced by different longline capture durations. A subsample of *S. lewini* were also tagged with survivorship PSATLIFE tags, and a predictive model was developed to estimate the probability of survival as a function of hook time, shark condition, and blood chemistry. This model will allow for the prediction of total capture-induced mortality, including at boat (hooking) mortality and cryptic (post-release) mortality rates of *S. lewini*. To date eight PSATLIFE tags have been deployed and the results suggest 100% survival post release. The physiological stress parameters have also been found to scale negatively with time since hooking and condition factor in both species. These data will be useful for providing mortality estimates of *S. lewini* and *S. mokarran* in the Atlantic bottom longline fishery.

Keywords: scalloped hammerhead, great hammerhead, stress physiology, post-release survivorship, bottom longline.

Fatty acids as a tool for the study of trophic ecology and dietary reconstruction in two species of tropical Myliobatiformes (Myliobatoidei: Dasyatidae)

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Fatty acids (FA) is a natural biomarker used in studies of food ecology and for tracking trophic interactions. This work aimed to estimate the muscle tissue FA profile of *Hypanus americanus* and *Hypanus guttatus* to test its applicability as a tool for dietary reconstruction. Twelve stomachs with contents were assayed for *H. americanus* and 94 for *H. guttatus*. Muscle tissue samples of 10 stingrays obtained from five individuals of each species, were analyzed for their FA profile. The main item category on the diet of *H. americanus* was Teleostei (60.87%-IRI), Sipuncula (14.02%-IRI), Crustacea (12.89%-IRI), *Octopus vulgaris* (9.52%-IRI) and Bivalvia (2.69%-IRI). *H. guttatus* diet shows Crustacea (48.83%-IRI), Bivalvia (34.37%-IRI), Teleostei (13.10%-IIR), Polychaeta (0.87%-IIR) and Sipuncula (0.74%-IRI). Muscle tissue of *H. americanus* contained polyunsaturated FA primarily (ΣPUFA; 40.71±3.47%), mostly consisting of C20:4n6 (ARA; 12.58±2.13%) and C22:6n3 (DHA; 11.07±1.44). Saturated FA (ΣSFA) contributed with 33.76±0.91% dominated by C16:0 (18.90±0.76) and C18:0 (13.11±0.64). Monounsaturated FA (ΣMUFA) contributed 19.49±2.95%, most represented by C18:1n9 (8.97±1.81) and C18:1n7 (7.19±0.41). In *H. guttatus* FA profile PUFA was present in higher with 41.19±4.19%, mostly consisting of C22:6n3 (DHA; 20.78±3.54) and C20:4n6 (ARA; 8.04±0.46). SFA represented 38.11±2.57%, predominant by C16:0 (23.20±1.84) and C18:0 (14.31±1.71). MUFA contributed 15.63±1.37% of FA profile, mediated by C18:1n9 (9.19±1.00) and C18:1n7 (5.08±0.57). The individuals analyzed of *H. americana* were young-of-the-year to one year (DW: 41.5-45.2cm). The n3/n6 ratios (0.74±0.08%) can suggest malnutrition of the individuals, caused by stress of the transition from an endogenous diet (calf) to an exogenous diet (prey). In contrast, in *H. guttatus* samples just adults were present (DW: 48.5-56cm). The n3/n6 (1.81±0.31%) ratio reflects the individual ability to explore the feeding resources of the environment. *H. americanus* and *H. guttatus* presented significantly different FA profiles (ANOSIM: Global R=0.78, p<0.05), PCO and SIMPER showed that the FAs that most influenced this dissimilarity were: DHA (23.76%); ARA (11.08%); C16:0 (10.76%); C22:4n6 (9.14%) and 18:0iso (5.45%). The FA indicated by SIMPER as responsible for most of the dissimilarity between the analyzed profiles were FA that occurred in both species, however, in different concentrations. The highest concentrations of C16:0, C18:0, ARA and DHA in *H. americanus* and *H. guttatus* muscle tissue can be an indication of a diet based in crustaceans, teleost fishes and/or *Octopus* sp, corroborating the analyzes of stomach contents. Thus, FA analyzes have proved to be a useful tool for studying and reconstructing the diet of tropical elasmobranchs.

Keywords: trophic ecology, diet, *Dasyatis*, *Hypanus*.

Feeding ecology of three dasyatids (Myliobatoidei: Dasyatidae) on the coast of Northeast of Brazil: evidence for resource partitioning

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Hypanus guttatus, Hypanus marianae, and *Hypanus americanus* occur at Pernambuco coast. These species live in the same area but during different stages of their life cycle. This study aimed to verify the resource partitioning and dietary overlap of three dasyatids. The stomach content of 94 *H. guttatus* (WD: 15.10 to 75.00cm; mean=44.71±12.28cm),44 *H. marianae* (WD: 15 to 37.80cm; mean=26.53±4.82cm) and 12 *H. americanus* (WD: 41.5 to 86cm; mean=58.59±18.74cm), and stable isotopes data from muscle tissue obtained from five *H. guttatus* (WD: 32.6 to 51.5cm; mean=45.32±7.53cm), four *H. marianae* (WD: 23.2 to 27.8cm; mean=26.4±2.15cm) and five *H. americanus* (WD: 35.4 to 86cm; mean=58.36±24.50cm) were analysed. *H. guttatus* most important diet items were Bivalvia (34.37% IRI), *Alpheus* sp. (19.05% IIR) and Teleostei (12.96% IIR) from a total of 31 dietary items identified. *H. marianae* diet consisted on small crustaceans and polychaetes, of 17 items, Polychaeta (36.02% IRI), Dendrobranchiata shrimp (27.81% IRI) and Isopoda (8.79% IRI) were the most important. The diet of *H. americanus* showed Teleostei (60.87% of IRI), Sipuncula (14.02% of IRI) and *Octopus vulgaris* (9.52% of IRI) as most consumed from a total of 10 items identified. The species presented different dietary compositions (ANOSIM: Global R=0.2, p<0.05) and consequent low diet overlap (Schoener Index: *H. guttatus* and *H. marianae*=0.33; *H. guttatus* and *H. americanus*=0.40; *H. marianae* and *H. americanus*=0.25). Different prey were responsible for the similarity in the diet of each species according to SIMPER (*H. guttatus*: Bivalvia 32%; Upogebiidae 25.1%; Portunidae 16.01%; and Alpheidae 9.94%. *H. marianae*: Polychaeta 59.89% and Dendrobranchiata shrimp 29.59%. *H. americanus*: Teleósteo 89.66%). *H. guttatus* showed high variation for $\delta^{13}C$ (-16.39±1.71‰) and $\delta^{15}N$ (11.46±2.21‰). The results indicate the different habitat (estuarine and marine) use in stingray life cycle and with the species occurs in multiple trophic chains. *H. marianae* ($\delta^{13}C$=-14.76±1.41‰; $\delta^{15}N$=11.33±1.82‰) and *H. americanus* ($\delta^{13}C$=-14.31±0.86‰; $\delta^{15}N$=10.57±1.35‰) presented similar isotopic signatures, indicating that both can are inserted in the same trophic network, feeding on different preys that have the same 13C and 15N source. *H. marianae* is a species associated with coral reefs. *H americanus* can occur in a variety of marine habitats. The combination of partial segregation of the three species among different habitats and use of distinct food resources in the same environment can be a strategy to avoid interspecific competition, facilitating their co-occurrence at the Pernambuco coast.

Keywords: feeding, trophic ecology, *Dasyatis*, stable isotopes, diet overlap.

Characterization of La Paz Bay as a nursery area of the Pacific Sharpnose Shark (*Rhizoprionodon longurio*)

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Shark nursery areas are found in coastal zones where females give birth to their offspring. These areas are used as refuges for neonates and juvenile sharks and are characterized by an abundance of prey and protection against predators. The identification and characterization of these nursery areas is fundamental for designing management plans and conservation strategies for sharks in their most vulnerable stages. The aim of this study is to determine if La Paz Bay (LPB) is a nursery area for the Pacific sharpnose shark, *Rhizoprionodon longurio* by examining: (i) pupping times of the year, (ii) seasonality, (iii) trophic habitat (stable isotopes $d^{13}C$ and $d^{15}N$ in blood), and (v) movement patterns (active acoustic telemetry) of neonates and juvenile sharks. Sharks were captured with hook and line to take measurements, place conventional and acoustic tags, and to obtain blood biopsies. Two hundred and thirty seven (237) sharks were caught from March 2015 to March 2016, with a range of sizes of 35-84 cm total length (LT) for males (n = 114), and 38-86 cm LT for females (n = 123) and a sex ratio of 1:1 male:female. The estimated pupping season was May-June, which correlates with a lag of one to two months before LPB reaches the warmest temperatures. Warm waters benefit the development of embryos and accelerate the metabolism of neonates and juveniles. Stable isotope analyses showed that both females and males are feeding on the same prey and in the same areas with a very high trophic overlap. These sharks were tertiary consumers with an opportunistic diet breadth. Isotopic signals from neonates show that these are fed in more coastal areas. On the other hand, juveniles and adults feed on similar prey, however, adults have the widest trophic spectrum and with the most distant isotopic signals from the coast. The telemetry analysis shows that this shark moves randomly in the bay, moving greater distances and greater depths during the day. The southern part of LPB can be considered as a nursery area for the Pacific sharpnose shark because it meets the three criteria to determine a nursery area: 1) greater abundance of neonates and juveniles compared to studies done in other areas, 2) sharks are born in the LPB and remain there until they mature sexually, having a high fidelity to the area, and 3) the bay is used repeatedly during several years as a pupping, refuge, feeding area.

Keywords: nursery areas, *Rhizoprionodon longurio*, telemetry, stable isotopes, La Paz Bay.

Spatial distribution of cartilaginous fish captured with a horizontal longline in oceanic waters of the Colombian Caribbean in a depth of four isobars (40, 80, 250 Y 500 M)

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Ichthyofauna data was collected specifically from cartilaginous fishes (Elasmobranchii Subclass) from different environmental characterizations and offshore monitoring carried out between 2014 and 2017 for the Colombian Caribbean, ranging from the southern sector near the Gulf of Uraba to the northern sector in La Guajira, besides capturing them in different layers of depth (40, 80, 250 and 500 meters). We identified 137 specimens, belonging to four orders, six families, 12 species and a morphotype at family level, which were captured in 65 transects using horizontal lines as a sampling method. Of the total of species, eight are currently within the categories vulnerable and close to the threat, evidencing the urgency of studying this biological group. Studies for the Colombian Caribbean correspond to the coastal zone and depths of less than 100m, being these records of the few known towards the oceanic part. Low-frequency species such as *Carcharhinus obscurus* (dark shark) and *Prionace glauca* (blue shark) and two new records were recorded for the area: *Carcharhinus brachyurus* (copper shark) and *Centrophorus squamosus* (black scab) were captured. The main factors that influenced the distribution of the species are explained by the life history of each species (seasonality), the aggregation of fish at the moment of capture, abiotic factors such as temperature, salinity, nutrients and the randomness that the longline presents as a method of capture. For the entire Caribbean there is a strong need for protection due to the pressure exerted by anthropic factors such as fishing, a factor that threatens biodiversity.

Keywords: Elasmobranchii, offshore, Colombian Caribean, palangre.

Neonatal nutritional strategies of cownose rays: lipid metabolism and trophic interactions

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The present study investigated the nutritional strategy and trophic interactions in early-life of the cownose ray, *Rhinoptera bonasus* (histotrophic viviparous). Lipids, fatty acid profiles (FA) and stable isotopes (SIA) were analyzed in different tissues, as tools to evaluate biomarker changes during growth in young-of-the-year (YOY) rays, divided into two stages; YOY I (≤50 cm, n=32) and YOY II (50-70 cm, n=16). Plasma triglycerides did not differ between YOY I (145.5 ± 59.5 mg/dL) and YOY II (130.6 ± 63.3 mg/dL). Plasma cholesterol was higher in YOY I (98.9 ± 40.2 mg/dL) than in YOY II individuals (66.7 ± 30.5 mg/dL; p<0.01). FA profiles were similar in plasma and muscle, with a predominance of polyunsaturated FA (ΣPUFA, 40-61%), followed by saturated FA (ΣSFA, 28-37%) and monounsaturated FA (ΣMUFA, 10-20%). With increasing body size, there was a decrease in C22:6n3 (DHA, YOY I: 19.9 ± 4.0%; YOY II: 16.8 ± 2.3%, p<0.01) and C20:4n6 (ARA, YOY I: 7.8 ± 1.4%; YOY II: 6.0 ± 1.1%, p<0.01), and an increase in C20:5n3 (EPA, YOY I: 1.3 ± 0.4%; YOY II: 2.0 ± 0.4%, p<0.01) resulting in a decrease in DHA/EPA ratio in muscle (used as an indicator of trophic position). In terms of SIA, $\delta^{15}N$ values decreased with increasing body size with higher $\delta^{15}N$ values found in dorsal fin and red blood cells (RBC) of YOY I compared to YOY II animals (Fin: 11.4 ± 0.8‰; 10.7 ± 0.4‰, respectively and RBC: 10.8 ± 0.9‰; 10.3 ± 0.5‰, respectively; p<0.05). In YOY I and II, the $\delta^{13}C$ values of fin (-14.8 ± 0.6‰; -15.0 ± 0.7‰, respectively) were higher than RBC (-16.1 ± 0.6‰; -16.6 ± 0.5‰, respectively; p<0.01). These combined data demonstrate significant maternal investment in cownose rays, resulting in a positive nutritional state of young at birth. Importantly, the data suggest that pups did not show essential FA (EFA) deficiency, as observed in placental sharks. High values of DHA, ARA and cholesterol in YOY I animals, and a subsequent decrease in values with increasing body size, confirms the use of these substrates in metabolic processes. In addition, data indicate larger animals have improved foraging skills, demonstrated by increased plasma levels of EFA and a decrease of ΣSFA in YOY II rays. Such metabolic aspects linked to neonatal nutritional strategy are fundamental factors for understanding the patterns of maternal investment and energy resources required in the early life stages of viviparous elasmobranchs.

Keywords: *Rhinoptera bonasus*, fatty acid profile, stable isotopes, metabolites, maternal investment.

Plasma fatty acid composition of blacktip sharks: preliminary analysis with insights into their trophic ecology

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Fatty acids (FA) analysis has been established as non-lethal method to investigate aspects of animal metabolism, food web dynamics and predator-prey interactions. However, little is known about the composition and dynamics of plasma FA in sharks. In this preliminary study, we investigated plasma FA profiles in blacktip shark (*Carcharhinus limbatus*) and evaluated if and how FA profiles varied between sexes and over time, to understand nutritional aspects of this species. We analyzed 36 sharks (n=17 ♂; n=19 ♀) measuring 147.2 ± 24.5 cm total length - TL), captured in Biscayne National Park (BNP) and Everglades National Park (ENP), Florida, USA. Blacktip shark plasma present a higher percentage of polyunsaturated FA (ΣPUFA, 35.1 ± 4.4%), followed by saturated FA (ΣSFA, 28.3 ± 4.1%) and monounsaturated FA (ΣMUFA, 27.0 ± 5.5%). Dominant FA, in decreasing percentage order included C16:0 (18.3 ± 2.9%), C22:6n3 (DHA, 11.8 ± 2.7%), C18:1n9 (8.4 ± 3.8%), C20:4n6 (ARA, 8.3 ± 1.7%), C18:0 (7.2 ± 1.0%), C14:1 (7 ± 3.1%) and C17:0 (6.9 ± 2.1%). No significant difference were detected in FA profiles between males and females. Similarly, FA profiles did not differ between sharks sampled in year 2013 (n=16) and 2015 (n=18), indicating stability in patterns of resource use over time. The relatively high percentages of DHA and low values <0.3% found for C16:1n7/C16:0 (0.2 ± 0.15) are characteristic of marine food webs based on dinoflagellates. However, the n3/n6 ratio (1.3 ± 0.49) suggests a dependence on freshwater resources. Moreover, higher percentages of ARA suggest sharks are feeding on estuarine/coastal prey. Sharks from BNP exhibited higher values of ARA (8.8 ± 1.8%) than sharks from ENP (7.5 ± 1.4%; ANOVA, p = 0.03). The results showed still that sharks contained higher levels of bacterial markers (branched and odd-chain), including C17:0. Shark length and DHA were positively correlated, suggesting that as sharks increase in size they may have access to more marine resource or that they access higher trophic level prey. These preliminary results demonstrate the utility of using FA as tool for studying aspect of shark trophic ecology.

Keywords: ecophysiology, *Carcharhinus limbatus*, food web, biomarkers, non-lethal methods.

Description of egg capsules of *Sympterygia brevicaudata* from the Peruvian coasts, aspects about its embryonic development and observations about the captive breeding experience

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Sympterygia brevicaudata is a species of small skate that belongs to the family Arhynchobatidae and lives in shallow waters from Ecuador to the center of Chile. Little is known about their biology due to the limited information available, making it difficult to evaluate the species. The present study describes the egg capsules, aspects about their embryonic development and observations about the breeding experience in captivity of *S. brevicaudata*. 45 capsules were collected, from Arequipa, Lima and La Libertad between 2014 and 2017. According to the morphometric measurements (mean ± stand. dev.), the capsules reach a length of 42.7 ± 9.9 mm, a width of 33.1 ± 7 mm, an anterior edge length of 22.3 ± 5.8 mm and a posterior edge length of 23.4 ± 5.8 mm. The capsules are rectangular and have a brownish green colour. They have anterior horns that point towards the interior of the capsule, as do the posterior horns that point in the same direction with the presence of very long tendrils that end up joined by a small circle. They present 4 respiratory fissures in the form of grooves, two on each of the sides. We could establish and describe some stages of embryonic development using the embryos extracted from some of the capsules based on diagnostic characters such as yolk sac without the embryo, pharyngeal openings, branchial filaments, spines on the tail and pigmentation. The capsules hatch approximately 15 to 18 weeks after they have been expelled and placed in macroalgae forests. Individuals leave with the pectoral fins folded to the center of the body on the back side of the capsule, reaching sizes between 70 to 80 mm of total length, with a vestige of external yolk sac and little internal yolk sac. The individuals were kept in tanks with an average temperature of 17°C, a pH of 7 and a salinity of 35%, carrying out an inter-day replacement of 1/3 of the water in the tank, and were fed with *Emerita analoga*, from a smaller size to the diameter of the mouth of the individual.

Keywords: Short tail fans kate, ovigerous capsules, mermaid purse, development, Peru.

Testicles Morphology analysis of *Rhizoprionodon porosus* (Carcharhiniformes: Carcharhinidae) Captured on the Pernambuco Coast, Brazil

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The elasmobranch reproductive organs morphophysiology became better understood in the last years of the past century. However, little is known about the reproduction morphology of several species. This study aimed to determinate the *Rhizopriono-don porosus* ((Poey, 1861) captured on the coast of Pernambuco. The specimens were morphometrically characterized, where Total Length (CT) and Pre-Caudal length (PC) were measured in cm along with their weights (g). The animals were sorted and eviscerated; the testicles were obtained to determine their weight (g), length and width (cm). For the histological analyses, these organs were fixed in 10% formaldehyde for 48 hours. However, they were cleaved within the first 24 hours and then returned to the fixative solution. Afterward, the samples were transferred to 70% ethanol and later submitted to the processing protocol for histological analysis. The reproductive stage of each specimen was classified according to the macroscopic gonad description based on ICES (2013) reference. This species has the diametric type of testicles. The total of 8 males captured, one was immature, 3 in development, two capable of reproduce and 2 active stage. In the immature individual, the testicles width range was 0.8 to 1.0 cm, and flexible clasper was present. Histologically, type I spermatogonia and spermatocytes were present. For the specimens labeled as "in development," the testes were developed, although they did not fill the entire surface of the epigonal organ, the width ranged from 0.9 to 1.1cm. The clasper of these animals was partially calcified. A well defined germinative zone was observed, with spermatozoa spermatogonia, spermatocytes I and II and spermatids cysts present and disposal in diametric position. The capable of reproduce males had fully calcified claspers. The clasper length had already passed the pelvic fin. The developed and well-irrigated testis had variations of 1.2 to 1.4 cm in width. Microscopically the testis at this stage had a substantial part of seminiferous cysts with the presence of spermatozoa whose head was facing the periphery and tails facing the lumen. Regressing males were not observed. This found can be related to the facts that females ready for copulate can be found at any time throughout the year.

Keywords: reproduction, spermatogenesis, sharks.

Ovary and uterus morphology of the *Rhizoprionodon porosus* (Poey, 1861) caught on the coast of Pernambuco Brazil

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Rhizoprionodon porosus, the Caribbean Sharpnose Shark is common in the artisanal fishery landings in Pernambuco coast, Brazil. The species exhibit sexual and size segregation, and some events of their life cycle take place in the coastal zone. In this study, the objective was to describe the ovary and uterus morphology of *R. porosus* capture in Pernambuco coast. Twenty-one females were morphometrically identified. The Total Length (CT), Pre-Caudal Length (PC) (cm) and Weight (g) were recorded. The animals were sorted and then eviscerated. The ovaries and uteri were submitted to determine their weight, length, and width. For the histological analysis, the organs were fixed in 10% formaldehyde for 48 hours. However, cleavage occurred within the first 24 hours, and the organs were then returned to the fixative solution. Subsequently, they were transferred to 70% ethanol and later submitted to the processing protocol for histological analysis. The ovary and uteri macroscopic description classified the female maturation stage according to ICES 2013. Of the 21 females, six were at the beginning of the pregnancy, where full and rounded uteri were found with encapsulated eggs with no visible embryos. The uterus consists of three layers: mucosa, muscular and serous, and in mucosa layer was possible to observe the site to placental disc will be attached. Eight females were in the middle of the pregnancy, in which the uterus was thick, with embryos already formed but without pigmentation. In this pregnancy period, the embryos exhibit an evident yolk sac attached to the uterine mucosa. Seven females were at the end of the pregnancy period, with fully developed embryos, with visible pigmentation and reduced or absent yolk sac. The ovaries presented a simple epithelial tissue lining varying from cubic to columnar. In all pregnant females, the ovaries showed post-ovulatory follicles; and thick oviductal gland. However, in the last pregnancy stage, the presence of oocytes in vitellogenesis was observed, suggesting new ovulation after birth. Many oocytes were in atresia. The results support that female ready to copulate immediately after parturition.

Keywords: reproduction, elasmobranchs, histology.

Brazilian electric ray, *Narcine brasiliensis*, anesthetized with benzocaine

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The use of anesthetics in aquaria is very common, since it helps to reduce the stress caused by handling and subsequent procedures. Despite its regular use, little is known about ideal dosages or species-specific exposure times. Benzocaine is the chemical anesthetic most commonly used in fish because of its low value and easy obtaining. Here we tested benzocaine efficiency in the Brazilian electric ray, *Narcine brasiliensis* (Olfers, 1831) in order to establish the adequate dose for safe management of this species, which performs electric discharges during handling without anesthesia. An adult female held in Santos Aquarium (564 g, 33.5 cm in total length and 25 cm of disc width), was exposed to benzocaine-based anesthetic solution (Benzocaine, Sigma, USA) at a 0.5 g.L-1 concentration by immersion in seawater at 25 °C. Visual monitoring was performed every two minutes in order to evaluate spiracular frequency per minute (mpm), and heart rate (bpm) through the use of a vascular Doppler device (MARTEC DV600, Brazil). Swimming performance and straightening reflexes were observed. Before anesthesia, spiracular frequency was 56 mpm. Due to the shock discharge interference on vascular Doppler device, heart rate was not assessed at the beginning or at the end of the anesthesia. Just after the immersion, spiracular movements increased to 60 mpm, and after five minutes of immersion the movements decreased to 20 mpm. In eight minutes of immersion, swimming reflex and straightening reflexes were absent, indicating an appropriate level of sedation. The female was then transferred to a recovery tank without anesthetic for monitoring. In the eleventh minute after exposure, the spiracular frequency was 44 mpm and the heart rate was 48 bpm. After 29 minutes the spiracular frequency was 59 mpm and the ray was recovered from the exposure. This was a preliminary study using only one female. Trials with *N. brasiliensis* with different sexes and weights will help to establish a safe dose of benzocaine.

Key words: immobilization, spiracular frequency, heart rate.

Low genetic diversity of *Pseudobatos percellens* (Chondrichthyes, Rhinobatidae): a endangered guitarfish

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Overfishing is an activity that causes a massive impact on survival of several marine groups, including the elasmobranchs, which in this group includes the stingray that is also known as guitarfish species *Pseudobatos percellens* (Rhinobatidae). Nowadays, this species in "near threatened" on the IUCN red list and there isn't enough information about the life habits of this species. The control region (D-loop) of mitochondrial DNA, for being polymorphic and having a high mutation rates, presents very favorable characteristics as a molecular marker, being indicator of variability in population on genetics studies. This study aimed test the hypothesis of panmixia through sequencing and analyzing the population genetic of *P. percellens* using the D-loop region of mtDNA, from specimens captured on the coast of the region of Santos (SP) n=20; Mongaguá (SP) n=10; Guarujá (SP) n=3; Cananeia (SP) n=5; Pontal do Paraná (PR) n=25 and Florianópolis (SC) n=5. The fragments of tissue removed were fixed in alcohol and used for the extraction of total DNA, which were submitted to PCR for amplification of the control region and subsequently sequenced by automated sequencer. The sequences obtained were edited and analyzed with the programs Geneious, DNAsp 5.1, MEGA 6.0, ARLEQUIN 3.01 and Network 4.6. The analyzed sequences showed the existence of two mutational sites in the 72 samples analyzed (nucleotide diversity 0.00089), which resulted in four haplotypes. The populations presented FST=0,180 and diversity haplotypic Hd = 0,281, with the haplotype 1 being the most frequent in the populations and the samples from Santos (SP) presented the highest haplotypic diversity.Thus, we can conclude with the results obtained in the present study, that the species *P. percellens* is a panmitic unit, where it urgently needs conservation actions, since it has great commercialization and consequently suffers with large indices of low population.

Keywords: mitochondrial DNA, D-loop, guitarfish, conservation.

Shark and ray MPAs: how effective are they?

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Sharks and rays face a global crisis with significant declines in many populations due to overfishing and a quarter of all species threatened with extinction. There has been growing support for spatial management as a tool for protecting sharks from the threat of overfishing, with a rapid increase in areas of the ocean designated as shark and ray MPAs. A synthesis of knowledge about the spatial approaches to shark conservation and the extent to which they protect shark populations revealed that spatial protection can be effective when it is well planned, designed and managed with good governance, socioeconomic considerations and adequate enforcement. The species most commonly reported to benefit from spatial protection are those that use reef habitat for part or all of their lives with the key biological attributes of residency, philopatry, site fidelity and critical habitat use. Wide ranging species and adults of some reef species derive less benefits from spatial protection. Features that contribute to the benefits of shark and ray MPAs are isolated location, long-term protection, no-take or reduced fishing pressure and high value habitat. It is crucial to reduce shark and ray mortality for long-term maintenance of viable populations. Shark and ray MPAs can make a significant contribution but could be markedly improved by a systematic approach that establishes well-defined goals and conservation targets and incorporates the best available science on shark movement, habitat use and information on socio-economic factors. When combined with sufficient resources, this would ensure that spatial protection of shark and rays has the capacity to make long-term significant advances for shark conservation.

Keywords: marine protected areas, global review.

Juvenile white shark incidental catch inside a nursery area: description of fishing interactions and high-risk areas.

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Sebastián Vizcaíno (SVB) is located in the medium part of the Baja Peninsula, Mexico and has been confirmed as a nursery area for white sharks (WS) in the Northeastern Pacific. Nursery areas are critical habitats for the conservation and management of sharks, as they are crucial for juvenile survivals, one of the most important elements for the population growth of WS. This species is listed as "vulnerable" and is protected under Mexican legislation. Despite regulations and that part of BSV has been declared as Marine Protected Area (MPA), incidental caches of WS by artisanal fisheries still occur. This study aims to describe the fleet dynamics and identify incidental catch high-risk areas inside SVB through fishermen knowledge. A total of 77 fishermen were interviewed through a semi-structured survey at landing sites in the mayor fishing camps along SVB. Around 60% of fishermen had 20 or more years of experience. Gillnets are the most common fishing gear with higher use between April and August, while longlines and traps are most commonly used in fall-winter months. A total of 21 fish species were identified as target species and other 15 species as bycatch. The three main target species in SVB are white seabass *Atractoscion nobilis*, California halibut *Paralichthys californicus* and shovelnose guitarfish *Pseudobatos productus*. These species are caught with bottom gillnets, which is the principal fishing gear related with WS incidental catch. Around 75% (55) of fishermen stated that they have incidentally caught at least one white shark in their life as fishermen, with highest occurrence of response at Las Casitas (82%) and Laguna Manuela (71%) fishing camps. Less than 15 sharks are caught in the area each year, and the most common size of WS is <2 m TL (sizes of Young of the year and juveniles), usually caught at nearshore areas, while sharks between 2-3 m TL are caught in offshore areas. WS are more commonly caught in bottom gillnets (75%) during the late spring and summer months. Major risk areas are located nearshore of the mouth from Ojo de Liebre lagoon, including areas outside MPA polygon, where fishermen from different fishing camps operate their gears. The high-risk areas identified in this study can help to develop management strategies, where consistent monitoring programs to record incidental catches of white sharks in the area are necessary to understand their effect on their population dynamics.

Keywords: white shark, fishermen knowledge, incidental catches, Marine Protected Area.

Use of a costal lagoon by juvenile white sharks in a nursery area in the Northeastern Pacific

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Ojo de Liebre lagoon has been described as part of a nursery area for juvenile white sharks located at Sebastián Vizcaíno Bay (SVB), Mexico. Understanding how these juvenile white sharks (JWS) use the lagoon is necessary in order to develop management and conservation strategies for this vulnerable species. The use of this nursery area was investigated by acoustic-tagging young of the year and JWS from 2013 to 2017. We installed an acoustic receivers array (n=11) covering inside (n=7) and outside (n=4) areas of the lagoon. A total of 17 JWS were detected during the study on nine of the receivers, from which 13 sharks were detected inside the lagoon stations. Eight of the sharks were caught and tagged at SVB and nine in Southern California Bight, USA. At least one shark was detected during all months of the study. The frequency of detection of the individuals ranged from one day to 115 non-consecutive days. Multiple sharks (>1) were detected on 47 of 1246 monitoring days, with four sharks being the highest number detected in a single day. The highest occurrence of JWS was in the months of May and September. Inside the lagoon, white sharks were detected mostly from December to May, with the highest occurrence in December and March. White sharks were detected with higher occurrence in the receivers near the entrance of the lagoon (inside and outside). The relationship between the presence of white sharks with temperature, salinity, tide level, moon phase and time of the day will be presented. These findings allow to understand the time and season use of the Ojo de Liebre Lagoon by JWS, which will help to improve current management strategies.

Keywords: white shark, nursery area, acoustic telemetry, Northeastern Pacific.

Shark Attack in the Fernando de Noronha Archipelago - Pernambuco, Brazil

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The Archipelago of Fernando de Noronha - FNA (03°54'S; 32°25'W) has been part of the State of Pernambuco Brazil since 1988. The FNA is one of the most visited Brazilian islands. Most visitors search for tourist packages that include the interaction with the fauna of the region and in some cases also disregard environmental and safety "norms". One of the main attractions of the FNA is the possibility of diving with sharks and, once searching this option, visitors expose themselves to risky situations referring to negative interactions which end up, increasing the likelihood of incidents. In Pernambuco, incidents with sharks have been recorded since 1992, totaling 63 cases, with the last three recorded in the FNA, itself. The first recorded case occurred in December/2015, when a Brazilian tourist was diving at Baía do Sueste. The second occurred in Praia do Leão, also in December of the following year (2016). The third and the most recent, occurred in January 2018 with a surfer, when he fell off the board in Praia da Conceição. The main factors that contribute to the occurrence of incidents with sharks are: The proximity between sharks and humans; Thus, the growing number of visitors in the AFN. surpasses the tourist support capacity in the archipelago where the limit is 246 visitors/day, but currently the average (2018) is 273 visitors/day. It was recorded between 2014 and 2016 that the number of visitors in the first months of the year in the FNA increased by 34% whereas from 2016 to 2018 increased again by 8%. Other factors, such as the configuration of the archipelago, favor the approach of large species; The continuous will of bathers trying to interact with sharks and other physical effects, such as climate changes and ocean currents, can attract large sharks to the FNA. Finally, the anthropic impact, such as overfishing and disposal of biological materials from this activity in the vicinity of the FNA, may also increase the likelihood of incidents involving sharks in the area. In order to mitigate the incidents in the FNA, it is necessary to regulate the number of visitors and better controlling of fishing activities.

Keywords: interaction, male - shark, CEMIT.

Participatory Fisheries Monitoring of the bycatch of elasmobranchs by beach seine fishing of Bertioga, Guaíbe Sector, São Paulo coast, Brazil

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The Participatory Fisheries Monitoring (PFM) is considered a strategic resource for the fisheries management and for the conservation of endangered species, promoting a dialogue between scientific and traditional knowledge. The implementation of PFM in partnership with the beach seine fishing fishermen, who work in the Bertioga city, Guaíbe Sector of the Marine Environmental Protection Area of the Central Coast of São Paulo, Brazil, has contributed with valuable information on bycatch of rays and sharks. The mainly goal of this fishery is snook *Centropomus* spp., croaker *Micropogonias furnieri*, mullet *Mugil* spp., and as elasmobranch have no commercial interest, they are usually released. The technical accompaniments of the responsible researchers, supervising the fishermen partners are periodic, and the bycatches are reported by fishermen through images, videos and annotation of the catch worksheets. The PFM of the occurrences of elasmobranchs bycatch in the beach seine fishing were registered between November/2015 and February/2018. A total of 1061 specimens were registered, and from this total 261 were identified as follows: *Aetobatus narinari* (n= 58), *Gymnura altavela* (n=07), *Hypanus americanus* (n=03), *H. guttatus* (n=26), *Narcine brasiliensis* (n=15), *Pseudobatos horkelii* (n=09), *P. percellens* (n=17), *Rhinoptera bonasus* (n=104), *R. brasiliensis* (n=15), *Rhizoprionodon lalandii* (n=03), *Sphyrna lewini* (n=04). The 800 specimens were identified until genus level, *Hypanus* spp. (n=79), *Mobula* spp. (n=01), *Pseudobatos* spp. (n=21), *Rhinoptera* spp. (n=699). Among the eleven species registered, four are classified as Critically Endangered (CR) by MMA Ordinance Nº. 445/14 (*G. altavela*, *P. horkelii*, *R. brasiliensis* and *S. lewini*). Due to the difficulty of full-time monitoring of fisheries by the researchers or the institutions responsible for fisheries management, the PFM is an important alternative for obtaining data for a more effective fisheries management, as well as increasing fishermen's perception of the relevance of their collaboration in the process of building knowledge about fishing activity, conservation and sustainable use of natural resources.

Keywords: ray, stingray, shark, accompanying fauna, conservation.

Insights into the trophic ecology of the sympatric rays inferred by stable isotope analysis

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Knowledge of the trophic ecology and habitat use of rays in nursery habitats is fundamental to understanding community dynamics for developing effective management and conservation strategies. In this preliminary study we describe the stable isotope profiles (SIA) of red blood cells (RBC) and fin of 5 sympatric rays species in the region of Bertioga, southeastern Brazil. The specimens sampled were obtained from the bycatch of the beach seine fishing. In young-of-the-year (YOY) *Rhinoptera brasiliensis* (Disc width [DW]) = 50.7±6.3 cm), $\delta^{15}N$ (n=13; 10.5±0.7‰) and $\delta^{13}C$ values (-14.8±0.5‰) of fin were higher than RBC (n=8; 9.5±0.2‰ and -16.7±0.3‰, respectively; p<0.001). The same trend was observed for $\delta^{13}C$ values (Fin: -15.0±0.2‰, n=3; RBC: -16.2±0.7‰, n=7; p<0.05) in juvenile *Hypanus guttatus* (DW= 51.1±11.3 cm). In contrast no differences were detected between RBC and fin $\delta^{15}N$ values for *H. guttatus* (Fin: 11.9±0.3‰; RBC: 12.3±1.0‰). Differences between fin and RBC in *R. brasiliensis* identify temporal variation in isotope values, and likely reflect a maternal signal in fin (turnover rates long). Equally $\delta^{15}N$ and $\delta^{13}C$ values for YOY *Aetobatus narinari* (DW= 58.0±20.7 cm) did not differ (fin: 12.7±0.9‰; RBC: 12.9±1.1‰ and fin $\delta^{13}C$ values: -13.4±0.9‰, n=4; RBC: -14.3±0.8‰, n=8). The $\delta^{15}N$ values from *R. brasiliensis* was sig-

nificantly lower than that found for the other rays (p<0.05). Neonates of *Pseudobatos horkelii* (n=8; 9.3±0.5 cm total length) showed intermediate $\delta^{15}N$ values (Fin: 11.3 ± 0.5‰), and were also significantly different from other rays (p<0.05). The umbilical scar of these neonates was observed, suggesting that isotope values also correspond to the maternal signature. There were no differences in the $\delta^{15}N$ values between *A. narinari, H. guttatus* and *Gymnura altavela* (Fin: 12.9±1.6‰, n=2; 68.5±9.2 cm DW). *A. narinari* $\delta^{13}C$ values, however, were significantly different from *H. guttatus* and *P. horkelii* (Fin: -15.0±0.4‰) (p<0.05), but not compared to the *G. altavela* (Fin: -15.3±0.4‰). Preliminary data suggest that *A. narinari, G. altavela* (juveniles) and *H. guttatus* (juveniles and adults) feed at a similar trophic level, despite difference in stomach content data published in the literature. In contrast, $\delta^{13}C$ data showed that these rays forage in different areas/or on prey from different carbon sources, indicating a degree of resource partitioning. This is the first study to investigate the trophic ecology and carbon sources supporting mesopredators (mother and juvenile) in this region of Brazil. These data suggest more complex resource partitioning by these sympatric rays which requires investigation.

Keywords: feeding ecology, biomarkers, nursery area, habitat partitioning, elasmobranchs.

Report of grouping behavior of the Southern stingray *Hypanus americanus* in a no-take marine protected area in southeastern Brazil

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Grouping behavior and social interactions have been documented in the literature for a wide range of terrestrial and aquatic organisms. This behavior can be active, such as schooling in fish, or passive, in which the individuals aggregate due to food availability or habitat conditions. Grouping resulting from social motivations is regarded as social groups, otherwise it is treated only as aggregation. These patterns have been described also for some elasmobranch species for different causes. The present study reports a grouping behavior of *Hypanus americanus* in a Marine Protected Area (MPA) in southeastern Brazil. Six sampling expeditions were performed in six islands in São Paulo state, Brazil, in March, May, July, September, December/2016 and January/2017. Palmas, Cabras and Alcatrazes islands are part of Tupinambás Ecological Station, a 30 years old no-take MPA, while Mar Virado, Tamanduá and Búzios islands are areas open to fisheries. In each expedition, six Diver Operated stereo-Videos 20mx2m transects were performed on the leeward side of each island, in which three of them were in the shallow part above the rocky reef and three in the interface zone between rocky reef and sandy bottom. Environmental variables were collected using a CTD (Conductivity, Temperature and Depth) and a Secchi disk. A total of 32 specimens was recorded in Palmas Island in July/2016, during the transects in the interface zone (first transect n=11, second n=11 and third n=10). Disc width varied between 419mm and 1308mm with an average of 598.6274.28mm. The depth was of 12m, the water temperature was 24.4°C, salinity 34.6 and visibility 4.5m, with no presence of thermocline. Sex identification was not possible. Based on disc width, it is possible to suggest the presence of adults of both sexes. This indicates that this behavior can be associated with mating, which would characterize it as a social group. In this case, as the gestational period is about 5-7 months, the offspring would be born in spring/summer, pattern described for other species of the family Dasyatidae. It can also be related to feeding, since large aggregations pursuing preys have been registered for this family. The fact that this encounter occurred only in this area indicates that, despite being a small size MPA (3km²), it may be used as a refuge or feeding and mating grounds for the species, highlighting the importance of the area.

Keywords: Batoidea, Southwestern Atlantic, conservation, stereo-systems, EventMeasure.

Age and growth of the lesser electric ray *Narcine brasiliensis* (von Olfers, 1831) (Chondrichthyes: Narcinidae)

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Narcine brasiliensis are rays of the family Narcinidae endemics from the southern Brazilian shelf, most frequently occurring in depths between 20 and 50m. Despite being heavily fished as bycatch by the artisanal and industrial fleet in the region, there is very little information available on its biology, especially concerning its growth parameters. Therefore, *N. brasiliensis* is considered data deficient by the IUCN. Age and growth aspects are crucial for the assessment and management of the species because it provides information to determine growth and mortality rates, age at maturity and lifespan. The objective of this study was to provide estimates of age and growth parameters for *N. brasiliensis*. A total of 175 specimens (111 females and 64 males) were collected in Southeastern Atlantic coast (23°08′09″S–25°24′23″S, 44°23′25″W–47°39′04″W) and 5 to 7 vertebrae were extracted of each individual. Sagittal vertebrae sections of 0.2mm were performed, and the growth bands along the corpus calcareum were counted, in order to estimate the age of each individual. Total Length (TL) of specimens ranged from 326 to 380mm for males and 215 to 470mm for females. The age structure used in the estimates ranged from 3–11 years for females and 3–9 years for males. The birthmark was observed at 0.47±0.067mm from the vertebrae centrum and the relationship between TL and vertebrae radius was significantly linear (r^2= 0.71) for sexes combined. Growth models were fitted to the observed length-at-age data to estimate the growth parameters. The more appropriate model according to Akaike's Information Criterion (AIC) was the von Bertalanffy growth model with two parameters. Growth parameters were significantly different between sexes, in which $L\infty$=499.21mm (TL), k=0.14 year^{-1} were described for females and $L\infty$=438.38mm (TL), k=0.14 year^{-1} for males. Although edge analysis has not been validated, the results weakly indicated an annual band pair deposition pattern. Growth rate (k) for *N. brasiliensis* is considered slow to moderate, similar pattern described for other species of the family Torpediniformes.

Keywords: elasmobranchs, Batoidea, Southwestern Atlantic, fisheries management.

Preliminary data on trace elements concentration in a population of lesser spotted dogfish (*Scyliorhinus canicula*) from Central Mediterranean Sea.

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Since 2016 a phD project for recostructing life history traits of a population of lesser spotted dogfish (*Schyliorhinus canicula*) in the Central Mediterranean Sea has been started. One of the goal of this research is to delineate the heavy metals and other trace elements concentration rates in vertebrae and their effects on the immune system of the species and, consequently, on parasitic charge. Human being, in addition to represent a direct threat to sharks, also indirectly exerts a strong pressure on these animals, due to the continuous release of polluting elements in the water and the atmosphere. Sharks, as predators at the top of marine food chain, act as final receptors for a series of polluting elements that are regularly discharged into the sea. At present, heavy metals and trace elements of 28 vertebrae from 28 different spotted dogfish sharks collected in the Tyrrhenian Sea have been analyzed with ICPMs. 46 different heavy metals and trace elements were found in vertebrae and the most abundant were: lead, iron, zinc, manganese, copper and arsenic. The concentration of trace elements and heavy metals was correlated with the sex, lenght and growth of the sharks. The relationship between heavy metals and trace elements concentration and sex was significant with lead: females tend to accumulate more lead than males and the accumulation probably occours through the skin and diet. As regards the correlation with the lenght, arsenic has been slightly significant and the accumulation occours through respiration and diet. Finally, the correlation with the growth was extremely significant for zinc and manganese. Both zinc and manganese concentration increases during the growth of the sharks but the accumulation of zinc occurs probably through diet and skin, while that of manganese only through diet.

Keywords: trace elements, *Scyliorhinus canicula*, Central Mediterranean, bioaccumulation.

Genetic diversity of the mitochondrial genome of scalloped hammerhead shark *Sphyrna lewini* (Carcharhiniformes: Sphyrnidae) in breeding areas of the Mexican Pacific

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The scalloped hammerhead shark (*Sphyrna lewini*) is a coastal and semioceanic species with high dispersal capability. It is considered as endangered globally, although is heavily exploited by fisheries and bycatch. Elasmobranchs are characterized by low mutational rates for the mitochondrial DNA; therefore using the complete mitochondrial genome provides more informative sites to infer the maternal lineage composition of populations, which contribute to the design of strategies to achieve fisheries sustainability, since females migrate to coastal areas to give birth, where newborns are most vulnerable to bycatch. The objective of the present work was to characterize the genetic diversity and divergence of the mitochondrial genome of *S. lewini* in estuaries of the Mexican Pacific, which they use as breeding areas, and to determine if the species exhibit a philopatric behavior. The mitochondrial genomes of 198 samples were analyzed, corresponding to neonates and juveniles from the commercial catch obtained between 2014 and 2017 from major breeding areas in the Mexican Pacific. Genetic diversity and divergence were estimated obtaining 115 variable sites and 73 haplotypes, with a high haplotypic diversity H = 0.925 and a low nucleotide diversity π = 0.00023. Regarding the genetic divergence, there were no differences between neighbour estuaries. However, genetic differences were observed between estuaries grouped into locations (counties; F_{ST} = 0.08-0.11, $p < 0.004$) and regions (northern, central and southern; F_{ST} = 0.03, $p < 0.003$). These results suggest that *S. lewini* displays a philopatric behavior at a regional scale.

Keywords: Philopatry, endangered sharks, molecular diversity.

Elasmobranch population and health assessment in Florida's southern Indian River Lagoon.

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Florida's Indian River Lagoon (IRL) is an "estuary of national significance" that has experienced recent anthropogenic impacts affecting water quality and ecosystem health. Unfortunately, there is a substantial data gap surrounding the status of elasmobranchs in the southern IRL. Moreover, microbial communities associated with elasmobranchs are likely necessary for organismal function but may also include opportunistic pathogens. Despite this, there has been no characterization of these microbiomes in the southern IRL. Thus, we have implemented a long-term fishery-independent survey (bottom longline, gill net) to 1) characterize the abundance and distribution of elasmobranch communities from Sebastian to St. Lucie Inlet and 2) determine the culturable biome of IRL elasmobranchs and evaluate correlations between water quality and microbial assemblages. Since July 2016, over 500 individuals of 15 species have been sampled and tagged, including two critically endangered smalltooth sawfish (*Pristis pectinata*), a species once thought to have been extirpated from the lagoon. Oral and urogenital swabs have been collected across ten species of elasmobranchs yielding an array of microbial species. The most prevalent bacteria cultured included potential human pathogens; *Pseudomonas fluorescens*, *Plesiomonas shigelloides*, and *Aeromonas hydrophila*. Preliminary analysis found significant differences in the culturable biome associated with multiple water quality measures including temperature, salinity and dissolved oxygen. As the survey continues, assessment of abiotic parameters (e.g., temperature, salinity) may help predict assemblage dynamics and microbial communities of elasmobranchs and estimate how major anthropogenic events (freshwater releases, harmful algal blooms, etc.) influence elasmobranch distribution and health. Continued sampling will provide a more comprehensive understanding of elasmobranch habitat use and microbial diversity in the IRL and may provide insight on antibiotic resistance in microbial species.

Keywords: sharks, rays, distribution, microbiology, water quality.

Occurrence of *Squalus* cf. *albicaudus* Viana, Carvalho & Gomes, 2016 (Squaliformes: Squalidae) in the coast of Pernambuco, Brazil

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Squalus cf. *albicaudus* is a recently described shark species from the Southwestern Atlantic Ocean with distribution from Bahia to Espírito Santo state in Brazil. The present study aimed to identify *Squalus* species found in the coast of Pernambuco state and clarify their occurrences in the Brazilian Northeast region. Twenty specimens measuring between 248–860 mm TL were caught at about 300 m depth in the continental slope of Pernambuco state. To confirm the identification, 44 external measurements were taken and compared to those provided in Viana et al. (2016). These measurements were expressed as percentage of total length (%TL). The results revealed that the specimens show external morphology and color pattern of body similar to those of *S.* cf. *albicaudus* as described in Viana et al. (2016). Measurements also overlap such as: precaudal length (78.1–82.5%TL in Viana et al. 2016 vs. 77.2–82.9%TL present study), pre-first and pre-second dorsal length (27.1–39.9 %TL vs. 27.6–32.7%TL and 57.8–64.4%TL vs. 59.2–67.1%TL), prepectoral length (20.2–24.0%TL vs. 19.9–23.9%TL), prepelvic length (39.3–54.2%TL vs. 43.7–49.9%TL), pectoral-pelvic space (15.4–25.4%TL vs. 18.6–24.9%TL), interdorsal space (22.8–27.5%TL vs. 20.1–31.6%TL), dorsal-caudal space (10.7–14.1%TL vs. 9.3–13.0%TL), first and second dorsal-fin inner margin length (4.9–6.1%TL vs. 4.7–7.0%TL and 4.1–5.2%TL vs. 3.3–5.5%TL). Other morphological characteristics of *S.* cf. *albicaudus* are also found in the specimens of our analysis, supporting that this species occurs in the region. For instance, first dorsal-fin spine located anterior to vertical traced at free rear tips of pectoral fins, prenarial length smaller or equal than inner nostril-labial furrow space, and pectoral fins with pointed free rear tips. These findings corroborate the results of previous authors that indicated the occurrence of *S.* cf. *albicaudus* in Pernambuco coast. Therefore, the geographical distribution of this species across the Brazilian Northeast waters is herein updated.

Keywords: taxonomy, morphology, Brazilian whitetail dogfish, southwestern Atlantic ocean.

Scalloped hammerhead swimming performance and thermoregulation strategies during deep dives into cold water

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Adult scalloped hammerhead sharks (*Sphryna lewini*) utilize oceanic habitats around the Hawaiian islands where they dive repeatedly at night to depths exceeding 800m and water temperatures as low as 4°C, presumably to forage on deep-dwelling prey. We hypothesized that *S. lewini* dive duration is limited by ambient water temperature at depth because body cooling associated with excursions into cold water can reduce muscle power output, cardiac function and visual acuity. To determine how *S. lewini* respond to cold ambient water temperatures experienced during deep dives, we equipped adult individuals with instrument packages capable of directly measuring depth, ambient water temperature, activity rates and swimming muscle temperature. Our specific objectives were to determine whether: (1) *S. lewini* maintain core body temperature during deep dives via simple thermal inertia, or instead employ active, physiological, thermoregulation, and (2) whether swimming performance changes during deep, repetitive dives into cold water. We obtained 180 total days of data from 9 free-swimming adult *S. lewini* with individual deployment durations ranging from 7 to 23 days. Our data suggest dive termination is triggered by slight cooling (2 to 5 degrees) of swimming muscles, and thus *S. lewini* are able to maintain swimming performance during their ascent to warmer surface waters. This dive termination response is crucial because internal muscle cooling continues even after sharks return to the warm surface layer, and it takes 45 to 75 minutes for swimming muscles to fully equilibrate with ambient mixed layer water temperatures. Understanding how *S. lewini*, a warm-water species, are physiologically able to exploit resources in deep, cold habitats provides important insights into the broader ecology of this regionally endangered shark.

Keywords: scalloped hammerhead, deep diving, accelerometer, thermoregulation, dive physiology.

Scalloped hammerheads swim on their side with a diel shift in roll magnitude and frequency

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While most sharks maintain an upright posture while swimming, it has been demonstrated that great hammerheads (*Sphyrna mokarran*) swim on their sides to for greater hydrodynamic efficiency by utilizing their dorsal fin as a lift-generating surface. While great hammerheads are unique amongst sharks in having a dorsal fin longer than their pectoral fins, scalloped hammerheads (*Sphyrna lewini*) have the next highest ratio of dorsal fin to pectoral fin lengths, which might allow for similar hydrodynamic efficiency by exhibiting the same rolling behavior. In this study we equipped adult *S. lewini* with multi-instrument tag packages to directly measure depth, body orientation and swimming performance. Our specific objectives were to examine whether (1) *S. lewini* exhibit any rolling behavior while they swim and if they do, (2) examine for any pattern of variation in the magnitude and frequency of their rolling. We obtained 180 total days of data from 9 free-swimming adult *S. lewini* with individual deployment durations ranging from 7 to 23 days. Rolling behavior was observed in all sharks throughout their entire deployments, with each shark spending about 95% of their time swimming on their side. The degree (magnitude) and frequency of rolling showed a diel pattern. During the day the sharks would change sides on average every 45-60 seconds and maintain roll angles between 40-50 degrees for each side, whereas at night the roll frequency would decrease with a change of sides every 120 seconds while magnitude would increase with roll angles increasing to 60-70 degrees. The observation of this behavior in another member of the Sphyrnid family provides important insights into the evolutionary context of this behavior strategy. The diel variation in the rolling behavior raises interesting questions on the locomotor function of this behavior.

Keywords: scalloped hammerhead, rolling, accelerometer, diel variation, swimming behavior.

Ecological risk assessment of sharks caught in the Gulf of California artisanal fisheries: considerations for management and future research.

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The Gulf of California (GC) is the most important region for shark fisheries in Mexico, supporting an artisanal multi-specific fishery with high socio-economic value. The lack of biological information and catch data makes difficult the evaluation of the populations through conventional methods (i.e. stock assessment). In recent years, methods to evaluate the fish populations under a fishery regime with data-poor situations have been developed. In this study an Ecological Risk Assessment commonly used in data-poor and data-deficient fisheries, Productivity Susceptibility Analysis (PSA), was applied to 38 shark species in order to evaluate their vulnerability to the GC artisanal fishery. The capability of a species to recover after potential depletion (Productivity) and the potential impact of the fishery on the species (Susceptibility) were evaluated by scoring a set of attributes related with the life history parameters of the species and fishery aspects. Several workshops with stakeholders of the artisanal shark fishery were conducted to allow stakeholders to provide input on the scores. The biological productivity in the analyzed species ranged from low (89% species) to moderate (10.5% species); none of the species resulted with high productivity. The species with the lowest productivity were *Carcharhinus leucas*, *Carcharhinus obscurus*, *Galeorhinus galeus*, and *Sphyrna mokarran*. The highly productive species were *Rhizoprionodon longurio* and *Sphyrna tiburo*. The majority of the species (66%) were moderately susceptible to the fishing activities, 12 species (31%) were low susceptible, and only one species, *Mustelus californicus*, were highly susceptible to fishing. Seventeen species were cataloged as low vulnerable, and twenty-one as moderate vulnerable. Our results allowed us to recommend that future research should be focused to evaluate the possibility of *Sphyrna lewini*, *Carcharhinus falciformis*, *Sphyrna zygaena*, *Squatina californica*, and *Mustelus* spp. to support the pressure of the GC artisanal fishery using more robust methods. *Carcharhinus leucas*, *Carcharhinus obscurus*, *Nasolamia velox*, *Negaprion brevirostris*, *Galeocerdo cuvier*, and *Triakis semifasciata*, require urgent attention to confirm their population status in the GC. A specific monitoring program focusing on *S. mokarran*, *Sphyrna media*, *Sphyrna corona*, *S. tiburo* in landings sites is important to confirm their possible extirpation from the GC. Other managements recommendations are presented.

Keywords: productivity susceptibility analysis, vulnerability, data-poor fisheries.

Paternity analysis to identify the mating system in *Sphyrna zygaena*

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Sharks are an important worldwide resource in fisheries, some of which are being over-exploited leading species to an endangered status. Due to their life strategies, elasmobranch species are susceptible to fishing with a low ability to compensate excessive losses in their populations. Given to above, the conservation efforts should be based on biological and ecological information from each species. Reproductive biology is an important area of knowledge to consider in the improvement of conservation measures. Identify the mating system can reveal information about the ability of species to overcome population decreases due to fisheries overexploitation. *Sphyrna zygaena* is a semipelagic *Sphirnid* species that distributes throughout tropical and temperate waters worldwide with a wide commercial importance in Mexico. The objective of this research was to identify the mating system in *S. zygaena* through paternity analysis, using four microsatellite molecular markers. The results revealed multiple paternity in three litters, which were sired by a minimum of 2-5 fathers. In all litters, there was a bias in reproduction success of sires where a male fertilized the most eggs. This results suggest that there are cryptic pos-copulatory processes contribute to male reproductive success. This is the first record of polyandry in *S. zygaena* in the Gulf of California, so we suggest considering this feature in the management strategies to this species.

Keywords: *Sphirnids*, mating system, microsatellites, multiple paternity.

Biogeography and biodiversity distribution of sharks, rays and chimaeras (Chondrichthyes) from the Southwestern Atlantic

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Detailed knowledge of chondrichthyan distribution is relevant to address basic questions in biogeography, ecology, conservation and management. We provide the first biodiversity study based on the analysis of maps of probability of occurrence for chondrichthyans of the Southwestern Atlantic (24°S to 57°S; shoreline to 2500 m depth). We could model the distribution of 74% of the species that occur in the study area. The species were separated into 3 groups: 1) Batomorphi (BD), 2) Selachii + chimaeras (SD), and 3) Class Chondrichthyes (CC) (Batomorphi + Selachii). We used MaxLike models to estimate the probability of occurrence of each species. This modelling approach uses all background data of the study area to estimate the probability of occurrence of a species by maximizing the likelihood conditioned on the probability of observing a cell given the species is present. Then, we obtained a binary (presence–absence) map by applying a threshold of occurrence to the probability of occurrence. In order to identify chondrichthyan associations, first we determined the measured pairwise distances between grid cell assemblages with the beta-sim index. Then, chondrichthyan assemblages were determined by agglomerative hierarchical clustering. The validity of the clustering was evaluated using co-phenetic correlation coefficient. To determine the optimal number of cluster groups we inspected evaluation plots. BD was more diverse on the Argentinean shelf, with the largest number of species, mainly, off the Río de la Plata mouth. By contrast, SD diversity peaks off southern Brazil, decreases by more than half just south of the Río de la Plata and is considerably lower off Patagonia. Finally, for CC, the pattern of diversity, shows the greatest biodiversity off south Brazil, with a secondary peak off northern Argentina. Then, species diversity decreases throughout the Patagonian shelf. Cluster analysis evidenced the zoogeographic scheme of the region. A northern assemblage is recognized from 24°S to 44°S, which vears shoreward at about 35°S, that is consistent with the Argentine Biogeographic Province. A southern assemblage, consistent with the Magellanic Biogeographic Province, covers the whole shelf from the southern tip of the continent to 44°S, and only the outer shelf from 44°S to 35°S. Finally, a slope assembly stands out from about 38°S to the southern end. Our results, obtained analysing the highest number of species for the region so far and with quantitative techniques to define species distribution, agree with previous, less comprehensive, work on diversity distribution and biogeographic scheme of the region.

Keywords: biodiversity, zoogeographic scheme, chondrichthyan, maxlike, Southwestern Atlantic.

Gulf of California artisanal fishery: an historical landings reconstruction of hammerhead sharks (*Sphyrna* spp.), 1960–2014.

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In the Gulf of California (GC) no formal population assessments have been conducted for most shark species due to the lack of time series of landings and fishing effort. In the GC six hammerhead shark species are distributed, and two species, *Sphyrna lewini* and *Sphyrna zygaena*, are important species in the GC artisanal fishery landings. Based upon an exhaustive review of extant literature and alternative data sources, and following several approaches for reconstructing catch time series, we have reconstructed the historical landings of three hammerhead shark taxa, *S. lewini*, *S. zygaena*, and *Sphyrna* spp. (which could include *S. lewini*, *S. zygaena*, *Sphyrna mokarran*, *Sphyrna media*, *Sphyrna corona*, and *Sphyrna tiburo*) for the 1960-2014 period. The average estimated landings for all the period (1960-2014) were 1,600 t for *S. lewini*, 239 t for *S. zygaena*, and 40 t for *Sphyrna* spp. In the estimated ladings trends was observed a notorious decline for *Sphyrna* spp., with only 3 t per year the last ten year of the time series. For *S. lewini* and *S. zygaena* the landings appear to be stable. The historical trends indicate a fishing pressure of more than seven decades for these species, and for *S. mokarran, S. media, S. corona,* and *S. tiburo* the records are scarce since the 1990´s decade. Future research efforts should analyze the current exploitation level of these hammerhead sharks to be able to develop adequate management plans and conservation measures.

Keywords: data-poor fishery, fisheries catch reconstruction, landings trends, time series data.

The present molecular phylogeny of genus *Gymnura* Van Hasselt, 1823: A mitochondrial perspective

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The butterfly rays of genus *Gymnura* are easily distinguished from other batoids by their relatively broad body discs (which are wider than their length), and filiform tails. These rays are cosmopolitan species found in coastal regions of tropical, subtropical, and temperate seas, on sandy or muddy bottoms. While they are morphologically distinct from other batoid species, their morphology is relatively conservative, which is reflected in a number of taxonomic uncertainties at the levels of species. Recently, the genus was revised mainly because the non-taxonomic validity of *Aetoplatea*, and the description of two new cryptic species previously classified as *Gymnura micrura* (*Gymnura lessae and Gymnura sereti*). *G. lessae* is restricted to North and Central Atlantic and *G. sereti* to West Coast of Africa Continent. For the present study, 10 specimens of *Gymnura micrura* and seven of *Gymnura altavela* were sampled along to Southwestern coast of the Atlantic. A 641 base pair of Cytochrome C Oxidase Subunit I (COI) was sequenced for each specimen. For phylogenetics inferences, a Maximum Likelihood (ML) and a Bayesian Inference (IB) trees was construct with our sequences and sequences for other species of the genus retrieved for Genbank. The results indicate that *G. lessae* is a genetically valid species and more closely related to *G. micrura*. However, one specimen of Southwestern Atlantic (Pará state) was recovered as genetically distinct for all Atlantic specimens (*G. micrura, G. lessae and G. altavela*) with high levels of phylogenetic support for the two inferences used. *G. altavela* was recovered more related to *Gymnura natalensis*. Also, the phylogenetic analysis shows the presence of multiple non-monophyletic lineages inside of *G. natalensis* and *G. australis* based on the sequences obtained from Genbank. The results obtained here indicate that the genus *Gymnura* possibly contain more cryptic species not yet described, requiring morphological and molecular revisions.

Keywords: *Gymnura*, molecular phylogeny, COI, cryptic species.

Molecular discrimination of *Sphyrna* genera from other sharks species marketed in Brazil, based on the amplification of ITS2 gene

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Shark fisheries have expanded in size and number around the world since the mid-1980s, with many species directly targeted in teleost fisheries. The international trade of shark fins has been the primary cause of the recent increase in the overfishing of elasmobranchs. Shark fin is a delicacy in many Asian countries, particularly in China, where its market price could reach US\$ 1,000 per kilogram. The demand for fins in Asia led to the overfishing of several shark species worldwide. The population collapsing is mainly caused for a number of reasons: overfishing, bycatch captures and habitat's loss. In fish markets, the identification of the species is quite challenging mainly because the finning process which remove the morphological characteristic of each species. The mainly objective of finning is reducing the volume shipped of species to accommodate larger amounts of fins per m³. This has causing several damages in shark's population, where some species have drastically reduced in the last few years. Giving all the threats of sharks populations, management techniques are urged to those species specially, information about the species marketed without the morphological characteristics. Molecular identification has already been used to identify misidentified processed shark species affected by fisheries in many countries, including Brazil which having proofed be very useful. The main objective of our study is show the effectiveness of ITS2 nuclear gene for discriminating species of Sphyrnidae family from other shark's species. Genomic DNA was extracted from 11 tissue samples from 5 *Sphyrna* species and 13 samples from 9 shark's species totalizing 24 samples. After this PCR's of nuclear ITS2 gene was performed for each individual and the products where electrophoresed in 1.5% agarose gel. The results shows that all *Sphyrna* specimens have a banding pattern of 700 base pairs (bp) and all other species of sharks used in the present study show's band patters above 1000 bp. The ITS2 was quite useful to discriminate *Sphyrna* specimens from other sharks genera. This approach is important to tracking hammer sharks marketed in Northern Brazil where almost all species of this genus are threatened status on IUCN. The molecular identification of fisheries stocks, like hammerhead sharks, becomes a fundamental issue for tracking illegal marked of those species in fish markets around the world.

Keywords: *Sphyrna*, molecular identification, finning, fin, Northern Region.

Education and Awareness: Tools in the Conservation of Sharks and Stingrays in Alagoas State, Northeastern Brazil.

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The conservation of endangered species has been a global concern, particularly of target fish or bycatch species. Environmental education has been a tool in reducing the impacts and conflicts of unmanaged fishing. Thus, the Tubarões e Arraias Project aims to contribute through environmental awareness to conservation of elasmobranchs in Northeast Brazil. For that, three municipal schools frequented by son of artisanal fishermen were selected in the North, Central and Southern Alagoas coasts, where we held lectures and ludic activities focused on sharks and stingrays. We used pictures, figures, texts, models, jaws, head, skin, preserved shark specimens, both eggs cases skate and sharks, as didactic materials, highlighting the species already registered in the region, especially the species threatened as the nurse shark, *Ginglymostoma cirratum*. A teaching kit containing didactic material (PPT lesson, preserved animals, teeth, skins of stingray and shark) was donated to the schools visited. Before and after these activities, we registered the perception of the classes in texts or drawings made by the students. The data (n=438 students) were organized and classified in positive evaluations, when they were perceived as ecological importance, or negative, when they were represented as aggressive. In the Northern coast of Alagoas, we had 177 assessments, the negative ones being reduced from 33% to 2%, after the lectures and play activities, the positive results were 66.7% and then 98%. In the Central coast, there were 207 drawings student's, the negatives had a reduction of 35% from before to after the activity, the positive ones totaled 96% after the activities. In the South coast, 54 evaluations were done, 45% negative and after the educative activities, 100% positive. The lessons and ludic activities emphasized on the Elasmobranchs were efficient in the change of students' perception. We observed that information about sexual maturity, longevity, size and behavior of sharks and stingrays attracted students' curiosity. We confirm the importance of educative activities in changing the perception of the importance of the conservation of the Elasmobranchs, helping the programs and plans of conservation of species threatened with extinction.

Keywords: students, information, environmental perception.

Small cities, big business: The finning in Alagoas State, Northeast Brazil

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Finning is an illegal activity in many countries, but due to fins high prices on the international market, it continues to be carried out, especially in developing countries. The State of Alagoas is a small fish producer in the Northeast of Brazil and until now its participation in finning and commercialization of shark fins was unknown. In February 2018, a federal action of fiscalization confiscate 42 shark's fins being commercialized in a small artisanal fisherman village. All fins were sent to the Laboratório de Ictiologia e Conservação, Universidade Federal de Alagoas, being photographed, measured and species were determined through literature. Tissues were collected for future genetic analysis. Information on finning and on the fin black market was obtained from local fishermen through free interviews. A total of 22 pectoral and 20 dorsal fins were analyzed from 26 adult sharks of 6 species belonging to 2 families: Carcharhinidae (9 individuals of *Carcharhinus limbatus*, 5 of *C. falciformis*, 1 of *C. signatus* and 1 of *C. leucas*) and Sphyrnidae (7 specimens of *Sphyrna lewini* and 3 of *S. mokarran*). Of these, we highlight *C. signatus*, *S. lewini* and *S. mokarran*, which are in the national red list of endangered species, classified as vulnerable (VU), critically endangered (CR) and endangered (EN), respectively. The others, *C. leucas*, *C. falciformis* and *C. limbatus* are considered EN in the IUCN international list. According to the free interview results, finning and the clandestine commercialization, occur in Alagoas State to a decade, being considered important and lucrative activities. These fins would be sold for an average of US $ 63.00/kg, send to the state's capital, Maceió, and possibly exported to Asia. These results show that in addition to illegal trade, endangered species are also targeting fisheries. The implementation of management measures and fishing monitoring programs, as well as the promotion of control finning and black-market fin trade in Alagoas, are fundamental for the conservation of sharks and other endangered species by fishing.

Keywords: fishing, endangered species, illegal trade.

Preliminary data of the onefin skate *Gurgesiella dorsalifera* McEachran & Compagno, 1980 (Chondrichthyes: Gurgesiellidae) captured in the southern coast of Santa Catarina, Brazil

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Gurgesiella dorsalifera is a small endemic deep-water skate from southern Brazilian upper slope, with distribution from Rio de Janeiro State to Santa Catarina State (South Brazil), between 400 and 800 meters. The individuals analyzed in this study came from commercial fishing cruises, which occurred in September and October 2002, off the southern coast of the State of Santa Catarina. Captured animals were stored on ice along the trip and transferred to 4% formalin solution in laboratory. Data on disc width, total weight and length of clasper were obtained. A total of 279 specimens of *Gurgesiella dorsalifera* were analyzed, which 148 females (53.0%), 130 males (46.5%) and 1 specimen (0.3%) not identified. Minimum values of disc width (DW) were 71 mm for females and 72 mm DW for males, while maximum values were 285 mm (females) and 272 mm DW (males). The disc width-weight relationships did not show a significant difference between males and females (t-test, P> 0.05), obtaining the equation: y= 8E-06DW3,029 com R^2 = 0.95 for grouped sexes. Regarding the total weight of these organisms, the minimum values were the same for males and females (approx. 4g), but females reached higher values (237.5g) than males (134g). The analysis of the length of the male claspers showed that it is possible to observe a significant increase in their length from 225 mm DW, suggesting that this is their initial maturation size. The small Brazilian endemic skate *G. dorsalifera* is considered "Vulnerable" (VU) in its global evaluation, under the IUCN red list criteria, due to its restricted geographic distribution and the increase of fishing pressure, specially the bottom trawling. This fact emphasizes the need to have more information about its biology and life history, which could provide the understanding of their role in the ecosystem of deep water off the Southern Brazil, and establish conservation and management plans for this species.

Keywords: Gurgesiellidae, Deep-water skate, Conservation.

Reproductive aspects and feeding habits of the southern sawtail catshark *Galeus mincaronei* Soto, 2001 (Elasmobranchii: Scyliorhinidae) captured in the southern coast of Santa Catarina, Brazil

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Galeus mincaronei is a species of shark endemic to the Southwest Atlantic Ocean, and it is found on the continental shelf break to the upper slope of southeastern-southern Brazil, between 200 to 700 meters deep. The individuals analyzed in this study came from commercial fishing cruises, which occurred in September and October 2002, off the southern coast of the State of Santa Catarina. A total of 39 individuals of *G. mincaronei* were obtained, which 24 females (61.5%) and 15 males (38.5%). The composition of sizes ranged from 24.8cm up to 43.1cm of total length. The length-weight relationships did not show a significant difference between males and females (t-test, P> 0.05). Males and females presented differences in relation to the minimum weights (30.1g and 41.4g, respectively) and maximum weights (184.6g and 197.0g, respectively). Analysis of stomach repletion of *Galeus mincaronei* showed that almost all animals analyzed had percentages of repletion ranging from 25% to 100%, being found three items: squid (*Illex argentinus*) occurring in 66.6% of the analyzed stomachs, followed by hake (*Merllucius* sp.) with 22.2%, and shrimp (*Aristaeopsis* sp.) with 11.1%. For reproductive studies, 25 females were analyzed and showed only the functional right ovary, and around 6 and 13 oocytes measuring 23mm of maximum diameter. The analysis of 13 males showed that 9 ejaculated sperm when pressing the abdomen, in clear demonstration of reproductive activity. Considered as "Vulnerable" (VU), according to IUCN criteria, *G. mincaronei* is caught as bycatch by commercial deep-sea fisheries, which may pose a serious threat to this species. As its ecological role is virtually unknown at present, therefore this species needs a bigger research effort that generates better information about its life history, distribution and abundance. In this way, it will be possible to set effective conservation and management plans for *Galeus mincaronei*.

Keywords: Scyliorhinidae, deep-water shark, conservation.

Occurrence, spatial prediction and habitat overlap of sharks and rays in the southern end of the Brazilian continental shelf

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The majority of shark and ray species have suffered from high population declines caused by overfishing. Understanding habitat use, predicting its distribution, and identifying areas of greater concentration have made it possible to clarify ecological questions relevant to the conservation and management of the group. Thus, this work aims to identify and predict areas of occurrence and to calculate the habitat overlap of two species of sharks (*Carcharhinus brevipinna* and *Rhizoprionodon lalandii*) and two species of ray (*Myliobatis goodei* and *M. ridens*) at the southern end of the Brazilian continental shelf, using the maximum entropy approach (MAXENT) and Schoener overlap, adapted for the study, with values between 0 (minimum overlap) and 1 (maximum overlap). Presence and absence data were obtained from observers in fishing with gill nets. The abiotic variables used in the models were bathymetry, inclination of the seabed, distance to shore, surface temperature and chlorophyll-a concentration. The data were grouped and analyzed in two groups (sharks and rays) and two periods (spring and summer - autumn and winter). Were recorded 487 elasmobranchs (121 *C. brevipinna*, 82 *R. lalandii*, 131 *M. goodei* and 153 *M. ridens*) at 124 points, between 2 and 120 m depth. Bathymetry and surface temperature were the most important variables in all scenarios, explaining on average about 80% of the variability. During the summer the occurrences were predominant within the 20 m isobath, mainly in the region between the Farol Sarita and Albardão. In winter the occurrences were predominant to the south between 20 and 50 m and to the north between 50 and 100 m. Habitat overlap also had a similar pattern between groups and periods with values above 0.70 in all scenarios. The pattern of occurrence can be explained by the reproductive migratory movement, antipredation strategies and the presence of the Brazil and Malvinas currents that bring waters of different temperatures to the region. The four species studied give birth in low depth areas in late spring and early summer, at high temperatures (Brazil current). During periods of lower temperatures (Malvinas current) the species move to deeper areas. The high overlap of habitats is an important factor for the conservation of the species, since management strategies aimed at the preservation of the area of occurrence will act in a greater range of species.

Keywords: *Carcharhinus brevipinna*, habitat use, *Myliobatis goodei*, *Myliobatis ridens*, *Rhizoprionodon lalandii*.

The influence of fasting and feeding on nitrogen excretion and metabolism in captivity brownbanded bamboo shark (*Chiloscyllium punctatum*) at different salinities

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Marine elasmobranchs are ureothelic organisms which synthesize, retain, and excretes preferentially urea as the end-product of nitrogen metabolism, maintaining their internal body fluids iso-osmotic or slightly hyperosmotic relative to the external environment. In these animals, the high requirement for nitrogen for both growth and maintenance of their ureosmotic strategy, might make elasmobranchs limited by the availability of food. Thus, the present study aimed to evaluate the rates of waste excretion of the main nitrogen end-products (ammonia_N and urea_N), oxygen consumption, nitrogen quotient, and levels of nitrogen compounds (ammonia and urea), osmolality, major ions (Na+ and Cl-), total protein and glucose in plasma of captive juvenile *Chiloscyllium punctatum*. The specimens were acclimated to both 32 and 20ppm, and kept on regular feeding regime (23% of body weight) or fasting for 7 days. The results showed that urea is the main nitrogen product excreted by brownbanded bamboo sharks kept at both fasting and feeding regime. After feeding, sharks at 32ppm significantly increased ammonia excretion, an effect not seen in animals acclimated to 20ppm. However, at lower salinity, animals quantitatively increased the total nitrogen excretion, particularly fasted sharks, as seen by the increased ammonia and urea excretion rates in comparison with animals maintained at 32ppm. Oxygen consumption was not affected by either fasting or feeding regime at both tested salinities. The nitrogen coefficient showed that the aerobic metabolism of brownbanded bamboo sharks acclimated to both 32 and 20ppm is highly dependent on the oxidation of proteins and amino acids, as already reported to other elasmobranchs species. At 32ppm, *C. punctatum* displayed an increase in catabolism of proteins related to the strategy of nitrogen conservation, particularly related to ammonia synthesis, while an increase in anabolism associated with synthesis of both urea and protein was seen in animals acclimated to 20ppm. The acclimation to lowered salinity resulted in decreases in plasmatic urea and chloride levels of *C. puncatum*, resulting in lowered osmolarity, suggesting that these animals have the ability to regulate the concentration of these osmolytes in their internal fluids, to maintain their osmotic balance in environments where external salinity is reduced. Overall, our results indicate that in lowered salinities the juveniles *C. punctatum* are strongly limited by the nitrogen acquired through feeding in order to maintain their ureosmotic strategy, and that fasting for prolonged periods at low salinities can negatively disturb their osmoregulatory homeostasis and affect the retention of nitrogen by the animals.

Keywords: urea, ammonia, fasting, oxygen consumption, nitrogen quotient.

Genetic diversity of spiny angelshark *Squatina guggenheim* in Southeast Brazil

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The spiny angelshark (*Squatina guggenheim*) is an endemic, relatively small, shelf bottom-dwelling shark of the Southwest Atlantic. It is distributed from the Rio de Janeiro State in Brazil until the northern Argentine Patagonian. Despite its endemism, the species is possibly composed of heterogeneous local populations throughout its distribution range with distinct patterns of genetic diversity, migration and gene flow. *S. guggenheim* is under legal protection in Brazil though it is frequently caught, mostly as by-catch, by fishing trawlers and gillnets. Its abundance decreased by 85% already, mostly due to their life-history traits coupled with large population depletion, the species is assessed as "Endangered" in the Red List of Threatened Species of the International Union for Conservation of Nature (IUCN). So, in order to characterize the species genetic diversity and genetic population structure, the present study sequenced the mtDNA control region of 55 individuals from four localities from São Paulo State, Ubatuba, Santos, Cananéia and Cardoso Island in Brazil. The sequences measure 747 base pairs and identify 6 haplotypes, the haplotype and nucleotide diversities are 0,00174 and 0,527 respectively. The AMOVA results in $\phi ST = -0.04149$, corresponding to the absence of populational structuring between the sampled locations. These preliminary analyses demonstrate a low genetic diversity, typical in endangered species, and the characterization of a single population in this region. The results are important for the proper endangered species assessment because the ongoing population depletion can reduce even more the genetic diversity and compromises the species evolutionary-adaptative potential or could extinguish different lineages or even entire local populations. Continuing the survey with the inclusion of individuals from the whole species occurrence area will allow genetic stocks delimitation, the haplotypes distribution, migration, and gene flow to promote management plans fitted to their ecological needs, being of great relevance for conservation efforts.

Keywords: *Squatina guggenheim*, mtDNA control region, genetic diversity, genetic population structure, conservation.

The impact of simulated capture stress on elasmobranch cardiac function

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High levels of plasma potassium (hyperkalemia) and acidosis following capture are often thought to be indicative of post-release mortality. However, while hyperkalemia is known to disrupt cardiac function in vertebrates, this has yet to be evaluated in elasmobranch fishes. To investigate this link, isolated cardiac strip performance was measured under hyperkalemic (7.4 mM K+), acidotic (a pH decline of 0.26 units), hypoxic, and acute temperature (+/- 5° C) challenges. The ability of a b-adrenergic agonist (isoproterenol, 9 mM) to ameliorate negative effects of simulated capture stress was also assessed. Cardiac strips were harvested from three phylogenetically disparate (but sympatric) species from the coastal Mid-Atlantic: clearnose skate (*Rostraja eglanteria*), smooth dogfish (*Mustelus canis*), and sandbar shark (*Carcharhinus plumbeus*). All data were analyzed using generalized linear mixed models with Tukey's post-hoc tests for significance. We found a significant negative impact of hyperkalemia on net force across all species (p<0.05), and a significant negative impact from the acidosis and hypoxia in sandbar shark (p<0.05). Temperature did not impact net force generation. Isoproterenol significantly increased force from the hyperkalemia treatment across species (p<0.05) to levels that equaled or exceeded control values. Our data demonstrate hyperkalemia has a detrimental impact on cardiac function in elasmobranchs, which likely impairs cardiac function post-capture when high cardiac output is necessary. Our results also imply that future work attempting to use at-vessel blood chemistry measurements to assess post-release mortality should consider the ability of individual species to invoke an adrenaline response before assuming hyperkalemia alone is indicative of mortality.

Keywords: cardiac, capture stress, hyperkalemia, acidosis, heart.

Biological data of the lizard catshark *Schroederichthys saurisqualus* Soto, 2001 captured on the southern coast of Santa Catarina, Brazil

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Schroederichthys saurisqualus is a small shark endemic to the southwestern Atlantic and occurs on the continental shelf break to the upper slope of southeastern-southern Brazil between 122 to 435 m. At early 2000 decade, the Brazilian government had promoted an international fishing vessel leasing for deep sea fisheries starting the exploration of these areas that previously not sought by the national fishing fleet. Some national vessels also started to fish at deep areas and provided specimens of several species that were collected and preserved for future studies. The present work shows results of the analysis of 124 specimens of *S. saurisqualus*, 65 females (52%) and 59 males (48%) that were collected at depths between 280 and 500 meters, in front of the coast of the State of Santa Catarina (South of Brazil), from September and October 2002. The composition of sizes ranged from 25.2 cm up to 61.0cm total length (TL) for males, and 28cm to 60.2cm TL for females. All males above 58 cm possessed claspers calcified with presence of sperm by pressing the abdomen, and males around 55cm TL showed claspers in beginning of calcification. Seven females (52.4 the 60.2cm TL) presented eggs in formation in their oviducts. The length frequency distribution proved to be relatively uniform for males between 34 to 54cm, while females showed a unimodal in 38cm TL. There was no significant difference in length-weight relationship between males and females (t-test; p> 0.05), obtaining the equation: TW= 3,0831TL0,0082 (R^2 = 0.9573). The liver weight of this species represented 1.5% of the medium total weight. The analysis of stomach contents showed that the species feeds on squid (*I. argentinus*) (76.86% of stomachs examined) crustaceans (family Aristeidae) (11.57%), unidentified Teleost (7.44%), crayfish (1.65%), gastropod, isopoda and polychaete unidentified (0.83% each). The data suggests that *S. saurisqualus* feeds over squids in areas of breeding season of the *I. argentinus*. As well as, adult males and females *S. saurisqualus* use these sites for copulation, a fact corroborated by the capture of ovigerous females and adult males. This feature increases the vulnerability of the species to bottom trawling, representing a threat to this species. As *S. saurisqualus* has the status of "Vulnerable" (VU) in its IUCN overall assessment, it is necessary a greater research effort to determine features of life history, distribution and abundance of species, and thus, facilitate the establishment of effective conservation measures.

Keywords: Scyliorhinidae, deep-sea shark, conservation.

Biological data of the Sharpnose Sevengill Shark *Heptranchias perlo* Bonnaterre, 1788 captured on the Southern Coast of Santa Catarina, Brazil

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Heptranchias perlo is a cosmopolitan lecithotrophic shark from external shelf and upper continental slope that inhabits between 100 to 1000 meters deep along Brazilian coast. At early 2000 decade, the Brazilian government had promoted an international fishing vessel leasing for deep sea fisheries starting the exploration of these areas that previously not sought by the national fishing fleet. Some national vessels also started to fish at deep areas and provided specimens of several species that were collected and preserved for future studies. The present work shows the results of the analysis of 203 individuals, which 114 females (56%) and 89 males (44%) were collected at depths between 280 and 500 meters, off the south coast of the Santa Catarina State (South of Brazil), between September and October 2002. The size composition ranged from 24.4 cm to 57.7 cm, indicating that all were young (maturation TL ~ 87 cm). There was no significant difference in length-weight relationship between males and females (t-test; p> 0.05), obtaining the equation: TW= 2E-06TL3,049 (R2= 0,86). The liver of this species represented an average weight of 4.3% of its medium total weight. The length-frequency distributions were strongly unimodal for males (38cm TL) and trimodal for females (27.0cm, 34.0cm and 45.0cm TL). Analysis of the stomach contents of 116 specimens revealed that 76.3% had a low degree of stomach repletion (1/4 full) and that 92.0% had squid remains (*Illex argentinus*). Our results suggest that the food strategy adopted by the young shark *H. perlo* is associated with the seasonal availability of the food resource *I. argentinus*, which lives in the same areas and it is related with the squid reproduction timing. This fact exposes the population to bottom trawling that targets squid, representing a serious threat to this shark species. As *Heptranchias perlo* has the "near-threatened" (NT) status (IUCN) in its global evaluation, it is necessary a greater research effort to determine life history, distribution and abundance characteristics that are essential for establish conservation measures for this species.

Keywords: Hexanchidae, deep-sea shark, conservation.

Movement patterns and diving behaviour of juvenile reef manta rays in a nursery area of Raja Ampat's Wayag lagoon

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Though conservation and management of reef manta ray populations (*Mobula alfredi*) in Indonesia have shown considerable advances in the past six years, data on the behaviour and movement patterns of newborn and juvenile mantas is sparse and is urgently needed to inform better conservation planning. Here we report on the spatial movements and diving behaviour of five juvenile reef mantas from a confirmed manta nursery ground in the Wayag lagoon in northwest Raja Ampat, as divulged by GPS Fastloc-enabled satellite tags deployed on these mantas in 2015 and 2017. The estimated disc width of the five tagged juveniles ranged from 1.9 to 2.3 m. Tracking periods ranged from 14 to 71 days. Home range estimation using Autocorrelation Kernel Density Estimation (AKDE) showed that each of these juveniles spent the majority of their time within the 2,500 ha Wayag lagoon, with occasional short excursions outside the lagoon. The furthest trip outside the lagoon reached 50 km. The juveniles frequently dived to 88 m depth (the maximum depth of lagoon), and occasionally dived as deep as 416 m during excursions outside the lagoon. Nonetheless, all individuals spent the majority of their time in shallow water, averaging 15–37% of their time at the water's surface, 17–32% at 1–5 m depth, and 28–75% of their time in the 5–50 m depth range. Over 90% of the mantas' time was spent in water temperatures between 28–30o C. The high residency of juvenile reef mantas in the Wayag lagoon highlights the importance of this area in providing shelter during their early life stages, and the urgent need for management interventions to limit potentially harmful boating activities inside the lagoon.

Keywords: juvenile reef manta, satellite tagging, manta nursery, Raja Ampat, movement pattern.

Trophic niche variability of an elasmobranch assemblage revealed through stable isotope analysis

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Elasmobranchs can encompass a variety of trophic niches and are considered important apex and mesopredatory species. The northcentral Gulf of Mexico supports high elasmobranch diversity, which suggests efficient resource use among these species. To investigate elasmobranch trophic patterns in this region, we examined spatial and temporal trends in carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios. We conducted bottom longline surveys from Mississippi, USA to Florida, USA, where we collected blood plasma samples for stable isotope analyses. We sampled 340 individuals across 14 species of elasmobranchs and found isotope values varied by species, size, and sex, as well as seasonally and regionally. Values ranged from -15.2‰ to -24.5‰ and 10.7‰ to 16.6‰ for carbon and nitrogen, respectively. Much of this isotopic variation can be accounted for by the following three species: Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), blacktip shark (*Carcharhinus limbatus*), and southern stingray (*Hypanus americanus*). δ^{13}C values of *R. terraenovae*, a small coastal shark species, covered a range of 3.3‰ while δ^{15}N values ranged from 13.0‰ to 15.9‰, the highest of the three species. An ontogenetic shift in carbon and nitrogen values was shown for males, but not for females. *C. limbatus*, a larger coastal shark species, showed the highest variation in δ^{13}C values, -15.2‰ to -22.0‰, yet covered a relatively narrow range of 2.0‰ for nitrogen. Carbon varied ontogenetically for male and female sharks, but no trend was found for nitrogen. Lastly, the benthic species *H. americanus* occupied a range of 3.5‰ for carbon and ranged from 10.7‰ to 14.9‰ for nitrogen, suggesting they feed at the lowest trophic level. An ontogenetic shift was found for female *H. americanus* for both carbon and nitrogen, but not for males. To quantify isotopic niches between species, we generated standard ellipses and found *C. limbatus* occupied the largest isotopic niche. However, isotopic niche size varied seasonally, with *C. limbatus* occupying the smallest isotope niche in spring, but nearly doubling in size in the fall. All three species exhibit different feeding behaviors, yet show trophic niche overlap across seasons, suggesting possible seasonal shifts in prey availability and/or feeding habits. These findings characterize an isotopically diverse predatory guild and help elucidate feeding habits for these species across the northcentral Gulf of Mexico.

Keywords: stable isotopes, Gulf of Mexico, blood plasma, trophic niche.

Baseline assessment of the coastal elasmobranch fauna of eastern Cabo Verde using baited remote underwater video

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An increasing onus on tropical elasmobranch management by multilaterals, regional bodies and nations has revealed a paucity of data on abundance, distribution and fisheries. The Republic of Cabo Verde is drafting their national plan of action for sharks and a lack of coastal fisheries dependent and independent information on elasmobranchs necessitated the creation of a baseline. From 2015 through 2017, 203 baited remote underwater video (BRUV) replicas were deployed around the eastern islands of Sal, Boavista and Maio, including the remote offshore reef João Valente. Over 200 hours of footage revealed 216 elasmobranchs spanning 16 species from 6 taxonomic families. The BRUV catch per unit of effort (CPUE) yielded 1.064 elasmobranchs hour-1 and a frequency of occurrence of 1.345. Three findings were particularly notable: i) CPUE was highest in Maio (1.298) – the island with the smallest human population, followed by Boavista (1.0) and Sal (0.937); meso-predatory often demersal, species such as *Mustelus mustelus* and *Paragaleus pectoralis* constituted the majority of observations, with the latter not recorded for the island of Sal. ii) Inversely, Carcharhinidae spp. were observed in considerably greater abundance in Sal (0.413), followed by Boavista (0.253) then Maio (0.105), although many sites displayed an absence of large-bodied Carcharhinids, including all recordings from João Valente. iii) Species richness was consistent across islands with Boavista and Sal recording the highest number of species (11) then Maio (9). More putative nursery areas were identified in Boavista evidenced by the high number of neonate and juvenile species observed, particularly Carcharhinidae. Results suggest that amongst Cabo Verde's eastern islands there exists high relative diversity and abundance of coastal elasmobranchs compared to populations in West Africa, nonetheless, higher trophic levels species show evidence of intensive exploitation. This trend is most notable in the decreasing abundance of Carcharhinids with increasing proximity to the capital city Praia, such latitudinal distinctions suggest fishing effort from the capital is negatively affecting the abundance of large-bodied higher trophic predators. Our study suggests that artisanal and semi-industrial fisheries are catching more elasmobranchs than recorded and are strongly impacting coastal populations. This study revealed several critical pupping, nursery and feeding habitats for threatened elasmobranch species including the scalloped hammerhead (*Sphyrna lewini*), which have broader conservation significance for populations and warrants focused local and national management efforts to support population persistence.

Keywords: Elasmobranch, BRUV, baseline survey, marine megafauna.

Use of traditional ecological knowledge to reveal trends in the artisanal and elasmobranch fisheries of Cabo Verde

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In the absence of comprehensive landings or fisheries-independent field data on artisanal fisheries, the collection of traditional ecological knowledge (TEK) can provide a historical and contemporary overview of marine species, their distribution and fisheries. Standardised structured interviews (n=217) were conducted with traditional fishers in Cabo Verde to characterise historical and contemporary coastal artisanal fisheries and elasmobranch captures. Results reveal that 88% of fishers acknowledged having caught sharks, with endangered hammerheads (*Sphyrna spp.*) cited as the most widely captured species. Only 3.2% of fishers acknowledged targeting sharks. Historically, shark meat had little value in Cabo Verde, however, cultural and religious linkages have seen dried shark meat replace dried cod imported from Portugal. This increase in consumption of dried shark meat (known locally as cação) is driving targeted fisheries whilst growth in other fisheries and the expansion of the use of gillnets, is resulting in higher incidences of bycatch, with at least 4 locally identified shark nursery areas overlapping with key fishing ports. Rays are reportedly not targeted but, similarly to sharks, are taken opportunistically in demersal fisheries, where they are consumed or used as bait. Almost all fishers (95%) noted a decline in marine resources over the past 5-10 years, with 70% perceiving significant reductions in the number of sharks captured. Although artisanal shark fisheries remain small and under-developed by comparison to those in continental West Africa, results indicate that these are increasingly commercial and extractive. In combination with high levels of fishing effort across the majority of other fisheries, including the foreign industrial fleets operating within Cabo Verde's waters, artisanal fisheries are having a significant impact on elasmobranch populations. Conversely, widespread underreporting of catches and a lack of fisheries management is obscuring the true status of elasmobranchs in Cabo Verde. Results of this study are considered conservative: although fishers interviewed were anonymous and care was taken with the structure and delivery of survey questions, fishers were often reluctant to share information as many believe elasmobranch fisheries to be illegal. Fisher responses highlight the need for greater community-based work to understand the drivers of elasmobranch fisheries and fisheries-independent monitoring to improve management of near-shore elasmobranch populations for their long-term persistence.

Keywords: social surveys, TEK, shark and ray fisheries, Atlantic, west Africa.

When sharks are away, rays will play: consequences of top predator removal on coral reef ecosystems

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Many elasmobranch populations are decreasing globally due to overfishing, however the ecosystem effects of these decreases are poorly understood. Southeast Asia has the highest level of elasmobranch catch globally, while the Western Pacific, in coastal areas, has a relatively low level of elasmobranch catch. However, both of these regions are relatively understudied relative to elasmobranch abundance. The aims of this study were to investigate the ecological consequences of removal of sharks from coral reef ecosystems, including changes in community composition and species behaviour. Baited Remote Underwater Video Systems (BRUVS) were deployed at 20 sites across six countries (American Samoa (2), Australia (3), Indonesia (4), Malaysia (4), Solomon Islands (3), and Vanuatu (4)) to determine elasmobranch presence, relative abundance, and document interactions between sharks and batoids. Batoids were significantly more abundant at Southeast Asian sites, while sharks were present in signifi-cantly higher abundances in the Western Pacific. As batoids can be major diet components for some sharks, differences in relative abundance of sharks and batoids between the two regions was quantified to look for evidence of mesopredator release, or al-ternatively, if differences resulted from variations in batoid behaviour under different levels of predator abundance. Preliminary results showed that when shark abundance was low, batoids spent significantly more time in view and repeatedly visited the same BRUVS, suggesting bolder behavior in the absence of sharks. This trend was primarily observed in smaller batoid species which are more likely to be prey for a larger suite of shark species. These results suggest that removing top predators from coral reef systems will not only affect abundance of lower trophic species, but also prey behaviour. Understanding the consequences of predator removal on coral reefs is important for the future for fisheries, tourism, and overall ecosystem health.

Keywords: Southeast Asia, Western Pacific, ecology, BRUVS, predator-prey relationships.

Shark conservation activist perspectives on science and management: results of a global survey

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At the last Sharks International in South Africa, I presented the results of a global survey of shark researchers. It showed that vast majorities of researchers believe that sustainable shark fisheries are possible, exist in the world today, and should be the goal of conservation policymaking instead of fisheries and trade bans. However, in recent years, the majority of conservation advocacy has focused on fisheries and trade bans. To attempt to determine the source of this mismatch in priorities and effort, I distributed a voluntary online survey to employees of organizations that focus on shark conservation. Questions focused on policy preferences, understanding of the state of management-relevant shark research, and perspectives of scientist interactions with the conservation community. Results will be compared with scientist preferences, and placed into the broader context of the research-advocacy-policy interface.

Keywords: shark conservation, social science, knowledge and attitudes, management, policy.

Community-wide metrics suggest comparable trophic structure of skate assemblages at ocean basin scales

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The trophic behavior of predators is an essential component of ecosystem functioning, knowledge of which can aid contemporary, holistic management approaches. Skates are a speciose, cryptic group of marine predators, which serve important ecological functions throughout global benthic food webs. Despite the ecological significance of skates, little is known of their trophic behavior, particularly whether communities display similar trophic characteristics at ocean basin scales, and the associated implications this may have for broader ecosystem function. Carbon and nitrogen stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$) were generated from 11 species (632 individuals) to compare the trophic characteristics of skate assemblages across three locations: central California, the Gulf of Alaska, and the northwest Atlantic Ocean. Specifically, the following community-wide metrics were calculated based on bivariate species means: carbon range (CR), nitrogen range (NR), total area of convex hull (TA), mean distance to centroid (CD), mean nearest neighbor distance (NND), and standard deviation of the nearest neighbor distance (SDNND). At the community-level, skate assemblages exhibited similar resource-use dynamics (similar CR, NR, and CD values), suggesting species may forage on a similar diversity of prey items, within food-webs supported by a single primary production source. Similarly, the relative degree of species packing (NND, SDNND) appeared highly uniform across all communities, implying potential functional trophic redundancy. Individual species did, however, display differentially sized isotopic niches (TA), suggesting some trophic niche specialization may occur between species within each community, potentially to reduce high levels of resource competition. Collectively, our findings present a robust comparison of community-wide trophic behavior within skate assemblages, suggesting high uniformity across spatially segregated biomes. Such information provides novel perspective from which to link the functional traits of poorly-studied predators with broader ecosystem function.

Keywords: Stable isotope analysis, niche, Atlantic ocean, Pacific ocean, Rajidae.

Lifting the largest fish in the world: Indonesian whale shark finmount tagging program

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The movement and behavior of whale sharks (*Rhincodon typus*) hasn't been fully understood, mainly due to challenges in deploying biologging devices long enough in order to capture the full picture of its elusive behavior. In Indonesia, whale shark commonly aggregates near the "bagan" liftnet vessels which target and aggregate the small baitfish and mysid shrimps that the whale sharks also like to eat. In the process, the shark is frequently caught in the fishermen's net. This provide us with a unique opportunity to deploy 40 Wildlife Computer SPLASH10-346A finmount satellite tags in 3 areas in Indonesia, Cenderawasih Bay, Kaimana, and Sumbawa. All shark tagged is juvenile, ranging from 3-7.51 meter total length (mean = 5.29 meter), and all is male, except for a 5.16 meter female from Sumbawa. So far, we have analyzed 88 – 499 days of consecutive data from 15 tags that is deployed in Cenderawasih Bay from June 2015 to May 2016, where mean track length = 2,496 km from initial tagging position (range = 676 - 5,154 km). Even though from this study reveals interesting movement pattern beyond Indonesia's ZEE, most of the sharks are spending their time close to the initial tagging location. With this novel technique that we've developed, we are now able to perform a full body measurement of the shark on ±1 cm detail. Given that we're also able to recapture previously tagged shark on a relatively high frequency, we're able to detach the satellite tag and download the high resolution archived depth and temperature data. All that, while also performing another measurement to assess the growth of the animal. In July 2017, collaborating with the Georgia Aquarium, we've successfully performed world's first wild whale shark health assessment, exploiting this unique opportunity to draw biological samples from the shark. The data obtained suggested that neither the bagan interaction nor the attachment of satellite tags is a significant stressor. These information is used by our partner, Government of Indonesia, in developing a better whale shark tourism management. This technique has opened a pathway to uncover the elusive behavior and life history of the whale shark. As a next step, in near future our team are planning on deploying accelerometer tag in order to better understand the diving behavior of Indonesian whale sharks.

Keywords: whale shark, *Rhincodon typus*, finmount, satellite telemetry, Indonesia.

Morphometric differences between females of *Squalus albicaudus* and *Squalus* cf. *mitsukurii* caught from Pernambuco, Brazil

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A large number of sharks and rays show a high degree of morphological characters overlapping between species and distribution areas, presenting, consequently, a great difficulty for taxonomic differentiation. The genus Squalus) is a good example of that problem. It has presently 30 recognized species, of which 4 were recently described for the southwestern Atlantic Ocean. In the present study, 15 females of *Squalus albicaudus* and 15 females of *Squalus* cf. *mitsukurii*, caught in the coast of Pernambuco, northeastern Brazil, were compared with regard to their morphological differences. From each individual, 45 measurements were taken and were expressed as percentages of total length (% TL), in centimeters (cm). The T test was used to verify the statistical significance of the differences ($P < 0.05$). The mean TL for *S. albicaudus* was 58.68 ± 1.63 (mean ± error), while for *S.* cf. *mitsukurii* it was 82.79 ± 0.64. Forty-two of the 45 measurements were significantly different, with greater discrepancy in the upper dorsal caudal margin (CDM), the distance between second dorsal-fin insertion and origin of upper caudal lobe (DCS), and distance from origin of lower caudal lobe to the point of greatest curvature of the ventral caudal lobe (CPV). For *S. albicaudus* the values found were CDM= 17%- 18% TL, DCS= 12%-13% TL, and CPV= 8%- 9% TL. For *S.* cf *mitsukurii* these percentages were, respectively: 19%- 27% TL, 11% TL, and 10%- 11%. Values of trunk width (TRW) and height (TRH) also presented statistically significant differences, but these measures may vary according to the physiological condition of the animal (nutritional condition, gestational period, etc.). For *S. albicaudus*, these values were TRW= 10%- 11% TL and TRH= 8% TL; while for *S.* cf *mitsukurii*, these values were TRW= 12%- 14% TL and TRH= 9%- 11% TL. These results show the importance of morphological characters to differentiate these two species, since 93% of the measurements, 53% of which related to the fins, were significantly different.

Keywords: morphology, brazilian whitetail dogfish, Southwestern Atlantic Ocean.

Identification of the bacterial composition of different captive and wild stingray species and body parts from Rio de Janeiro, Brazil

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Bacterial communities consist of many species interacting with each other, making it difficult for the host to exert control over each species individually. This microbiota is important for hosts, facilitating nutrient absorption, regulating individual metabolism and defending against pathogens. Knowledge on the elasmobranchial bacterioma is scarce. Thus, the aim of this study was to investigate the bacterial composition of the sting and skin mucus of wild (Guanabara Bay) and captive (AquaRio) stingrays. Samples (dorsa and stings) were collected from *Gymnura altavela* from Guanabara Bay, along with sediment and water from the same site, and from AquaRio. *Dasyatis hypostigma* adults and neonates have been studied only at AquaRio. Total DNA was extracted using PowerSoil DNA isolation kit, sequenced by Ilumina Miseq Series and processed using Quantitative Insights into Microbial Ecology. High quality sequences were grouped into operational taxonomic units (OTUs) and data generated up to genus. At Guanabara Bay, Proteobacteria (45%) dominated, followed by Bacteriodetes in water, sediment and sting samples, while Actinobacteria from stingray dorsa were noteworthy. A genus OTU from Chromatiales (Proteobacteria: Gammaproteobacteria) was more abundant in sediment (14%) and sting (12.6%) samples, while in water an OTU from Alteromonadales (9.3%) (Proteobacteria: Gammaproteobacteria) predominated. Regarding dorsum samples, *Mycobacterium* (7.9%) (Actinobacteria: Mycobacteriaceae) was dominant, while Chroma-tiales displayed importance (2.5%). Chromatiales are gram-negative bacteria restricted to superficial, anoxic and organic environments, such as sediments. *Gymnura altavela* is demersal, facilitating colonization by these microorganisms. In captivity, Proteobacteria dominated, except for *D. hypostigma* and *G. altavela* stings, exhibiting many Bacteriodetes (40%). *Sediminibacterium* (Bacteriodetes: Chitinophagaceae) was abundant in *D. hypostigma* (71%) and *G. altavela* (50%). *Oceanimonas* (Proteobacteria: Aeromonadaeae), on the other hand, dominated on the backs of adult *G. altavela* (47.5%) and *D. hypostigma* (25.8%). Neonate *D. hypostigma* dorsum samples displayed mainly *Corynebacterium* (Actinobacteria: Corynebacteriaceae) (14.7%). This genus is related to infections in animals. In neonate water samples, a Rhodobacteraceae genus (7.9%) was prominent, comprising *Tenacibaculum* (7.6%) (Bacteroidetes: Flavobacteriaceae). *Tenacibaculum* is responsible for skin lesions in fish. The dominant genus in the adult stingrays was the same and both adult and neonate *D. hypostigma* shared 3 OTUs of the 10 most abundant genera. However, adult *G. altavela* did not present any OTU in common with neonates. When comparing wild and captive *G. altavela* specimens, a dominance of almost 50% of one genus in the captive rays was observed. Unlike wild rays, the most abundant OTU was of 10%, indicating that Guanabara Bay stingrays display a more diverse taxonomic composition than captive animals.

Keywords: Guanabara bay, bacteriome, rays, elasmobranch.

Analysis of the bacterial diversity of different captive and wild stingray species and body parts from the coast of Rio de Janeiro, Brazil.

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Organisms with all their associated microorganisms are an evolving selection unit. This coexistence is intended to attempt increases in microorganism fitness, and, generally, also increases that of the host. Information regarding the bacterial composition of stingrays, however, is still very incipient. In this context, the aim of this study is to investigate, for the first time, the bacterial community present on the sting and skin mucus of wild (from the Guanabara Bay, Rio de Janeiro) and captive (Rio de Janeiro Marine Aquarium - AquaRio) stingrays, and verify if the surrounding environment displays any influence on these bacterial communities. *Gymnura altavela* (Spiny Butterfly Ray) samples were obtained from Guanabara Bay with sediment and water. Adult and neonate of *Dasyatis hypostigma* (Groovebelly Stingray) and the water where the neonates inhabited were obtained from AquaRio. A non-lethal methodology was applied, where swab samples were taken from the dorsum of the stingrays and stingers were cut. Total DNA was extracted using the PowerSoil DNA isolation kit and the samples were then submitted to sequencing on the IluminaMiseq Series platform. Data processing was performed using the Quantitative Insights Into Microbial Ecology program package. A total of 1,019,459 sequences were obtained from the 26 analyzed samples through the analysis of the 16S rRNA gene and new generation sequencing. Regarding the beta-diversity analyses, using non-metric multidimensional scaling and PERMANOVA, only water and sediment from Guanabara Bay were significantly different (p=0.029), while the other samples presented similar bacterial communities, indicating the influence of the medium on *G. altavela* microbiota, with no distinction between body parts (dorsum skin mucus/sting). This scenario was different for the captive rays, comprising a group formed by the sting samples of both species and another comprising the dorsum swab samples, indicating that the diversity difference conditioner is the sampled site (dorsum skin mucus/sting) and not stingray species. The dorsa of the two adult captive species did not, however, differ, while *G. altavela* and *D. hypostigma* neonates were significantly different (p=0.027). As for *D. hypostigma* adults and neonates, there was no difference in diversity, whereas a significant difference was observed (p=0.004) between neonate dorsa and water. Thus, it is concluded that the medium plays an important role in stingray bacteriomas, whether wild or captive, as well as different parts of the body, although further studies are still required to better understand the ecology and the role of these microorganisms.

Keywords: Guanabara Bay, bacteriome, rays, elasmobranch.

The combined use of remote sensing and fuzzy logic to help identify areas of susceptibility to shark occurrence

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The southern coast of the metropolitan region of Recife is an example of an imbalanced environment. The construction of the port of Suape, which caused the morphological and estuarine modification of the region, forced sharks that used to live in the surrounds to migrate to the north, where there are similar environmental characteristics to Suape, such as sea surface temperature (SST) and the concentration of chlorophyll on the surface of the sea (SSC). The numbers of shark attacks on the coast present lethal risks to the population. The main species recorded in the incidents are: *Galeocerdo cuvier* (Tiger shark) and *Carcharhinus leucas* (Bull shark). These species usually frequent coastal waters with high temperatures located mainly in tropical and subtropical regions of the Oceans. The objective of this work is to evaluate the use of data obtained by Remote Sensing and create maps of susceptibility to the presence of sharks. For validation, the susceptibility levels were compared with 37 attacks occurred in the period between 1997 and 2013. Due to the lack of geographic coordinates associated with shark attacks, they were spatially mapped taking into account land-based reference sites. Three distances (minimum, medium and maximum) were estimated

for each attack according to the type of activity of the victims during the attack. For the generation of the susceptibility maps, fuzzy logic was used on 24 climatological images of SSC and SST, between January and December from 2002 to 2017. For this analysis, two transformations were performed for normalization: one linear, for SSC data and one Gaussian for SST. Due to the interest in acquiring a more restrictive product, the AND operator was used, once the output controlled by the lowest membership value. Five classes, from very low to very high, were stipulated for the susceptibility to the presence of sharks. To increase reliability over imprecise addressing, a regular rectangular grid was built under the addressed points. The results indicate the predominance of the very low class on the occurrence of attacks. Nevertheless, the months of May, June and July obtained pixels of low susceptibility, coinciding with cells with occurrence of shark attacks, totaling respectively 27%, 24% and 48% of total recorded attacks. In this way, it fair to say that remote sensing data integrated with geoprocessing techniques can be used as an auxiliary tool to identify areas susceptible to the presence of sharks.

Keywords: geoprocessing, remote sensing, shark attack, fuzzy logic.

Hydrodynamics and morphodynamics of an atypical lemon shark nursery (Atol das Rocas)

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Atol das Rocas is described as an atypical nursery area for lemon sharks (*Negaprion brevirostris*), characterized by extreme tides and a lack of seagrass flats and mangroves. These differences in physical characteristics are thought to influence the behavioral ecology of young lemon sharks, such as survival rates, growth rates and population size. Here, we investigate the hydrodynamics characteristics and morphological changes of the nursery area on Atol das Rocas, in order to assess their influence on habitat use of by lemon sharks. We performed a series of synchronous measurements of the topo-bathymetric changes (between 2012 and 2017) and hydrodynamic data at the tidal channel (Lama Bay) where juveniles and newborns lemon sharks aggregate. The habitat use by lemon sharks was estimated from visual census techniques (between 2006 and 2017) and from previous published data. Results show substantial morphological changes in the Lama Bay, with the migration and enclosure of the tidal channel in the last decades, which causes the aggregation of young sharks at a smaller area close to the inlet. Visual census observations in this area shows oscillation in the abundance of individuals, with a decrease from 2000 to 2002 (average of 40 to 13 individuals) followed by an increase from 2003 to 2006 (average of 33 individuals) and stability from 2006 to 2017 (average of 30 individuals). In addition, the topo-bathymetric data shows the increase of the central flooding area with a progressive increase in the channel depth. This channel is flooded during only 3 h of the tidal cycle due to the high elevation of this part of the atoll. Comparison of water-level records identified a phase lag between the oceanic and Lama Bay water levels, with flood tides in the Lama Bay occurring up to 50 min after the oceanic flood tide. In situ observations of currents velocities (0 m/s to 0.5 m/s), water temperature (25.1 C to 37.1 C), wave height (0 m to 0.15 m) and wave period (0 s to 9 s), shows modulation by tides. Results show that hydrodynamic conditions control the protection window provided by the Lama Bay to young sharks, which are forced to leave the area during ebb tides and expand their movement range over the shallow parts of the lagoon, becoming more susceptible to predation. These results highlight the influence of physical environmental parameters in defining the habitat use of a dynamic nursery by lemon sharks.

Keywords: habitat use, nursery hydrodynamics, South Atlantic Ocean.

Historical fisheries data on the Smalltail shark, *Carcharhinus porosus*, captured in the western equatorial Atlantic

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The Smalltail shark, *Carcharhinus porosus*, is a relatively small species, reaching up to 150 cm in total length. Its distribution is continuous in the western Atlantic, from the Gulf of Mexico to the southern coast of Brazil. The Smalltail shark is mainly a coastal species, but it has been reported at depths greater than 80 m. This species is a mainly piscivorous, opportunistic predator. It is considered 'Critically Endangered' in the Brazilian red list, but is considered 'Data Deficient' by the IUCN Red List of Threatened Species. The aim of this study was to help fill in this gap of knowledge by characterizing *C. porosus* fisheries conducted in the equatorial Southwest Atlantic region in the late 1980´s, specifically from September 1985 to September 1988. This is the first study to report the depth captures for males and females of the Smalltail shark. The specimens were captured by two fisheries: (1) shrimp fisheries off Amapá State (northern Brazil) and (2) hook and line fisheries off Maranhão and Ceará States (northeastern Brazil). A total of 103 specimens were recorded (28 males and 75 females). The fisheries responsible for each capture was recorded for 73% (N=76) of the total number of specimens examined. Most sharks were captured as bycatch of shrimp fisheries (N=64; 84%) off Amapá. The remaining specimens (N = 12; 16%) were captured by hook and line off Maranhão and Ceará. Total length ranged from 33.3 cm to 127.5 cm. Only neonates/juveniles and adults were captured, and young specimens (from 50 to 70 cm) were notably absent from captures. Capture depth varied between 30 and 84 m, with 80% of all individuals caught deeper than 60 m. Moreover, both sexes occurred at practically all depths, suggesting there is no sexual segregation by depth.

Keywords: Smalltail shark, bycatch, depth, distribution.

Preliminary description of deformities in sharks teeth from Cretaceous, Calumbi Formation, Sergipe-Alagoas Basin

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The South Atlantic Ocean was formed along the Cretaceous period and part of its history preserved in the sedimentary sub-basin of Sergipe. The "Calumbi" Formation is one of the most recent geological formations, that develops in the periphery of the Metropolitan Region of Aracaju (Sergipe) and the exposed rocks dated from the Neocretaceous (Campanian to Maastrichtian - 84 to 66 Ma). One of the outcrops of this unit, Calumbi-1 (CAL01), located in the municipality of Nossa Senhora do Socorro, in Sergipe, has a great diversity of fossils, including shark teeth. Here we describe teeth of fossil sharks collected in CAL01, with indications of dental anomalies. The material described here is stored in the Laboratory of Paleontology of the Federal University of Sergipe (LPUFS). Screen washing techniques used to isolate the fossils from the rocky matrix, using two sieves with mesh widths between 5 and 10 mm, respectively. All residues examined and the fossils removed. From a sampling of 1,632 shark teeth, attributed to different species, eleven samples with anomalies and ante mortem morphological changes indicative of pathologies or dental malformations selected, and four of them described here. The LPUFS 5755 distinguished by having a distal cusp without definitive tip, by the absence of proximal cusp formation and by a sharp groove in the cusp, possible indicative of the beginning of interrupted proximal cusp formation. The LPUFS 5756 features a short crown with a slot in its distal side and four slots in its proximal portion, which are divisions of unformed cusps. The rounded root of LPUFS 5756 does not have a nutrient slot. The LPUFS 5764 shows a reversal of polarity on the second distal cusp. The LPUFS 5765 displays an extra proximal dentulo. The teeth described here identified as belonging to the genera *Cretalamnae and Squalicorax*. Studies describing existing shark teeth report anomalies as described here. These studies have linked the occurrence of anomalies with genetic mutations, diseases, nutritional deficiencies or injuries that can result in marked damage to dental tissue, leading to dental malformations. Lesions in the dental tissue, resulting from a diet duropurgical, for example, can explain, according to the literature, the deformities found in the LPUFS 5764 and LPUFS 5765. This is a pioneering study for the sedimentary sub-basin of Sergipe, launching a new look for the recognition of anomalous characters and the possible causes of these deformities in fossil teeth of shark.

Keywords: anomaly, morphology, fossil record, malformations.

A review of the biology, ecology and fisheries of the blue shark (*Prionace glauca*), with emphasis on the Southern Atlantic Ocean

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The blue shark (*Prionace glauca* Linnaeus, 1758) is considered a top predator in tropical and temperate oceanic marine ecosystems, being the most abundant and common species in pelagic longline fisheries. Fishing exploitation can lead to population declines due to the high demand of fins which has grown around the world. For this reason, the present study aims to compile available information on the species in Southern Atlantic Ocean. *P. glauca* is the species of elasmobranch more captured in longline pelagic fisheries (between 85 and 90% of total elasmobranchs in catches). Von Bertalanffy growth parameters reveal that the species has a fast growth and a maximum age around 12 years and maturation between 5 and 6 years. The sex ratio is 1:1 and the reproductive mode of the blue shark is placental viviparous, with a period of gestation of 9 to 12 months and average uterine fecundity of 30 embryos that are born 35-51 cm in total length (TL). The sexual maturity of the females is around 228 cm TL and the males about 225 cm TL. The reproductive cycle occurs with mating in the south of Brazil during the summer, followed by later off the northeast where ovulation and fertilization occurs. A large number of immature and juvenile *P. glauca* were recorded in southwestern Brazil. Although blue shark is highly exploited by fishing, conservation status in Brazil and in the world according IUCN is considering the species as NT (Near Threatened), a categorization that may be related to the need for more updated and reliable data. Despite the number of studies related to distribution, abundance and biology, data for further assessments on the *P. glauca* stock in the Southern Atlantic Ocean are still necessary for the management of the species.

Keywords: biology, fisheries, ecology.

Elasmobranch catch and trade profile in the South Coast of Paraná, Southern Brazil

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It is well-known that artisanal fisheries arose for subsistence purposes, but the commercial aspect was soon developed, and fishers now employ a range of different fishing crafts and modalities, providing an essential source of employment, nutrition and income to coastal communities. The aim of the present study was to describe the catch and trade profile of elasmobranchs in Matinhos, a municipality of great representativeness in the capture and commercialization of sharks and batoids in Paraná state. Data were obtained over five years, through interviews and observations during landing along with artisanal fishers. The community in question uses different methods of capture, targeting different species at different periods of the year. Elasmobranchs were frequently captured when fishermen used purse seine, single trawl, surface gillnet and bottom gillnet, as bycatch or as target-species. Big quantities of adult males and pregnant females of *Zapteryx brevirostris*, adult males of *Pseudobatos spp.*, and adult males and females of *Rhizoprionodon spp.* were captured and marketed in all years of monitoring. Despite the prohibition of capture and landing throughout the national territory, specimens of *Squatina spp.* already fully processed were also observed in large quantities, particularly in 2015, 2017 and first months of 2018. For *Sphyrna spp.*, the landing and marketing of individuals ranging from 50-200 cm were more frequent in 2015, while the landing of individuals ranging from 30-70 cm was more frequent in 2017. The landing of other species such as *Carcharhinus limbatus*, *C. taurus*, *C. obscurus*, *C. falciformes, Galeocerdo cuvier, Rioraja agassizi, Rhinoptera* sp.*, Gymnura altavela* and *Aetobatus narinari* was also observed over the years of monitoring, but in a less representative way, indicating that the catches occur randomly in the region. Commercial value varies from species to species and depends on the regularity of captures, utilization of the body parts and meat quality. All sharks were commercialized, however, regarding batoids, only *Z. brevirostris* and *Rhinobatos* spp. were marketed in the region. Despite the low representativeness of elasmobranch catches from artisanal fisheries and the low adherence of targeted capture in the region, many endangered and prohibited species are landed daily. Stocks have been declining and fishermen stand in a very frail situation, where they are forced to increase fishing effort and travel farther in order to maintain their income.

Keywords: fishing profile, artisanal fisheries, elasmobranchs.

Shark diving industry and food provisioning: a case study in Honduras and South Africa

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Shark-diving industry is a growing and well-established business in many countries, however, it may present implications on shark behavior and ecology, as well as implications for recreational safety when provisioning is involved. The use of bait to controversially attract sharks is common in practices such as cage-diving, baited-dive and shark-feeding, the former two common in South Africa and the latter in Roatan, Honduras. Regarding these three modalities, specific sites were investigated from August to September 2015 in South Africa and from July to August 2017 in Roatan. Cage-diving involves chumming to attract Great Whites, while baited-diving attracts sharks, such as Zambezi, Tiger and predominantly Blacktip by the use of a drum filled with bait. Shark-feeding is attributed to provision of fish from a bucket to Caribbean reef sharks. At all modalities, provisioning is done with small and selected amount of food commonly retrieved before feeding takes place, which possibly ensures natural hunting habits. Dive-operators numbers in South Africa is considerably high, using different diving and provisioning procedures at the same sites involving the same sharks. While in Roatan it is centralized, meaning shark-feeding is done only at one provisioning site (where a fixed mooring-line is secured to the reef) by one dive-operator, where the same sharks are resighted throughout the year. Monopolization and the use of standard procedures, including a precautionary approach, possibly ensure interference control. For all modalities, the sharks exhibited some degree of conditioning, once an anticipatory response prior to food provisioning was prevalent and the sharks were highly habituated to human presence. Regarding baited-diving and shark-feeding, possible linkages between conditioning and levels of depredation cannot be discounted, once 71% of Blacktip sharks in South Africa and 66% of Caribbean reef sharks in Roatan presented hooks or noticeable hook injuries, even when provisioning site was away from fishing grounds. Provisioning has generated significant concern as to the potential for negative influences on shark/human interactions, however experimental studies in this regard are recent and emergent. Further research on potential impacts of contrived feeding to shark behavior, ecology and animal welfare, as well as to recreational safety, socio-economic impacts and implications to research and conservation is warranted. Despite criticism, shark-diving is not only a profitable industry but may potentially be an invaluable practice for conservation awareness. When properly done, along with the customers and in combination with cooperative management of other marine activities, it maximizes benefit and promotes responsible tourism.

Keywords: behavior, diving, shark-feeding, depredation, cage-diving

What can Global Finprint tell us about local extinctions of sharks and rays from the world's coral reefs?

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With increasing human pressure on coral reefs leading to overfishing, increased bleaching, phase shifts and trophic cascades, the ability to support shark and ray populations has been reduced. Numerous studies have reported declines in coral reef associated sharks at specific reefs, while some report on the existence of healthy populations at others. To provide a more holistic understanding of human impacts on coral reef species, data from Global Finprint were examined for evidence of spatial patterns of diversity loss. Global Finprint has sampled over 400 coral reefs world-wide using Baited Remote Underwater Video Systems (BRUVS) to collect data on the species composition and relative abundance of sharks and rays. Using data on the known historic distribution of coral reef associated sharks and rays and estimators of species diversity we identified patterns of localised extinction. These data enabled us to identify the species most vulnerable to localised extinction and places with the greatest risk of localised extinction. Patterns of diversity and diversity loss were compared between the Atlantic and Indo-Pacific since these ocean basins have very different shark and ray species richness associated with coral reefs. Results of these analyses will be presented and the implications for conservation efforts for coral reef associated sharks and rays explored.

Keywords: BRUVS.

Movements of the white shark *Carcharodon carcharias* in the North Atlantic Ocean

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In the western North Atlantic, much of what is known about the movement ecology of the white shark *Carcharodon carcharias* is based on historical fisheries-dependent catch records, which portray a shelf-oriented species that moves north and south seasonally. The recent emergence of Cape Cod, Massachusetts, USA, as a seasonal aggregation site for the species has provided the first opportunity to deploy electronic tags on a large number of individuals in the region; here we report the results of several on-going tagging studies investigating broad and fine-scale movements. Since 2009, we have tagged 133 white sharks (62 females, 44 males, 27 unknown), ranging from 2.1 to 5.2 m total length with coded acoustic (n = 115) and satellite-linked (n = 63) tags. Acoustic telemetry data indicate that white sharks occur in coastal waters year-round but migrate seasonally from shelf waters along the northeastern United States (US) and Canada in the summer and fall to overwintering habitat off the southeastern US and the Gulf of Mexico. Multi-year monitoring of acoustically-tagged sharks has also revealed a large degree of individual variation in migration patterns, with some individuals exhibiting fidelity to certain sites over time and others exhibiting interannual shifts in seasonal core use areas. Based on satellite tracks collected from 2009-2015, it is apparent that white sharks are more broadly distributed, both horizontally and vertically, throughout the North Atlantic than previously understood. Satellite tracks corroborate coastal migration patterns inferred from acoustic telemetry data, but also indicate that white sharks exhibit an ontogenetic shift from coastal, shelf-oriented habitat (where individuals spend 95% of their time at depths <50 m) to pelagic habitat. During the pelagic phase, subadult and adult white sharks range widely during the fall, winter, and spring into the broader Atlantic over a 30° latitudinal range and as far east as the Azores, with frequent excursions to mesopelagic depths. These sharks move daily to depths of up to 1,128 m, spending significant time at specific mesopelagic depth zones at temperatures ranging from 1.6 to 30.4°C. We believe these movements are associated with offshore foraging facilitated by the thermal physiology of the species. Our findings extend the known essential habitat for the white shark in the North Atlantic beyond the geographic range of existing protections and have important implications for future conservation efforts.

Keywords: acoustic telemetry, satellite tagging, migration, habitat utilization, ontogenetic shift.

Behavioral sensitivity and pore distribution of benthic shark electrosensory systems

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Elasmobranchs have a specialized electrosensory system that enables them to detect bioelectric signals produced by other organisms, like prey. This sensory modality is made up of voltage-sensitive receptor cells, which aid elasmobranchs in prey detection and predator avoidance via a pore in the skin. Although the electrosensory system serves the same purpose in different species, the behavioral responses to electrical fields can vary by species. Electrosensory pore number, density, and location may also vary between species and directly affect the resolution of the electrosensory system in elasmobranchs. These behavioral and morphological differences are often tied to differences in a species' ecology. For example, coral catsharks have been known to hide in one place and wait for prey to swim by, whereas horn sharks actively forage in the sand for their prey items. This study aims to evaluate the differences in the behavioral responses to electrical stimuli between two benthic species: the coral catshark (*Atelomycterus marmoratus*) and the horn shark (*Heterodontus francisci*). Additionally, pore number, density and location were quantified in order to test for relationships between behavioral responses (sensitivity and accuracy of feeding strikes) and morphological differences in electrosensory pores. Catsharks were sensitive to <4.0 nV/cm and had a higher pore number dorsally than ventrally, as has been noted in other catshark species. Ongoing work with horn sharks will allow us to compare behavioral responses and electrosensory pores with those of the coral catshark in order to facilitate a comparison between species with differing ecological roles.

Keywords: behavioral ecology, sensory biology, foraging.

Validation of a novel satellite-transmitted data product to monitor long-term activity in free-ranging elasmobranchs

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While satellite-transmitted measurements of fish depth, temperature, and location are possible over timescales of months to years, whole-animal activity levels are generally only measured over much shorter time periods. Remote transmission of activity data, derived from accelerometer records, is limited by satellite tag data storage, sufficient battery for transmitting these types of data, and restricted Argos satellite bandwidth for receiving transmitted tag data. As such, studies of whole-animal activity are generally limited to relatively short deployments where logged data can be feasibly retrieved, or opportunistic retrievals of longer-term logged data. Activity data over longer time intervals (months to years), can provide researchers with the ability to gather information on fish activity levels, paired with environment and location data, for highly migratory species. Here, we validate a new satellite-transmitted data product for remote measurement of fish activity levels, movement, and temperature in situ, over a period of months, without requiring recovery of the tag. Although past studies have transmitted specific behavior modes or events from on-board calculations of logged acceleration values, we aimed to design a generalized, scalable transmission for activity levels. Accelerometer sensors from pop-off satellite archival tags (PSATs) measure fish activity, which is then transmitted as an 'activity time series' (ATS) along with depth, temperature, and irradiance data for geolocation, to the Argos satellite system. We tested these new PSATs which generated ATS data on captive cobia (*Rachycentron canadum*) and dogfish (*Squalus acanthias*), each over a period of 5 days. Deployments were paired with video monitoring to compare archived tag data, the transmitted ATS data product, and visually observed fish behavior including tail beat frequency (TBF). We used these data sources to validate ATS behavioral state classification using a supervised Hidden Markov Model (HMM). For highly mobile species whose behavior precludes the retrieval of long-term archival records, the ATS product may present an alternative for field-based studies of activity level under variable environmental conditions, and across broad spatio-temporal scales.

Keywords: satellite tag, activity level, behavioral state classification.

Why save sharks? A case for a relational values approach to studying shark conservation

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Sharks today occupy a unique role in human society: objects of conservation campaigns for healthy oceans, maligned predators inciting fear in beach-goers, fishery and tourism resources, and subjects of inquisitive scientists. There are more than 1250 species of sharks and their relatives (skates, rays, and chimaeras), which have persisted on Earth in some evolutionary form for over 420 million years, leading to their present occupation of diverse ecosystems - from arctic waters and tropical coral reefs, to deep seabeds and inland rivers. Sharks range in size from 20 centimeters (the dwarf lanternshark, *Etmopterus perryi*) to 20 meters (the whale shark, *Rhincodon typus*), and perform countless functions not only in their natural habitat, but also in human society. For conservation purposes, sharks have generally been framed as having either intrinsic or instrumental value, that is value simply by merit of their existence or value for the sake of human use. This presentation will examine them in terms of relational values - that is, human values derived from a relationship with sharks, such as self- or community-identity, moral obligation to conserve non-human species, notions of well-being, and stewardship. We propose that efforts to rebuild or sustain shark populations through regulating human activities are more likely to succeed through assessing and considering relational values of all stakeholders, and mediating conflicting value frameworks (e.g., fishers versus environmentalists). We also discuss how relational values through sharks have manifested in the scientific community, fishers, indigenous groups, tourists, and the public, the unique roles held by each in 'valuing' sharks, and how policies targeting these groups' behavior are well suited to include relational value assessments.

Keywords: Relational values, conservation, management, values assessment.

Non-lethal recovery of internal acoustic transmitter from a large-bodied carcharhinid shark, *Negaprion brevirostris*, after 13 years at liberty

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Electronic tagging has provided valuable insight into the distribution, movement, and daily lives of aquatic organisms. Tagging efforts have increased dramatically in recent decades in response to advancements in technology, which have reduced tag size, decreased cost, and improved data acquisition. With dramatic rises in the number of animals tagged, there is mounting concern regarding tagging procedures and tag burden on the study animals. Several studies have investigated short-term impacts of tagging on mortality, swimming performance, tag retention, and healing. However, few have addressed the prolonged, sublethal effects of tagging, especially in highly mobile marine species. Here, we present the non-lethal recovery of an internal acoustic transmitter from a lemon shark, *Negaprion brevirostris*, which was at liberty for thirteen years. This female, first tagged as a 3-year-old near South Bimini, Bahamas in 2004, was recaptured in 2017 and determined to be pregnant by ultrasonography. The initial acoustic transmitter was recovered during a surgery to implant a new acoustic transmitter into her coelomic cavity. The recovered tag was intact, uncompromised, and lacking any tissue attachment. It was free inside the body cavity and in roughly the same location as the original implantation. The initial tagging event had no apparent or noticeable effect on long-term growth or reproduction. Post release behavior and subsequent movement patterns indicated no negative effects from the second tagging event. Genetic analysis of this female's pups confirmed that successful parturition occurred following her capture and tagging in 2017. This shark displayed the typical natal homing behavior of other lemon sharks within Bimini's local population. This finding provides further evidence that a foreign body implanted in the coelom of a shark for more than a decade does not appear to significantly impact the life history parameters of growth and reproduction. Other lemon sharks within this study location have shown similar resilence to electronic tagging, but this is the first receevery of a transmitter after more than a decade at liberty. These findings have important implications for how internal electronic tagging effects the longterm health, behavior, and reproduction of large sharks.

Keywords: acoustic telemetry, internal tags, tag retention, long-term tagging effects.

Phylogeny of the genus *Scyliorhinus* and its relationships within the subfamily Scyliorhininae (Chondrichthyes: Carcharhiniformes: Scyliorhinidae)

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The so-called catsharks belong to the family Scyliorhinidae, the most diverse family of sharks. Morphological and molecular works proposed a closer relationship between *Scyliorhinus*, *Cephaloscyllium* and *Poroderma*, comprising the subfamily Scyliorhininae. However, there is some disagreement on which genus would be more closely related to *Scyliorhinus*. Furthermore, many doubts are found about the definition and composition of the genus *Scyliorhinus*, mainly by the unique characteristics presented by *S. canicula*. The aim of this study is to investigate the relationships of *Scyliorhinus* species with other scyliorhinines. Morphological data were obtained from preserved specimens of all Scyliorhinus species, four *Cephaloscyllium spp.*, two *Poroderma spp.* and representatives of almost all other catshark genera, in a total of 34 taxa (of which 22 are *scyliorhinines*). A total of 78 characters from coloration, external morphology, musculature, claspers and skeleton, and two meristic characters (monospondylous and total vertebral counts) were compiled in a matrix. Parsimony analysis was employed to generate hypotheses of phylogenetic relationships and character state transformations using the TNT 1.1 computer program. Asymbolus analis was used to root the cladogram. The analysis of the phylogenetic relationships resulted in three equally most parsimonious cladograms with 213 steps, with a CI of 0.42 and an RI of 0.68. Differences between the cladograms concern the phylogenetic relationships of non-scyliorhinines. The monophyly of the subfamily Scyliorhininae is supported on the basis of the absence of upper labial furrows, muscle depressor palpebrae nictitans and accessory marginal cartilage on the claspers, a lower number of ventral extra branchial cartilages, and a greater extension of the dermal terminal cover on the clasper. *Scyliorhinus* is proposed as a sister group of the clade formed by *Cephaloscyllium* and *Poroderma*, and the monophyly of the genus is supported by the occurrence of a projecting flap on the upper lip margin (also found in *P. africanum*). The presence of a terminal 3 cartilage diagnoses *S. boa*, *S. retifer* and *S. stellaris* from the other *Scyliorhinus spp*. The remaining species are grouped in three clades: i) *S. garmani*, *S. duhamelii* and *S. canicula*, ii) *S. cervigoni*, *S. ugoi*, *S. haeckelii* and *S. cabofriensis*, iii) *S. meadi*, *S. comoroensis, S. hesperius, S. torrei, S torazame*, and *S. capensis*. These results differ from the formerly proposed hypothesis of relationships within scyliorhinines, which considered *Cephaloscyllium* and *Poroderma* closer to each other than to *Scyliorhinus*. The phylogenetic relationships among *Scyliorhinus* species are presented for the first time in the literature.

Keywords: cladistics, morphology, catsharks.

Taxonomic review of the catshark genus *Scyliorhinus* Blainville, 1816 (Chondrichthyes: Carcharhiniformes: Scyliorhinidae)

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The genus *Scyliorhinus* belongs to the family Scyliorhinidae, the most diverse family of sharks, comprising 17 genera and approximately 160 species currently recognized. According to the literature, there are 16 valid species for the genus that present a varied color pattern that is extensively used in species identification. The long history of taxonomic rearrangements and inaccurate descriptions have contributed to the misidentification of specimens and lack of information on distribution range and diagnostic characters of species. Furthermore, species identification is further complicated due to sexual dimorphism, ontogenetic, individual and geographic variations in color patterns and maturity sizes. This study presents the results of an ongoing global taxonomic study of *Scyliorhinus*, which aims to recognize and diagnose the valid species, describe their variation and estimate their geographic distribution. In total, 1.191 specimens housed at museum collections and originated from the entire distribution of the genus were examined. Specimens of other catshark genera (e.g. *Cephaloscyllium*, *Poroderma*, *Schroederichthys*) were also examined as comparative material. A detailed morphological study, including the examination of external morphology, dermal denticles, teeth, musculature, neurocranium, visceral arches, pectoral girdle, claspers, and morphometric and meristic data, were performed. Sixteen species are recognized: *Scyliorhinus boa*, *S. cabofriensis*, *S. canicula*, *S. capensis*, *S. cervigoni*, *S. comoroensis*, *S. duhamelli*, *S. garmani*, *S. haeckelii*, *S. hesperius*, *S. meadi*, *S. retifer*, *S. stellaris*, *S. torazame*, *S. torrei*, and *S. ugoi*. *Scyliorhinus duhamelii* is resurrected and distinguished from *S. canicula* by a larger distance between the anterior nasal flaps (vs. anterior nasal flaps very close to each other), diffused color pattern (vs. color pattern with distinct dark blotches and saddles along the body), absence of cartilage terminal 3 (vs. presence) and a smooth terminal dermal cover (vs. papillose). *Scyliorhinus duhamelii* presents a more restricted distribution range than *S. canicula*, with locality records around the Adriatic and Mediterranean Seas. *Scyliorhinus tokubee* is considered a junior synonym of *S. torazame*. Information about the distribution ranges of the species was updated, especially for those with wide ranges (*S. canicula*, *S. haeckelii*, *S. retifer* and *S. stellaris*). Coloration, vertebral counts, maturity size and extension and shape of nasal flaps are the most useful characters that help distinguish these species. The claspers, underestimated structures in species descriptions, proved to be very reliable for identification purposes with each species presenting a unique combination of characters in their copulatory organs.

Keywords: taxonomy; *Scyliorhinus*; morphology.

Discrimination of shark species (Elasmobranchii, Chondrichthyes) of the Carcharhinidae family by simple PCR of repetitions of rdna 5s disembarked in Maranhão coast, Brazil

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Sharks (Elasmobranchii, Chondrichthyes) constitute an important link in the food chain of the marine ecosystem. They are among the most vulnerable to overfishing. The objective of this study was to identify by means of the molecular analysis of shark species landed on the coast of Maranhão. Samples of muscular tissue of sharks of the Carcharhinidae Family *Carcharhinus acronotus* (16); *Carcharhinus leucas* (11); *Carcharhinus porosus* (18); *Carcharhinus limbatus* (2), were collected at ports of landing of the municipalities of Tutóia and Raposa, from June 2015 to April 2016. The samples were registered in the Tissue Collection of Fauna Maranhense linked to the Postgraduate Program in Aquatic Resources and Fisheries / UEMA. Total DNA was isolated using the rapid salt extraction protocol. PCR amplification of the 5S fragments of ribosomal DNA was then performed, chosen as a highly conserved region among the species. The primers Cart5S1F (5'-CAC GCC CGA TCC CGT CCG ATC-3') e Cart5S1R (5'-CAG GCT AGT ATG GCC ATA GGC-3'). The amplification conditions were: 5 min at 94 ° C; 35 cycles of 1 min at 95 °C, 30 sec at 55° C and 45 sec at 72 °C and final extension for 5 min at 72 °C. In addition, a negative control was inserted in order to detect possible contaminations. PCR products were visualized by electrophoresis. To compare the size of the fragments was used the Ladder 100 bp, 25 reactions, Ludwig. The amplified DNA fragments of *Carcharhinus acronotus* were found to be approximately 400 bp, *Carcharhinus leucas* 450 bp, *Carcharhinus porosus* 500 bp, and *Carcharhinus limbatus* 520 bp. These results showed that the non-transcribed segments (SNT) in the 5S region of the ribosomal DNA produced different sizes of amplification fragments among the analyzed species, reinforcing that this DNA region can be used as an efficient genetic marker for the identification of family shark species Carcharhinidae, as well as to ratify the 5S rRNA PCR technique as an important and accessible auxiliary tool for the morphological identification of species of the Carcharhinidae Family, which may provide better subsidies based on the management and conservation of fish resources.

Keywords: elasmobranchs, genetics, conservation.

Can we keep having the guitar for the Mariachi? The shovelnose guitarfish (*Pseudobatos productus*) fishery in Mexico

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Worldwide guitarfishes have been identified as being amongst the most vulnerable of elasmobranch families. The Shovelnose Guitarfish (SNGF, *Pseudobatos productus*) distributes from San Francisco Bay, California, US, to the Southern Gulf of California (GC), Mexico, and is categorized as Near Threatened by the IUCN. In the US, this species is fished recreationally, while in Mexican waters is mainly targeted by the artisanal fisheries, where is the most important ray species in Northwestern Mexico (NWM). This study aimed to review the shovelnose guitarfish fishery in NWM by analyzing its catch trends, main landing sites, the effects of the fishing ban during May to July established since 2012, and to describe the fleet dynamics at two important SNFG fishing sites at Sebastian Vizcaino Bay (SVB). A time series of the SNGF catches was reconstructed from 1997 to 2015, based on several sources of information and official fisheries statistics that report total ray catch without any species composition data. Effects of the fishing closure were analyzed using information from landings sites with significant monthly catch records. And the fleet dynamics at SVB was investigated using results of semi-structured interviews with fishers. In average, 730 t of SNGF were annually landed, with an increment tendency during the last three years, reaching almost 1000 t. On average, 53% of the catch was landed at Puerto Peñasco located in the northern GC, while 35% was landed at different sites of the western coast of Baja California Peninsula (WCBCP). Before the establishment of the elasmobranch fishing ban, to protect their reproduction process, a high proportion of SNGF landings were reported during May to August. After the establishment of the ban, yearly SNGF landings did not show any decrement, but percentages by month changed significantly, and now April and August show the most significant values. A total of 60 fishers were interviewed at SVB´s two landing sites, to understand the fleet dynamics and the development of the SNGF at the WCBCP. Older fishers sustained that before fishing on SNGF, they used to fish on marine turtles and angel shark. Fishermen say that SNGF economic land value has increased, but started to show decreasing signs in its catches, while the horn shark (*Heterodontus francisci*) began to be targeted at SVB. This information can serve as a baseline for the development and implementation of the needed ray species-specific fishing management plans in the region.

Bacteriological evaluation of ShortfinMako (*Isurus oxyrinchus*) (Elasmobranchii: Lamnidae) meat commercialized in the city of Niterói, Rio de Janeiro, Brazil.

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According to FAO data, Brazil is currently the 11th producer and the 1st importing country in the world concerning shark meat, although no correct animal capture management is carried out. In the State of Rio de Janeiro, where fish are highly sought after and consumed, the commercialization of fresh shark fillets is noteworthy, particularly the oceanic species *Isurus oxyrinchus* (Elasmobranchii: Lamnidae), popularly known as the ShortfinMako. Shark meat, besides being a differentiated and well-accepted product, has a relatively low cost and was placed 5th among imported fish sold in Rio de Janeiro supermarkets in 2010. However, no current legislation promoting a standard regarding identity and food quality for consumer safety for these products is available. Thus, the aim of the present study was to verify the commercialization conditions and bacteriological quality of ShortfinMako (*I. oxyrinchus*) fillets obtained in markets in the city of Niterói, RJ, Brazil. The following bacteriological analyses were performed on 17 random fresh ShortfinMako fillets: *Salmonella spp.* detection, mesophilic aerobic heterotrophic bacteria, heterotrophic psychrotrophic bacteria, thermotolerant coliform and coagulase positive *Staphylococcus* counts, and, subsequently, the most probable number for *Vibrio parahaemolyticus*. Nonconformities in the studied samples were verified regarding *Salmonella spp.* according to the current Brazilian legislation, with the fillets unfit for human consumption. The same was observed for *Vibrio parahaemolyticus*, according to comparison to international standards. The values detected for the other analyses were within the proposed legislation limits. In addition, Good Handling Practices were observed during product commercialization, suggesting cross-contamination. Thus, ShortfinMako fillets marketed in Niterói may lead to risks concerning collective health, due to the presence of certain bacteria, which implies the need to implement fillet identity and quality patterns alongside official organs, in addition to the correct application of Good Handling Practices, in line with other quality control tools, by ShortfinMako fishermen and manipulators.

Keywords: shortfin mako, fisheries, trademarket, quality.

Genetic diversity and the influence biogeographical barriers of *Rhinoptera bonasus* (Chondrichthyes: Batoidea), in Atlantic Ocean

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Rhinoptera bonasus is a coastal ray species, also known as "cownose". It has suffered intense and increasing fishing pressure, especially for being accidentally captured in fishing directed to shrimp capture, currently, are listed in the IUCN red book as "near threatened". *R. bonasus* occurence is identify from United States to the south of Brazil, considered to be a highly migratory species. The aim of the project is to analyze the genetics' sequence and structure of populations of *R. bonasus*, collected on the Brazilian coast (Santa Catarina, São Paulo, Rio de Janeiro, Pernambuco) and in Mexico's Gulf (USA), through of cytochrome b gene of mtDNA (cytb) and still, test the hypothesis of the influence of the biogeographic barrier known as Amazon-Orinoco Plume (AOP) in the population dinamics this specie. To achieve these results, muscle tissue fragments were removed from the animals to obtain total DNA, gene amplification cytb and sequenced. The programs Geneious, DNAsp 5,1, MEGA 6,0 and ARLEQUIN 3,01 and Network 4.6 were used for editing and statistics analysis of the obtained sequences. The analysis consisted of 66 specimens of *R. bonasus*: 11 from Santa Catarina, 36 from São Paulo, 8 from Rio de Janeiro, 7 from Pernambuco, Brazil and 4 from the Mexico's Gulf. Where we obtained sequences fragments of the gene with 438 pb and 7 mutations. In the analyzed samples 4 different haplotypes were found, with haplotypic diversity value of 0.1179 and nucleotide diversity of 0.142857. Lastly, the AMOVA analysis reveled that 94,78% of the genetic variation is between the Mexico's Gulf and Brazil, where we can infer that the barrier AOP may be influencing the low gene flow, resulting in two different populations. The previous results of the present work helped us provide information to the understanding of populations dynamics in *R. bonasus*, understanding that biogeographic barriers act strongly defining and having direct and indirect consequences in the present populations.

Keywords: elasmobranch, Cyt-b, conservation.

Molecular identification of shark meat from local markets in Southern Brazil based on DNA Barcoding: evidence for mislabelling and trade of endangered species

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Elasmobranchs are especially vulnerable to overfishing due to low fecundity and late sexual maturation. A significant number of elasmobranch species are currently overexploited or threatened by fisheries activities. Additionally, several recent reports have indicated that there has been a reduction in regional elasmobranch population sizes. Brazil is an important player in elasmobranch fisheries and is also one of the largest importers of shark meat. However, carcasses entering the shark meat market have usually had their fins and head removed, which poses a challenge to reliable species identification based on the morphology of captured individuals. This is further complicated by the fact that the internal Brazilian market trades several different elasmobranch species under a common popular name: "cação". The use of such imprecise nomenclature, even among governmental agencies, is problematic both for controlling the negative effects of shark consumption and for informing the consumer about the origins of the product. In this study, we used DNA barcoding (mtDNA, COI gene) to identify, at the species level, "cação" samples available in local markets from Southern Brazil. We collected 63 samples traded as "cação", which we found to correspond to 20 different species. These included two teleost species: *Xiphias gladius* (n=1) and *Genidens barbus* (n=6), and 18 species from seven elasmobranch orders (Carcharhiniformes, n=42; Squaliformes, n=3; Squatiniformes, n=2; Rhinobatiformes, n=4; Myliobatiformes, n=3; Rajiformes, n=1; and Torpediniformes, n=1). The most common species in our sample were *Prionace glauca* (n=15) and *Sphyrna lewini* (n=14), while all other species were represented by four samples or less. Considering IUCN criteria, 47% of the elasmobranch species found are threatened at the global level, while 53% are threatened and 47% are critically endangered in Brazil. These results underline that labelling the meat of any shark species as "cação" is problematic for monitoring catch allocations from the fishing industry and discourages consumer engagement in conservationist practices through informed decision-making.

Keywords: cação, cytochrome oxidase-1, shark fisheries, wildlife DNA forensics.

Diel movements and habitat use of the freshwater stingray, *Potamotrygon motoro*, in the Bita River, Orinoco Basin, Eastern Colombia

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In this study, we used acoustic telemetry to investigate the diel movements and the habitat use of the river stingray, *Potamotrygon motoro*, in the Bita River, Vichada Department, Eastern Colombia. Thirteen individuals (six males and seven females; disc width between 23-45 cm) were collected, fitted with acoustic transmitters equipped with pressure and temperature sensors (Lotek MAP Series, MM-M-16-25-TP) and then released during the dry season, between March-April 2017. Stingrays were actively monitored (Lotek MAP 600 acoustic receiver) monthly through boat transects, from March to September 2017, including the rainy season (May to September). Any stingray died during the experiment, with all individuals being detected during the study period. Stingrays showed a strong site fidelity and a daily pattern of vertical movement. Some individuals were detected close to the release sites throughout the study (n=8) and others (n=5) moved a few hundred meters upstream or downstream, but returned to the release sites after five to 39 days.

During the day, stingrays stayed motionless or realized short-distance horizontal movements (i.e. around 10 m) in the river channel, in depths between five to eight meters and temperature around 27°C. At night, stingrays were found in shallow waters (less than three meters), near the river banks, moving, in waters around 30°C. The differences between diurnal and nocturnal activity and the spatial distribution observed along the monitoring suggest that *P. motoro* changes its bathymetric distribution daily and performs short-distance horizontal movements daily or weekly. These movements patterns indicate that possibly *P. motoro* is a small-ranging species and that disturbances in its habitat may negatively affect the species. As *P. motoro* and its congeners are highly targeted by ornamental fisheries in the Orinoco Basin and adjacent areas, information on the spatial ecology of freshwater stingrays can be useful to identify critical habitats and help to guide conservation strategies.

Keywords: acoustic telemetry, non-lethal methods, spatial ecology, Elasmobranch, behaviour, Orinoco Basin.

Environmental, spatial and temporal influences on the occurrence of White sharks (*Carcharodon carcharias*) along the New South Wales coast of Australia

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Occurrences of juvenile and sub-adult sharks in inshore habitats are often linked to biological, environmental and/or temporal factors, offering the opportunity to predict distributions in space and time. The quantity of data required to generate statistically sound predictions, however, has so far limited these types of analyses. We monitored the movements of 248 juvenile and sub-adult (< 4 m) acoustically tagged White sharks (*Carcharodon carcharias*) off the New South Wales coast of eastern Australia. Signals were tracked in near real time by a network of 21 VR4G satellite-linked receivers, covering ~1000 km of coastline. Based on detection records over a period of 14 months, we constructed generalised additive models to analyse animal detections in relation to spatial (receiver location), temporal (month, time of day), ecological (presence of other sharks within the receiver detection range), oceanographic (water temperature, tidal height) and celestial (moon angle) variables. We found marginal to significant relationships between all tested variables and the presence of White sharks. Detections indicated that the majority of individuals are seasonal visitors to the NSW coast with numbers peaking in the Australasian spring (September - November). Shark occurrences showed pronounced daily peaks between 8am - 9am and monthly peaks at the full and new moon (± 1 day). Our data resolves the environmental and spatiotemporal drivers of coastal shark occurrences in unique resolution, consolidating our ability to predict individual and population-level responses to changing environmental conditions. Overall, our understanding of such processes will enhance conservation efforts by facilitating the design of management strategies and policy-relevant studies.

Keywords: acoustic telemetry, environmental variability, generalised additive model, seasonality, tides.

Feeding behaviour and phytoplankton assemblages of whale sharks at Nosy Be (Madagascar)

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In December 2017 a research expedition was carried out off the island of Nosy be in Madagascar to study the feeding behavior of the whale shark. In particular, the investigations involved the description of the behavioral modules of the whale shark and their relationship with the phytoplankton assemblies. In total, 31 phytoplankton samples were collected in the following four conditions:1. absence of whale sharks; 2. presence of swimming whale sharks; 3. presence of whale sharks in horizontal feeding; 4. presence of whale sharks in vertical feeding. The samples were immediately filtered and then frozen to be subsequently analyzed by HPLC to identify the total biomass and contribution of the different functional groups of phytoplankton. Preliminary results seem to highlight a certain correlation between behavioral feeding modules exhibited by sharks and the presence of some families of algae that might be involved in the release of the dimethyl sulfide (DMS). This substance is produced by algal organisms in response to predation by zooplankton organisms. Since DMS is a substance characterized by a strong odor, the results seem to highlight the fundamental role of smell in the identification of food sources by the whale shark.

Keywords: whaleshark, behaviour, phytoplancton, DMS, Madagascar.

Biological and ecological factors affecting individual surface behaviour of bait attracted white sharks

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Individual surface behaviour of white sharks in th´z\e presence of bait has been studied from 2005 to 2017 at Dyer Island Nature Reserve (South Africa). Observations were made from a commercial cage-diving boat. We observed 220 white sharks that exhibited 9 different types of individual behaviour: parading, bait following, visual inspection, breach, tail slap, tail stand, spy hop, repetitive aerial gaping, and head-up vertical emerging. We compared the exhibition of these behaviors and the complexity of the ethograms to both biological (sex, age) and environmental (tides, cloud cover, underwater visibility, sea surface conditions, temperature, time of the day) factors. Breach and tail slap were most often performed by male sharks, and tail slap and tail stand were more often performed by mature animals. The general ethogram consisted of an average of 20 behavioural units. The comparison of the ethograms between males and females did not re- vealed significant correlations, but the ethograms of female white sharks were more complex with more transitions between behavioural units. A significant correlation was observed comparing ethograms of mature and immature white sharks: young sharks performed more complex ethograms with a higher number of behavioural units. We observed also that environmental conditions affected the sequence and structure of individual behaviors and in particular the approach to the bait, the duration of the etho- grams and the complexity of decisional trees and transitional matrices. In particular, we observed a strong influence of the cloud cover and, consequent- ly, underwater visibility Our observations suggested that the surface behaviour of white sharks is a complex tactical situation in which animals show plastic responses to environmental conditions and according to sex and age.

Keywords: white shark, behaviour, environmental factors, South Africa, ethogram.

Comparative genomics of the southern African endemic catshark genus, *Haploblepharus*

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The Scyliorhinidae (catshark) family is one of the most speciose shark families, contributing to approximately 8% of southern Africa's rich elasmobranch biodiversity. Accurate species identification allows reliable assessments of genetic diversity and population trends necessary for conservation and management measures, particularly in species listed in the threatened or data deficient categories by the International Union for the Conservation of Nature (IUCN) Red List (e.g. *Haploblepharus fuscus*, *Haploblepharus kistnasamyi*, *Halaelurus natalensis* and *Poroderma pantherinum*). The focus of this study is on the endemic catshark genus, *Haploblepharus*, due to the high degree of morphological conservatism between congeners. Additionally, interspecific hybridisation has been hypothesised due to the difficulty in classifying some specimens which display an overlap in diagnostic morphological and meristic characters of different *Haploblepharus* taxa. Previously, little to no sequence divergence was reported between three *Haploblepharus* species using four molecular species identification markers (cytochrome c oxidase subunit I, nicotinamide adenine dehydrogenase subunit 2, cytochrome b and internal transcribed spacer 2). Additional molecular resources are therefore required in order to characterise the genetic relationships between these morphologically conserved species, as well as other catshark species. In this study, reduced genome sequencing was performed for *Haploblepharus edwardsii* and *Haploblepharus pictus*, producing novel Next Generation Sequencing (NGS) data. Levels of genetic diversity and species differentiation were assessed for *H. edwardsii* and *H. pictus* using genotype data from 10 novel species-specific microsatellite markers mined from the NGS data. Cross-species amplification of microsatellite markers was then performed on eight catshark species to determine the transferability of the markers. Following this, the mitochondrial genomes of *H. edwardsii* and *H. pictus* were assembled and compared to identify variable regions between species. Comparative genomics of the reduced nuclear genomes was performed to identify potential differences between species and to evaluate interspecific divergence. These approaches will result in novel molecular resources which can be used to investigate genetic relationships between these, and additional catshark species.

Keywords: species identification, species differentiation, microsatellites, mitochondrial genome.

Assessing *Carnobacterium maltaromaticum* pathogenesis in stranded sub-adult common thresher sharks (*Alopias vulpinus*)

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Common thresher sharks (*Alopias vulpinus*) and salmon sharks (*Lamna ditropis*) have been periodically stranding along the West Coast of North America. The cause of these stranding has been attributed to disorientation resulting from massive brain and inner ear infection caused by *Carnobacterium maltaromaticum*. Yet how and why these sharks are becoming infected is unknown. In this study, we aimed to better understand the pathogenesis process in stranded common thresher sharks. For that purpose, we collected and compared the gut microbial community, brain and inner ear tissue of five stranded sharks with *C. maltaromaticum* infection, eleven healthy sharks caught by fishers and two stranded sharks that had no signs of infection or *C. maltaromaticum* presence. The gut microbiota has recently gained attention for the role it plays in the overall health of the host, such as that, an unregulated microbial community can be sign of disease. We were able to distinguish a core microbiome common to all sharks, nonetheless the microbiome of infected sharks was characterized by a significant increase in the presence of Vibrio strains, which have previously shown to be pathogenic in sharks, indicating an alteration of the gut microbiome in infected sharks. The microbial presence in the areas of infection (brain, ear and endolymphatic ducts) was also determined using Illumina sequencing, and showed high *C. maltaromaticum* presence in infected sharks while no bacteria present in healthy. To determine the health status of the shark, histology was used to assess the level of inflammation and infection in the brain and inner ear of all sharks, elucidating how *C. maltaromaticum* is potentially accessing the inner ear and brain through the endolymphatic ducts. Lastly, we analyzed the whole genome of 9 *C. maltaromaticum* strains isolated from the inner ear and brain of stranded thresher and salmon sharks. This analysis exposed genes unique to these strains, indicating which genes are aiding in the infection process. Although there is need for more research to better understand this periodic shark stranding phenomenon, this study was able to use the microbiome as a tool the measure shark health which can aid to predicting the health status of sharks in future studies.

Keywords: shark strandings, *Alopias vulpinus*, brain infection.

How much do young white and shortfin mako sharks have in common? Stable isotopes analysis reveals resource sharing in an aggregation site in northern Baja California, Mexico

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Artisanal fisheries on the western coast of Baja California (BC), have an impact on juvenile white sharks (*Carcharodon carcharias*; WS) and mako sharks (*Isurus oxyrinchus*; MS) as bycatch and target species, respectively. The purpose of this study is to determine habitat preference and resource sharing between both species using the analysis of stable isotopes analysis C and N. During 2015 and 2016, we collected muscle and blood samples from newborn, young of the year (YOY), and juvenile MS and WS from Sebastian Vizcaino Bay (SBV), a nursery area in Baja California, Mexico. A total of 171 MS and 11 WS muscles and 243 blood samples were collected, including whole blood, plasma and red blood cells (RBC). The size range for MS was 64.5-196 cm of total length (TL) and 130-292 cm TL for WS. For whole blood samples, mako shark $\delta^{13}C$ values ranged -23.2 to -16.2‰ and $\delta^{15}N$ values ranged 11.7 to 19.6‰. Whereas white shark $\delta^{13}C$ values ranged -18.3 to -14.2‰ and $\delta^{15}N$ values ranged 16.4 to 17.1‰. The isotopic values of plasma and RBC were similar to whole blood and had similar ranges for both species. We did not find significant differences among species for whole blood $\delta^{13}C$ values (W=228, p> 0.05) or $\delta^{15}N$ values (W=420.5, p> 0.05). For muscle, mako shark $\delta^{13}C$ values ranged -19 to -16.4 ‰ and $\delta^{15}N$ values ranged 13.6 to 20.1‰, whereas white shark $\delta^{13}C$ values ranged -18 to -15.4‰ and $\delta^{15}N$ values ranged 16.18 to 18.9‰. There were significant differences among species for muscle $\delta^{13}C$ values (W=335, p <0.05), but not for $\delta^{15}N$ values (W=1022, p> 0.05). In addition, similar sized shortfin mako and white sharks had similar $\delta^{15}N$ values. There was a positive relationship between shortfin mako shark length and $\delta^{15}N$ values for both tissues, suggesting a shift to ^{15}N-enriched prey either due to trophic level or environmental baseline. Given the baseline variation within SVB, isotopic variation in both tissues, and long incorporation rate of muscle, we propose that white and shortfin mako sharks actively forage within SVB for long periods of time. These data demonstrate how changes in an ecosystem's isotopic baseline can affect interpretation of ontogenetic dietary shifts. Our results demonstrate shared resources use between mako and white sharks within SVB, which was confirmed by the SIBER isotopic niche analysis.

Keywords: stable isotopes of N and C, mako sharks, white sharks, isotopic baseline, Sebastian Vizcaino, Mexico.

Trophic inference in two sympatric sharks, *Sphyrna lewini* and *Carcharhinus falciformis*, based on stable isotope analysis at Malpelo Island, Colombia

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Elasmobranchs can play important roles in marine communities, however the information about their diet and movement is still lacking. *Sphyrna lewini* consumes fishes, cephalopods, rays, and crustaceans and *Carcharhinus falciformis* feed on fishes, cephalopods, crustaceans and sea turtles. Until now there are no studies available on the trophic ecology of sharks in Malpelo Island. Thus, the aim of this study was to describe the trophic ecology of *S. lewini* and *C. falciformis*, using stable isotope analysis of δ^{13}C and δ^{15}N, to better understand the role of both shark species in the Malpelo Island ecosystem. During January, February, and November 2013, some specimens of *S. lewini* and *C. falciformis* were illegally caught at Malpelo Island and confiscated at the port of Buenaventura, Colombia. For each shark specimen the biological data (total length and sex) were registered. Samples of muscle tissue were taken from the nape of all specimens. A total of 14 *S. lewini* and 12 *C. falciformis* were analysed. δ^{13}C values were similar between *S. lewini* (–16.3 ± 0.1‰) and *C. falciformis* (–16.5 ± 0.1‰). *S. lewini* showed a wider trophic niche than *C. falciformis*, with low trophic overlap (5%) between the two species. The δ^{15}N values of *S. lewini* (15.9 ± 0.11‰) were higher than those of *C. falciformis* (14.9 ± 0.09‰). In *C. falciformis*, δ^{13}C values were similar in both sexes (–16.5 ± 0.1‰), while δ^{15}N values were significantly different between males (14.6 ± 0.1‰) and females (15.0 ± 0.1‰). The trophic position of *S. lewini* was 5.25 ± 0.12, and that of *C. falciformis*, 5.48 ± 0.18, which suggests that both shark species occupy a high position in the marine food chain. The SIBER analysis evidence a little isotopic overlap between *S. lewini* and *C. falciformis*, which suggest a resource partitioning between them. Both shark species co-occur at Malpelo Island, but they do not share food resources and feeding areas, which is previously reported for other sympatric sharks. Furthermore, they probably feed far from the island, using it as a resting and cleaning area.

Sexual dimorphism based on body proportions in the shortnose guitarfish, *Zapteryx brevirostris* (Müller & Henle, 1841) (Chondrichthyes, Rhinobatidae)

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The shortnose guitarfish, *Zapteryx brevirostris*, is captured as accompanying fauna from fisheries which is directed to the shrimp and demersal fishes catch under the Brazilian Continental Shelf, from northeast to southeast of the country. Besides it does not have commercial value, and it is usually returned to the sea by the fishermen, the species shows a significant population decrease, being characterized as vulnerable by the International Union for Conservation of Nature (IUCN). Although many studies have been made with this species, there are no data about sexual dimorphism based on body proportions. So, trying to fill this gap, the objective of the present study was to analyze sexual morphologic differences through the body proportions. The analyzed specimens were caught by the artisanal and industrial trawl fleet, off the coast of São Paulo (Brazil), and were registered in the "Regional Scientific Fishes Collection off the Coast of Atlantic Forest" from the zoological collection of the Santa Cecília University (AZUSC). Were taken 36 measures from 138 samples (81 females and 57 males) with average total length 396,71±98,11 (100-545)mm. The values from each measure (percentage in relation to the total length), for both sexes, were logarithmized and analyzed through the linear regression and posteriorly compared by the covariance analysis (ANCOVA), with 5% of significance. The results showed 18 different measures between the sexes, 07 in relation to the tail, 03 corporal, 02 in the disc, gill chamber and pelvic fin, 01 snout and interorbital. The males showed bigger values in relation to the tail and pelvic fins than the female, which showed bigger body measures. These results allow concluding that males are better swimmers, while females are bigger because of the pregnancy period, in which they need to carry the embryos.

Keywords: Elasmobranchii, morphology, morphometry.

Population history and specimen translocations can mitigate shark attacks: the case of the apex predator *Galeocerdo cuvier* (Carcharhinidae) in Brazil.

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The knowledge of the genetic structure of a species is of great importance for its conservation, because the genetic information may reveal patterns and processes never imagined in population histories. The tiger shark, *Galeocerdo cuvier*, is one of the main species involved in attacks in Brazil and worldwide. Until recently (2014), in the northeast coast of Brazil, specimens of tiger sharks were being caught near the beach, and then translocated, tagged and released in areas far away from the shore, to minimize the risk of incidents between humans and sharks. By means of satellite telemetry, many of these specimens had their movements monitored and some of them showed displacements towards Fernando de Noronha Island (around 350 km distant from coast). The aim of the present research is to answer the following question: the displacement pattern observed is a consequence of those translocations, that have been favoring artificial genetic admixture, or it represents a historical panmictic population occurring in the area? To answer this question, 76 specimens of tiger sharks (43 from the beaches in the metropolitan region of Recife- mrR and 33 from Fernando de Noronha Island- FNI) were sampled and three loci were sequenced [mtControl Region (CR), nuclear íntron of the Lactate dehydrogenase (iLDH), and ITS2]. In addition, 28 CR haplotypes provided by literature were added to the dataset obtained. The final dataset thus included 88 CR sequences, 20 iLDH sequences, and 48 ITS2 sequences. The data showed moderate to high haplotype and nucleotide diversities for both CR and iLDH loci. Yet, the data from ITS2 showed very low values. Tiger sharks are "near threatened" by IUCN, but the present genetic data did not reflect this category, suggesting a moderate to high evolutionary potential. Bayesian analysis of population structure and parsimony haplotype networking revealed a lack of population division between sampled areas, especially by the nDNA data. Signs of population structure revealed by CR data suggest a cohesive population occuring along the studied regions and reinforce the hypothesis of female phylopatry in *G. cuvier*, given the results from mtDNA. These data also reinforce the maintenance of translocations as a measure to mitigate attacks off the beaches from mrR, given the evidence of the panmictic population structure in tiger sharks in the region.

Keywords: tiger shark, DNA multiloci, population history, attacks.

Cryptic diversity and a DNA protocol to identify body parts of the nurse shark *Ginglymostoma cirratum* (Ginglymostomatidae)

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In Brazil there are 88 species of sharks where 31 of them are included in the latest endangered species list from the Brazilian environmental agency (Chico Mendes Institute for Species Conservation). *Ginglymostoma cirratum* is categorized as "data deficient" by IUCN. However, a population decline and fragmentation along its geographic range have been detected. The species is vulnerable to coastal fisheries and spearfishing and data have been required to improve its IUCN status. The present study aimed to investigate the genetic variation of the nurse shark as a way to assess its conservation status, to test for evolutionary discontinuities, and to develop a genetic protocol using SNPs (Single nucleotide polymorphisms) detection and PCR-RFLPs, in sequences of the DNA barcode region (COI-mtDNA) to identify the shark body parts. A total of 18 sequences of *G. cirratum* were obtained from USA (Florida), Mexico, Panama (Pacific Ocean), Brazil (Fernando de Noronha Islands, state of Pernambuco-PE, and state of Bahia-BA), and São Tomé and Príncipe (Africa). Haplotype (H) and nucleotide (π) diversities were measured to estimate the evolutionary potential of the species. A parsimony haplotype networking was obtained to test for the evolutionary discontinuity of the species along the sampled area. These COI data were also compared with other data available for endangered shark species from Brazil to identify exclusive *G. cirratum* RFLP markers with 6 endonucleases. Both haplotype (H= 0.904) and nucleotide (π= 0.034) diversities were high even just measuring the Atlantic data (H= 0.892/π= 0.03) indicating a good evolutionary potential. The parsimony networking recovered two COI haplogroups separated by 18 step mutations: one comprising the samples from PE (Brazil) and the other putting together the rest of the genetic variation including BA (Brazil). This suggests *G. cirratum* as hosting a probably unknown cryptic variation, possibly resulting of two pulses of colonization in the southwestern Atlantic. We also detected a total of 4 SNPs capable of distinguishing *G. cirratum* from other shark species. The RFLP markers indicated Alu I, Eco RI, Hae III, Hha I, and Mbo I as the best endonucleases. This study presents new evidences on the *G. cirratum* evolution and conservation, and also provides tools for the management/evaluation of the species catches in situations where diagnosable morphological features are absent, such as finning and/or filleting. Lastly, we recommend a special attention about this species in future IUCN assessments.

Keywords: nurse shark, COI, cryptic diversity, genetic identification, conservation.

SHARKS INTERNATIONAL

Diversity of sharks landed in the Andaman and Nicobar Islands, India, with a focus on the life history of the five most common shark species.

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India is amongst the top three global shark harvesters with a targeted shark fishery still operating in the Andaman and Nicobar archipelago. Despite being a biodiversity hotspot, official fish landing data is limited to overall quantities of landings with no species-specific information. To address this gap, we conducted systematic fish landing surveys, from January 2017 to February 2018, at major fishing landing sites of the Andaman Islands. We sampled 3244 sharks and assessed diversity across gear types and seasons, while interviewing fishing vessel crew regarding fishing areas. Of the 35 species recorded, nine are new records for the archipelago and one for India. The presence of Hasselt's bamboo shark (*Chiloscyllium hasseltii*) and the Indonesian shortsnout spurdog (*Squalus hemipinnis*) in landings are range extensions for these species. Landings were dominated by five species, namely the slit-eye *Loxodon macrorhinus* (32.6%), grey reef *Carcharhinus amblyrhynchos* (26%), scalloped hammerhead *Sphyrna lewini* (10.2%), silvertip *Carcharhinus albimarginatus* (7.6%) and slender weasel *Paragaleus randalli* (4.5%), comprising 81% of total shark landings. The size at 50% maturity for males of these five species indicated that males caught of the small-bodied species (<1000 mm TL) were mostly mature while large bodied species (>1000 mm TL) were mostly immature. Females of 16 species were gravid and neonates of ten species were observed with open umbilical scars. Abundance of landed species did not differ significantly across seasons and gears. The data also suggests the presence of nursing and breeding grounds in the study area. Our findings highlight the need for systematic fish landing surveys for elasmobranchs, the results of which need to be used to inform management of fisheries in the Andaman and Nicobar archipelago.

Keywords: Elasmobranchs, occurrence, fisheries-dependent surveys, biology, conservation.

Vertical distribution of shortfin mako sharks, *Isurus oxyrinchus*, varies with horizontal movements in the eastern North Pacific Ocean

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Resources in the pelagic environment tend to be patchily distributed, often resulting in animals engaging in adaptive movement behaviors to maximize foraging success. While these behaviors have been examined in horizontal and vertical dimensions, there has been limited work uniting these movements in sharks. To investigate how vertical behaviors change in relation to horizontal movements in juvenile shortfin mako sharks, *Isurus oxyrinchus*, 35 sharks (114 – 245 cm FL) were double-tagged between 2003 and 2008 with Pop-up Archival and Transmitting (PAT) and Smart Position or Temperature Transmitting (SPOT) tags within the Southern California Bight. We examined the daytime depth distributions of these individuals after their horizontal movements were first classified by thermal habitat based on water column thermal structure, and into one of two behavioral modes (resident search or transiting) using a first-difference correlated random walk switching state-space model based on autocorrelation in speed and direction. Despite high inter- and intra-individual variability, thermal habitat and behavioral mode influenced depth distribution. With warming thermal habitats, transiting sharks increased the proportion of their time below 50 m. Differences in the proportion of time spent in waters greater than 100 m between the two behavioral modes were also most pronounced in warmer thermal habitats. Further, maximum depths increased when sharks were engaged in transiting behavior, except for in the coldest habitat. These results suggest an expansion of vertical habitat use when sharks switch to transiting behaviors, which may increase the probability of locating prey resources, and that the degree of habitat expansion may be influenced by temperature.

Keywords: satellite telemetry, movements, dive behavior.

Egg cases of *Bathyraja cousseauae*, a poorly known large softnose skate from the Southwest Atlantic Ocean

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The Joined-fins skate *Bathyraja cousseauae* (Chondrichthyes: Arhynchobatidae) has recently been described from the Southwestern Atlantic Ocean (SWA), and has also been recorded in the Southeast Pacific. Currently, it is assessed as Near Threatened by the IUCN and crucial information about life history and reproduction is scarce. The genus *Bathyraja* is represented in the SWA by 11 species, most of them exploited as by-catch or target species. So far, egg cases of six species have been described. Here, we describe the egg case of *B. cousseauae*. A mature female bearing egg cases (total length: 1210 mm; disc width: 810 mm) was caught in April 2016 by bottom trawl at 54°14'2.4"S; 63°11'38.4"W, at 293 m depth. One egg case was found in each uterus. Thirteen morphometric characteristics were recorded. Egg cases were large, 127.8-128.2 mm total length (Lec, excluding horns), with maximum egg case width (Wmax) ~ 64 % of Lec. Lateral keel was relatively wide, about 9.5% of Wmax. Anterior apron was remarkably narrower (6.7–8.4 times) than posterior apron. Posterior horns were similar in size than the anterior ones. Anterior respiratory canals were relatively large, slightly longer (1.4-1.7 times) than posterior ones. Egg cases in fresh were uniformly bright golden, totally covered by a dense layer of sticky woven-like fibres. Surface had longitudinal striations with abundant, sharp and tall prickles well arranged giving a velvety texture to the touch. Prickles were smaller in the central zone and on posterior horns. Attachment fibres were observed at the bases of both anterior and posterior horns. An accurate species-level identification of egg cases is crucial for recognizing nursery grounds. The largest egg cases of *bathyrajids* from the SWA described so far correspond to *B. griseocauda* and *B. cousseauae*. They can be distinguished each other by their case surface, being smooth to touch in the former skate species. The remaining species have smaller egg cases than the joined-fins skate.

Keywords: Joined-fins skate, bathyrajids, capsules, morphology.

Embryo development timeline, mating behavior and reproductive parameters in *Sympterygia acuta* (Arhynchobatidae), a common coastal skate species from the Southwestern Atlantic

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Studies in captivity on chondrichthyans allow to investigate in detail embryonic development and other aspects of reproduction. Skates are oviparous and their egg cases can be easily maintained under laboratory conditions. Of the nine skate species inhabiting coastal waters from the Southwest Atlantic, embryo development timeline has been performed only in *Sympterygia bonapartii*. Here, we describe for the first time the complete embryonic development with a timetable of *S. acuta*, a coastal species with a marked seasonal reproductive cycle. Other features such as mating behavior, incubation period, size at hatching and sex proportion are also provided, through the study under controlled conditions of captivity. Three mature females of *S. acuta* were maintained in a 20000-liter tank with aerated seawater in a closed system, at Mar del Plata Aquarium. Specimens were kept trying to mimic natural conditions (11-21°C, natural photoperiod) from September 19th to December 22nd, 2017, but one female died by November 14th. A total of 53 egg cases were deposited in a period of 80 days. Egg cases were collected after deposition and placed in floating baskets in the same tank. Four mature males were also present in the tank. Embryonic development was described in detail analyzing a total of 42 embryos sampled every 14 days. The first half of the embryonic development shows the appearance of the embryonic axis and cranial structures, development and growth of gill filaments, presence of dorsal fins, growth of pectoral and pelvic fins with differentiation into claspers and a pulsatile heart. After 70 days until hatching, the embryo acquires the typical batoid disc, mouth and nares become neonatal, gill filaments are resorbed and spiracles begin to pump bringing oxygenated water into the internal gills, spinulation, epidermal and eye pigmentation are set, and yolk is being absorbed. After hatching, the embryo is fully pigmentated, breathes normally, has reabsorbed most of the yolk, and is able to swim independently. Incubation period at 11-21°C was between 89-108 days (mean±S.D., 94.2±5.9 days). Size at hatching ranged from 87-94 mm (mean±S.D., 90±2.5 mm total length), sex ratio (F:M) was about 1-1.1 and viability of egg cases was ~ 98%. Considering the time period shared by the three egg-depositing females (50 days), estimated relative fecundity was 13 eggs/female. Copulation events recorded by video are also described. *Sympterygia acuta* is a good model to carry out studies in captivity on skates, given its rapid adaptability and good reproductive performance.

Keywords: Bignose fanskate, embryonic development, incubation period, copulatory behavior, captivity.

Mercury levels and trophic interactions among sharks of the Colombian Pacific and risks to human health

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The purpose of this research was to identify the differences in mercury (Hg) concentrations in fins and muscle of seven shark species collected in the Colombian Pacific between 2009 and 2013. We analyzed total mercury levels (THg), their trophic interactions and the possible foraging overlaps between these species in order to inform consumers about potential risks of this metal in human health, and thus contribute to the conservation of these species. We assessed concentration of THg and chemical tracers of habitat and diet (d15N, d13C, respectively) in both tissues of seven shark species (n=175), which include: Whiptail Shark (*Alopias pelagicus*), Smalltail Shark (*Carcharhinus porosus*), Brown Smoothhound (*Mustelus henlei*), Sicklefin Smoothhound (*Mustelus lunulatus*), Scalloped Bonnethead (*Sphyrna corona*), Scalloped Hammerhead (*Sphyrna lewini*) and Bonnethead Shark (*Sphyrna tiburo*). Results showed that Hg levels in muscle tissue ranged between 2833 and 4046 ng g-1 dw, which exceeds the limit of consumption by humans determined by the FAO / WHO (Food and Agriculture Organization / World Health Organization), unlike fins whose concentration range oscillates between 90-440 ng g-1 dw. Hg levels in fin of *A. pelagicus* and *S. lewini* were significantly higher than Hg concentrations in fin of *M. henlei, M. lunulatus, S. corona* and *S. tiburo*. In the case of muscle tissue, only samples for two shark species were available: *A. pelagicus* and *S. lewini* (n=45). Significantly higher Hg concentrations were observed in muscle than in fin for these two species. Stable isotope analyzes in fin revealed that *M. henlei* had the highest trophic position (TP = 3.41) and *S. corona* the lowest trophic level among the seven species analyzed (TP = 2.60), whereas in muscle showed that *S. lewini* and *A. pelagicus* had the highest trophic level (TP=4.06 and TP=4.11, respectively) making these two species of sharks with a higher degree of predation than the other five. Regarding of niche overlapping, species like *A. pelagicus* and *C. porosus* tend not to present a specific niche and share habitat with most of the species. In contrast, *M. henlei, M. lunulatus*, and *S. corona* seem to inhabit more specific niches sharing habitats with other smaller competitors. These results suggest preliminary insights about the process of bioamplification of mercury suffered by shark populations of the Colombian Pacific and also highlights a potential risk for human health when top predators are consumed frequently, which may be of great interest as inputs for the conservation of these species.

Keywords: elasmobranchs, total mercury, ^{15}N, ^{13}C, bioamplification.

Inter-annual observations of the whale shark (*Rhincodon typus* Smith 1828) in a remote archipelago in the equatorial Atlantic Ocean.

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The understanding of site fidelity and habitat utilization by whale sharks in oceanic ecosystems is rather sparse, especially for the adults. The Saint Peter and Saint Paul Archipelago- SPSPA is a group of rocky islets located in the Mid-Atlantic Ridge (0°55'N, 29°20'W), where the population of whale sharks is equally mixed between juveniles and adults. Additionally, the archipelago is an ecologically important area for the species since evidences of reproductive behavior such as pregnant females and recent bite marks on pectoral-fins have been observed. In this study, we aimed at photo-identifying whale sharks by comparing the patterns of spots and stripes of the left flank and near the pectoral-fin to assess population parameters and site fidelity. The photographs and videos were collected from 2004 to 2017. The size of the whale sharks was estimated by comparing to the inflatable boat or another object of known size. The images were compared using the semi-automated Interactive Individual System- I3S software. Whale shark images from other regions of Brazil were also used in the analysis. Photographs were also compared to the global photo-ID library 'Wildbook for Whale Sharks'. No match was found among SPSPA, Brazilian coast and the worldwide library of whale sharks. However, two short-time re-sightings (3-4 days) and two interannual re-sightings were found for SPSPA. In the first match, a 10m female whale shark was sighted in June 2012 and re-sighted in March 2013. The second shark was an 8m female recorded in May 2016 then re-sighted in April 2017. These findings indicate a possible site fidelity to the archipelago by the whale sharks and suggest a potential reproductive philopatry by mature females. These results reiterate the relevance of oceanic habitat for adult whale sharks and highlight the ecological importance of the SPSPA for the conservation of the species.

Keywords: elasmobranch, oceanic insular habitat, reproductive ground, Rhincodontidae, population.

Population demographics, site usage and movement patterns of reef manta rays *(Mobula alfredi)* in Raja Ampat, West Papua, Indonesia

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Accurate information on population size, demographics and habitat usage is fundamental in understanding the conservation requirements of a species and for the development of effective management strategies. Reef manta rays (*Mobula alfredi*) are an internationally threatened species and declines in sightings have been reported in populations across the globe. Intensive population monitoring was conducted using photo-identification in the Dampier Strait region of Raja Ampat, West Papua (Indonesia) - a key aggregation area for *M. alfredi*. Sightings were recorded year-round, with a peak season occurring between November and April. Since 2009, a total of 670 individuals were identified from over 3500 encounters in the Raja Ampat region. Of these individuals, 339 (50.6%) females, 294 (43.9%) males and 37 (5.5%) of undetermined sex were identified. Mature adults made up 56.4% of the population, and an unusually high frequency (40.1%) of melanistic color morphs was recorded in comparison to other locations. The population comprised both resident and transient individuals, with 263 individuals sighted only once and 27 individuals sighted on >20 occasions. Multiple cleaning stations and feeding areas have been identified for *M. alfredi*, and large aggregations of up to 70 individuals were observed. Individuals displayed strong fine-scale preferences for various sites within a small study area, and sex and maturity status were likely to be major factors affecting these patterns of habitat use. Mesoscale movements of up to 200km across the archipelago were also recorded for some individuals. Ongoing monitoring will continue to build on these data in order to obtain an in-depth understanding of population dynamics and provide a basis for the development and refinement of efficient management and conservation plans.

Keywords: manta ray, *Mobula alfredi*, population demographics, photo-identification, Raja Ampat.

Demersal sharks from Pernambuco, Brazil, sampled by experimental fishing sets

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Until now, little information is available regarding elasmobranch species inhabiting Brazilian deep-sea waters. In the present study, the elasmobranch composition caught along the coast of Pernambuco, at different depth gradients, was described. From October 2014 to September 2016, 21 scientific expeditions were carried out aboard the research boats Sinuelo and Pedrinho, totalizing 63 fishing operations. Fishing sets were done using vertical longlines and 3 types of fishing traps (big, medium and circle), from 218 to 600 m depth (347.5 ± 63.9) and with temperatures ranging from 20.5 to 29.7 C (27.5 ± 1.7). A total of 196 sharks from 7 species were captured; 79.1% (155) from the Squalidae family; 18.4% (36) from the genus *Scyliorhinus*; 2% (4) from the genus *Mustelus*; and 0.5% (1) from the genus *Carcharhinus*. Of the family Squalidae, the following species were identified: *Squalus* cf. *albicaudatus* (44.5%), with total lenghts (TL) ranging from 24.8 to 83.8 cm (56.9 ± 15.3); *Squalus megalops* (27.7%), TL from 22.7 to 66.8 cm (48.2 ± 9.8); *S. mitsukurii* (12.9%), TL ranging from 78 to 86 cm (83.4 ± 2.5); and *Cirrhigaleus asper* (8.4%), TL ranging from 57.8 to 105.3 cm (92.3 ± 13.1). Most sharks were caught by fishing traps (78.6%), even though the percentage of longline sets with shark catches was slightly higher (57.1% for longlines and 54.8% for fishing traps). Even with higher catches by fishing traps, two species were exclusively captured by longlines: *Mustelus canis* and *Carcharhinus signatus*. Most species were captured during the day and night along all the sampled area, with the exception of *Mustelus canis*, captured only during the day, and *Squalus megalops*, captured almost exclusively during the night. Sharks were mainly caught from 300 m to 450 m. *Scyliorhinus* sp. was the only species captured along all depth gradients. *Cirrhigaleus asper* was also captured at deeper waters, near 500 m, and *Squalus megalops* was only found at depths lower than 350 m. No significant differences were found between elasmobranch catches in the first and second semester (X^2= 1,052; p <0,3511).

Keywords: elasmobranchs, deep-sea, *Squalus.*

Environmental perception about the elasmobrachs in the Parana coast, Southern Brazil

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Sharks and rays emerged since 400 million years ago and in their biological history, only a few changes can be notice in their morfophisiological conditions, evidencing their evolutionary success. With the decline of teleosts stocks, the elasmobranchs became to be a target species of the fisheries industry, mainly due the fins trade, mainly supplied by the Asian market. Furthermore, the habitat loss caused by degradation, the negative image that the media transmits and the lack of knowledge about the ecological importance of this group, contributes negatively to their conservation. With the purpose to change this framework we use environmental education tools to analyze and evaluate the environmental perception about the elasmobranchs in the Parana coast (Southern Brazil). A MCA (Multiple Correspondence Analysis) was applied over the answers matrix from the data obtained by the RAIAr da EduCAÇÃO project, in the first half of 2017, in the software R (R Development Core Team, 2017). A total of 134 interviews were made by pre-established questionnaires, containing questions about the ecology, human consumption and conservation of sharks and rays. When the interviewed answered any question wrong, the right knowledge was shared with them, as well as informative folders about the elasmobranch's conservation were given to them after the interview. The analysis results into two large groups of interviewed with different perceptions. The first group was composed by men, that lives in the Parana coast and have only basic education, but was familiarized with the questions about the ecology and conservation of elasmobranchs. The oppose group, composed by women, that lives far from the coast and have superior degree of education, that demonstrated a lack of knowledge in the questionnaires, being the group with less knowledge about the subject. These results corroborate with others studies of the same thematic and emphasizes that the environmental perception is an individual instrument dependent of personal experiences and interpretations and social and cultural factors. Furthermore, we evidence the need of bring information to population (especially for the groups poorest of information), about the importance of elasmobranchs in the ecosystems, in order to help the oceans health conservation.

Keywords: shark, rays, conservation, environmental education.

Historical changes in catch rates and species composition of batoids exploited by artisanal fisheries in the northern Colombian Caribbean Sea

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Colombian Caribbean artisanal fisheries have a great socio-economic importance, since the livelihood of a number of coastal communities depend largely on this activity. The catches of batoids by these fisheries are increasing over the last years due to a growing commercial demand. This species group has been little studied in the region, despite playing an ecologically important role in the exchange of energy between different trophic levels and transferring energy between coastal areas and deep zones. This group is characterized by having a high longevity and a low reproduction rate, thus making them very vulnerable to overfishing. Considering these factors, the objective of the present study was to evaluate the historical changes in the catch rates and the species composition of the batoids exploited by the artisanal fisheries that operate in the northern area of the Colombian Caribbean. To do this, databases of landing statistics collected in several coastal municipalities (Puebloviejo, Ciénaga, Santa Marta, Dibulla, Riohacha, Manaure and Uribia) during the periods 1994-1998, 2000, 2008 and 2013 were used. In general, there was an upward trend in the catch rates recorded in most municipalities evaluated. In addition, it was found that these resources are mainly captured with gillnets, longlines, beach seines and trawl nets. At the beginning of the time series available, the dominant species in the landings was *Hypanus americanus*, with a weight percentage of 70%, followed by *Rhinoptera bonasus*, with 21%. At the end of the time series (2013) the dominant species in the landings became *Hypanus guttatus* (50%), followed by *Hypanus americanus* (23%). These results reflect the occurrence of historical changes in both the catch rates and the species composition of the batoids landings in the northern area of the Colombian Caribbean.

Keywords: *Hypanus*, *Rhinoptera*, rays, CPUE, fishing gear.

Advances of Chondrichthyan systematics in Brazil: an historical overview and future research perspectives

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Brazil comprises one of the largest biodiversity hotspots of the Chondrichthyan fauna in the world, currently with 13 orders, 37 families, 83 genera and nearly 200 recognized species of sharks, rays and chimaeras. These species inhabit marine, estuarine and freshwater environments ranging from coastal and oceanic zones in the South-western Atlantic Ocean to freshwater rivers in the Amazonian, Northeastern and Western-central regions. Reports on the occurrence of Chondrichthyan species in the country date back to the pre-Linnaean era. Global efforts in systematics research of the group improved the knowledge of the local fauna, especially during the 19th and 20th centuries, in which many wide-ranging species were recognized and listed in national checklists and identification guides. Regional studies on the taxonomy and phylogeny allowed the description of several Brazilian endemic species in recent years and discussions about the interrelationships between species and higher clades of very specialized groups (e.g. Potamotrygonidae). This study provides an historical overview of the Chondrichthyan systematics in Brazil, pointing out recent progresses in taxonomic and phylogenetic research, and discussing future perspectives for improving the knowledge on the regional Chondrichthyan fauna. Despite high diversity and extensive historical taxonomic contributions, the Chondrichthyan knowledge in Brazil is likely to be misrepresented with many species of worldwide distribution often recognized in the country rather than endemic species, especially from marine and estuarine realms. It is estimated that there are over 11 undescribed species from Brazilian waters but these are still awaiting taxonomic assignment. Limited research efforts through scientific expeditions in marine and freshwater areas, scarcity of permanent taxonomists, and unavailability of research funds contribute to the local taxonomic impediment. This scenario jeopardizes the accurate identification of the Brazilian species for conservation and fishery management, and conceals the evolutionary history of Chondrichthyes in Brazilian waters. To gather Brazil within the worldwide modern framework in Chondrichthyan systematics it is suggested the creation and modernization of scientific collections and improvements in accessibility of their biodiversity data for the academic and general public, implementation of modern research methodology in systematics (e.g. DNA barcoding, eDNA), and strengthening the collaborative network among national and international specialists.

Keywords: biodiversity, phylogeny, taxonomic impediment, Chondrichthyes, Brazilian waters.

Taxonomic evaluation of rare deep-water skates of the genus *Okamejei* from off northern Mozambique

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The genus *Okamejei* Ishiyama, 1958 contains 12 valid species of rare deep-water skates with distributions in the Indian and Western Pacific Oceans. Two species, *O. heemstrai* (McEachran & Fechhelm, 1982) and *O. ornata* Weigmann, Stehmann & Thiel, 2015, occur exclusively in the Western Indian Ocean. The former species is originally described from off Kenya and Tanzania and known to occur up to Mozambican waters. The latter species is endemic to Socotra Islands. These species are only known from their type material and a single non-type specimen of *O. heemstrai*. Two specimens (adult female, 438 mm TL; juvenile female, 147 mm TL) were collected in 2009 off northern Mozambique during a cruise aboard the RV Dr. Fridtjof Nansen. The present study aimed to investigate the taxonomy of species of *Okamejei* from off northern Mozambique through comparative morphological analysis, including external morphology, morphometrics and meristic data. Type material of *O. heemstrai* was examined and data from *O. ornata* were taken from the literature for comparisons. The preliminary results show many morphological differences between the newly collected specimens and regional congeners regarding body color and proportional external measurements such as larger interdorsal space, disc length, disc width and preorbital snout length (vs. smaller in *O. ornata* and *O. heemstrai*). They also differ from *O. heemstrai* by having six interdorsal thorns (vs. 2 interdorsal thorns), and 39 tooth rows in upper jaw (vs. 31–35). Furthermore they are distinguished from *O. ornata* by body coloration (greenish brown body dorsally with innumerous ocelli and rosettes brown in color with each one surrounded by whitish ring, and snout reddish vs. ocher body with scattered rosettes dark brown in color each one surrounded by beige ring, and snout dusky) and shape of nasal curtains (thin with few fringes posteriorly, lateral margin markedly straight vs. heavy with many fringes posteriorly, lateral margin markedly concave). The morphological differences noticed herein support that *Okamejei* from northern Mozambique possibly represent an undescribed species, currently under taxonomic scrutiny by the authors. These specimens were collected at only 10m in depth, which go against the depth records for regional congeners (260–457m depth for *O. heemstrai*; 375–380m depth for *O. ornata*). This result indicates that *Okamejei* species are not restricted to deep-waters and possibly migrate to shallower waters for reproduction or feeding.

Keywords: taxonomy, morphology, Western Indian Ocean, Rajidae.

Assessing the elasmobranch diversity of Rio de Janeiro Coast, Brazil, Southwestern Atlantic

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The most important general studies on elasmobranchs in Brazil have started in 1900, when Miranda Ribeiro (1907, 1923) provided the first list of the Brazilian sharks and rays species, mainly based on specimens and data mostly from Rio de Janeiro. The present study aims to investigate the elasmobranch diversity of the coast of Rio de Janeiro State, Southeast Brazil, Southwestern Atlantic Ocean, updating the regional numbers and comparing with the Brazilian fauna of marine elasmobranchs known to date. In addition, we provide information on their distinctive taxonomic characteristics, their biology and global distribution. Currently, the Brazilian sharks are represented by 22 families, 43 genera and 86 species, and off Rio de Janeiro, by 20 families, 34 genera and 62 species. Marine batoids off the Brazilian coast are represented by 15 families, 33 genera and 64 species, of which 13 families, 22 genera and 39 species were recorded off Rio de Janeiro. The data herein presented are based on field observations, sampling on board fishing and research vessels, monitoring the fisheries landings on the beaches and ports, examination of species of relevant Brazilian ichthyological collections and information available in the literature. Our knowledge on the elasmobranch richness and diversity along Rio de Janeiro's coast reflects the research efforts primarily based on fishery-dependent data. Recent scientific research programs dedicated to explore the deep ocean have revealed the occurrence of numerous previously unknown species for Rio de Janeiro and Brazilian coast, besides allowing the description of new species.

Keywords: elasmobranchs, diversity, Rio de Janeiro, Brazil.

Trace metal assessment (arsenic, selenium and nickel) in blue shark (*Prionace glauca*), captured in the southeast-south coast of Brazil

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Blue sharks are highly exploited worldwide to suppress human demand for fins and meat, endangering its population as well as human health, because sharks can bioaccumulate metals. The goal of this work is to determine metallic trace elements, such as arsenic, selenium and nickel in *Prionace glauca*, a blue shark specie. Biological aspects, as fork length and approximate age, were also evaluated. Ten specimens were obtained through commercial fishing in the Southeast and South regions of Brazil, using pelagic longline fishing. On arrival at the port, specimens were weighed and sexed in its commercial weight (headed, finned and gutted). About 100 g of muscular flesh from dorsal region between the dorsal and caudal fin was removed. Metal determination in muscle tissue (wet weight basis) was performed through acid digestion (HNO3/H2O2 mixture). After the acid digestion, the concentration of metals was determined in duplicate by means of inductively coupled plasma optical emission spectrometry (ICP-OES). The ten evaluated specimens consisted by 9 males and 1 female, the fork length average was 200.9 ± 13.5 cm and estimated age average was 6.3 ± 1.01 years characterizing blue shark fishing during the winter in the Southeast-South region of Brazil mostly by small adult males. The average concentration of total arsenic (1.52 ± 1.11 mg/kg) and selenium (0.55 ± 0.11 mg/kg) was above the limits permitted by Brazilian legislation of 1.00 mg/kg and 0.30 mg/kg respectively. Total nickel concentrations (0.25 ± 0.08 mg/kg) were obtained from only the biggest shark (fork length 230.5 cm) sample, which was below the limits permitted by Brazilian legislation of 5.00 mg/kg, the other nine samples were below ICP-OES detectable limits. The United States Institute of Medicine (IOM) determined 0.40 mg/day for selenium and 1.00 mg/day for nickel as the Tolerable Upper Intake Levels (UL), which means, based on these study results, that an adult person should not daily consume more than 727 g of blue shark meat considering selenium and 4 kg considering nickel. The European Food Safety Authority (EFSA) established a UL for total selenium of 0.30 mg/day, with the daily intake of blue shark meat no more than 545 g. No positive correlation was found between the analyzed metals and sharks size/age, therefore the results do not indicate a metal accumulation, however more metal determination studies in commercial shark meat in Brazil, are essential to lessen human and environmental contamination, while promoting *Prionace glauca* conservation.

Keywords: blue shark, metal accumulation, South Atlantic.

Photographic catalog of the batoid species from Margarita Island, as a measure for the recognition of morphological characters and varieties.

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The elaboration of adequate guides for the identification of fish species is an extremely necessary element for the structuring of conservation management plans. In the case of elasmobranchs, the identification guides consist of photographic collections and schemes that illustrate taxonomic details such as position of the fins, width of the fins, position of the spiracles, etc. Most of these are published in regions with intense artisanal fishing activity (for example: Mozambique, Malaysia and India) and in the presence of emblematic species and genera such as *Rincodon thypus*, *Sphyrna* sp., *Pristis sp.*, *Mobula* sp. and the species of the order Torpediniformes. In Venezuela, for some time now there has been no formal revision and update of the elasmobranch species present in the territory. The existing records, when compared with the current identification guides, lack the detailed descriptions of their morphological characteristics and their varieties. Margarita Island has a rich marine biodiversity, with approximately 40 families of bony fish and 26 families of elasmobranchs, inspections carried out on the fishing landings during the last four years have been able to build a photographic database that registers in different planes the morphological characteristics of the striped species in the areas near the island, within the database the genus that stand out are *Myliobatis, Hypanus, Narcine, Mobula* and *Rhinobathos*. Detailed observations of the photographs highlight that there are marked morphological conservative differences that are related to the capture areas, these results could well refer to morphological differences between populations, each representing a variety of species or possible new species. Currently 3 taxonomic reviews are being carried out in the region, indicating new records for the Venezuelan coasts and the Caribbean.

A nursery area for rays in La Guardia cove (Margarita Island, Venezuela)

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Elasmobranch nurseries are habitats where females give birth to their young and juveniles spend their early life history. These provide the young a better source of food and protection against predation. Primary nurseries are habitats where parturition occurs and in which the young live for a short time and secondary nurseries are habitats in which juveniles are found after leaving the primary nursery and before reaching maturity. It has been recorded that along the La Guardia cove (Margarita Island, Venezuela) the rays *Narcine* sp., *Gymnura micrura*, *Rhinobatos* sp., *Hypanus americanus* and *H. guttatus* use the coastal waters of the north face of Margarita Island, characterized by muddy bottoms and water columns with a maximum depth of 10 m, as a delivery area from February to June, coinciding with the times of appearance and then fishing season of the shrimp *Xiphopenaeus kroyeri*. The presence of this resource undoubtedly conditions the area to be considered as a secondary breeding area where breeding can survive the first stages of life and then increase in size. There does not seem to be a spatial and temporal separation between the species, the use of the area by the rays is continuous throughout the period, this since throughout the 5 months individuals of different species representing different sizes were observed.

Keywords: early life-stages, habitat, artisanal fishery, elasmobranchs.

The timetable of the reproductive cycle of the female of *Prionace glauca* in the Southwest Atlantic

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Biometrical data and photographs of the female reproductive cycle of *P. glauca* were obtained off southern Brazil in 2004-2009. The months of January, February, March, June, July, August, September, October and December are represented in the data. Gestation started in January- March. Ovulation occurred from the pre-ovulatory ovarian follicle with mean diameter of 15 mm and mean weight of 1.6 g. The fertilized ova were deposited in the uteri as uterine eggs. Embryonic development reached mid-term in June-July with fork lengths (FL) ranging from of 10 to 30 cm. Full-term embryos, with FL of 35 to 49 cm, occurred in small numbers in August and were abundant from September to December. Thus, gestation lasted about nine months. During gestation, pre-ovulatory ovarian follicles grew and matured in the pregnant female until reaching diameters of approximately 10 mm shortly before parturition. After parturition in September-December the breeding female remained non-pregnant (NPR) until ovulation in January-March. The diameter of the pre-ovarian ovarian follicles of those NPR females increased in October 2008 and January 2009 to diameters ranging from 14 to 17 mm about the mean of 15 mm, thus reaching maturity for imminent ovulation. The reproductive cycle of the individual female of *P. glauca* consists of two phases. The first phase, from January-March to September-December, consists of pregnancy and start of pre-ovulatory follicle growth. The second phase is the NPR phase with growth and maturation of the ovarian follicles during three months within the period September-January. During those three months, breeding NGR females may coexist with breeding females that are still pregnant. The reproductive cycle of the individual breeding female lasts 12 months, of which nine months are occupied by pregnancy. The timing of the cycle varies between individuals. That is the reason why at the population level there may be pregnant females at all times of the year. Individual reproductive cycles in which pregnancy starts after January, will finish after December of the year of breeding.

Keywords: Blue shark, reproductive cycle.

Seasonal abundance and spatial distribution of blacktip sharks (*Carcharhinus limbatus*) in southeast Florida

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Southeast Florida's marine ecosystem experiences a seasonal influx of upper trophic level predators each winter due to the large-scale annual migration of blacktip sharks (*Carcharhinus limbatus*). Blacktip sharks occupy shallow, coastal habitats and are distributed from Georgia to North Carolina during the late spring and summer, migrate south during the fall to overwinter in Florida, and then migrate north in late winter and early spring. As they migrate, blacktip sharks form dense aggregations along Florida's coastline. Although these large shark aggregations attract significant public interest, surprisingly little empirical data have been collected on the shark abundance, spatial distribution, and the factors driving their migration. Manned aerial surveys of coastal waters were conducted from Boca Raton to Jupiter (2011-2014), and Miami to Jupiter (2015-2018). A high definition video camera mounted out the open window of the plane recorded the transect to a distance approximately 200m seaward of the beach. These videos were analyzed to determine blacktip shark abundance, and shark densities within inlet-bound sections of the coastline. Water temperature was also recorded to determine correlations with shark abundance. Results indicate that the highest shark densities, exceeding 1,000 sharks km-2, were in the northern-most sections of the transect (Palm Beach County) in February and March, when water temperature was at its lowest. Peak shark abundance was significantly inversely correlated with water temperature. This strong correlation between water temperature and shark abundance suggests that warming oceans might shift the southern terminus of the migration towards higher latitudes, causing ecological imbalances along the United States Eastern seaboard.

Keywords: Blacktip shark, migration, Southeast Florida.

Tracking 2020 marine biodiversity targets with Europe's Sharks and Rays

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The main threat to marine biodiversity is overfishing, yet the trajectory of marine extinction risk remains largely unknown. Risk trajectories are required by 2020 to track progress towards imminent international policy commitments. Here, we report a regional Red List Index (RLI) for Class Chondrichthyes (herein 'sharks and rays') in Europe, while accounting for uncertainty from data deficiency with status predictions. Regional shark and ray extinction risk is higher and worsening faster than for all globally assessed terrestrial groups. Large-bodied species with shallow depth distributions that overlap with fisheries face the greatest risk of extinction in Europe. This is particularly true in the Mediterranean Sea, where threat predominates compared with the Northeast Atlantic. Despite a decade of understanding the poor status of Europe's sharks and rays, there has been insufficient region-wide implementation of appropriate species protections and sustainable fisheries management to halt and reverse the loss of biodiversity. This is the first ever RLI for an exploited marine group, providing a powerful tool to track marine conservation and fisheries outcomes. Three years from the 2020 deadline, this RLI reveals Europe's failure to meet international policy obligations for sharks and rays.

Keywords: conservation, fisheries, policy.

Environmental influences on acoustic receiver performance in a satellite-acoustic array

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A series of fatal shark bite incidents along Western Australia's coast prompted the development of the Shark Monitoring Network (SMN) by the state government in 2012. The network consists of an array of satellite-linked acoustic receivers which enable near real-time notifications when acoustically tagged sharks are detected. One of the biggest logistical challenges associated with the SMN is its size; 27 sites are continuously monitored over 600 km of coast. Consequently, individual receivers are subject to a diverse range of physical environmental conditions. We analysed data from sentinel tags placed at each receiver between 2013 and 2016 with the aim of understanding the effects of key environmental variables on receiver performance. Detections of sentinel tag pings by individual receivers ranged from ~ 30% to near perfect (100%). While much of the variability in detection probability was attributable to characteristics inherent of individual sites, the combined effects of wind and swell were consistent across the array. Likewise, strong seasonal effects on detection probability were also found. These findings can be used to understand the overall efficacy of the network and help optimize performance of this and similar large-scale acoustic arrays.

Keywords: sentinel tags, acoustic telemetry, receiver efficiency, Vemco VR4Global.

Reintroduction of critically endangered sharks and rays through breeding: feasible or not? A pilot programme

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Worldwide, 25% of all sharks and rays are threatened with extinction (IUCN 2016, Red List of Threatened Species). In European waters, more than 30% of species are endangered. At the beginning of the 20th century, elasmobranchs were frequently found in the Dutch North Sea. Ten out of the twenty shark and ray species that still occur in the North Sea are on the IUCN Red List of threatened species, most sharks, rays and their habitats are not protected The angel shark (*Squatina squatina*) and the shagreen skate (*Leucoraja fullonica*) are probably extinct in the Dutch North Sea. Some populations have disappeared or decreased to such an extent that natural recovery does not seem feasible. Reintroducing sharks and rays which are (locally) extirpated in the North Sea such as the angelshark and the common skate (*Dipturus batis* complex) could possibly be the only way to reinstate these species in Dutch waters. In 2015, WWF Netherlands and 4 other NGO's started an innovative project investigating possibilities for a reintroduction program of endangered eligible North Sea sharks and rays. Pilot species is the thornback ray (*Raja clavata*), still quite rare in Dutch waters. A reintroduction program for marine fish species is unique. So far, 300 thornback ray eggs have successfully been reared at the breeding center Blue Linked, which is equipped to breed sharks and rays just for conservation purposes, 700 more will follow until 2019. Both the breeding and the reintroduction programme are set up in accordance with the IUCN Guidelines for Reintroductions and made visible to the public. When 6-8 months old the juvenile thornback rays are tagged and transferred to former oyster pits in Yerseke to acclimatise in natural North Sea water, where they also learn to catch live prey. After two weeks they are released into the North Sea. The first 30 thornbacks were released in October 2017. In order to individually follow released animals with a VEMCO system, thirty rays will get acoustics tags in 2018. The next step will be to breed more endangered shark and ray species such as the common skate and the angelshark. International cooperation is currently being set up and regarded vital for a successful program. All knowledge can be used for the reintroduction of other critically endangered species worldwide. Other pillars of this programme are education, bycatch mitigation, and supporting the establishment of marine reserves in collaboration with all Dutch stakeholders.

Keywords: mark recapture, reintroduction, angelshark, common skate, North Sea.

Genetic characterisation of the worlds' most remote whale shark aggregation - St. Helena Island in the south Atlantic

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Research efforts on whale sharks have so far been limited to sub-adult males which make up the vast majority of coastal aggregations around the world. The movements of mature sharks, their reproductive techniques and key habitats remain poorly understood, whilst details of this demographic group are the most important to mitigate current threats. The species was downgraded from 'vulnerable' to 'endangered' by the IUCN in 2016 due to a >50% decrease in global sightings within 10 years. Current genetic studies on the species have found a lack of structure across all oceans with the exception of individuals sampled in the northwest Atlantic, which have shown some differentiation in both nuclear and mitochondrial markers. However, the comparatively low differentiation across whale shark populations indicates some level of historical or current admixture between the Atlantic and Indian Ocean populations, leaving a question about the nature of this relationship. Another aggregation has recently been documented in the southern Atlantic Ocean, at St. Helena Island. This tiny (<130km²) volcanic island lies 2000 km west of the Angola/Namibia boarder and over 3000km north west of the west coast of South Africa. In addition to straddling populations which have already been studied, whale sharks from this area are unique from all others with a 50:50 male: female ratio of mature individuals. Mitochondrial DNA (mtDNA) from 40 individuals from the region will be analysed and compared to those from samples from Mozambique, Tanzania and further locations available from the online database, Genbank. Haplotype and nucleotide diversities will be estimated in ARLEQUIN 3.0 across and within populations, and population subdivision and structure estimated with an analysis of molecular variance (AMOVA) in ARLEQUIN. Population significance will be further characterised using phi st (Fst). Bayesian Skyline plots (BSP) will estimate historical effective population sizes (Ne) in Beast v2. The north-west Atlantic and western Indian oceans are expanses of suitable habitat for whale sharks, but the connection between them remains completely unknown. Data from St. Helena in the south Atlantic spans this enormous gap and will provide a missing link in the connectivity of this species. This data will form the preliminary results of a PhD study spanning the next 2 years which will use further genetic techniques to provide valuable information on cryptic habitats, behaviours and adaptability of the species. This can be practically applied to much needed future conservation and management actions for the species.

Keywords: population genetics, whale sharks, St. Helena, mtDNA.

Investigating the occurrences and ranges of the Atlantic Cownose Ray, *Rhinoptera bonasus*, and the Brazilian Cownose ray, *Rhinoptera brasiliensis* in the Western Atlantic using genetic tools

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The western Atlantic contains two species of cownose rays (Genus *Rhinoptera*): the Atlantic cownose ray, *R. bonasus*, and the Brazilian cownose ray, *R. brasiliensis*. *R. bonasus* is listed as Near Threatened, while *R. brasiliensis* is listed as Endangered (IUCN). The range of *R. bonasus* is believed to extend from Virginia, U.S.A to Brazil, overlapping with that of *R. brasiliensis*, which was historically thought to be endemic to 80 km along the coast of Brazil. Due to the two species' conserved morphology, visual differentiation between the two species in the field has been difficult. As a result, these species were historically identified in the field based on tooth plate counts in areas where the two species were known to overlap in range, or geographic location, where cownose rays north of Rio De Janeiro, Brazil were presumed to be solely *R. bonasus*. Recently, however, morphological and genetic data revealed that the range of *R. brasiliensis* extends to the northern Gulf of Mexico, highlighting the need to further investigate the occurrences and ranges of cownose rays in the western Atlantic. To accomplish this, we collected tissue samples from 428 cownose rays throughout their western Atlantic range from Virginia, U.S.A. to Brazil. DNA sequence data were generated for a 442 base pair portion of the NADH dehydrogenase subunit (ND2) region of mitochondrial DNA, resulting in two distinct lineages distinguished by 6.56%-7.01% sequence difference. The ND2 data revealed a total of 15 unique haplotypes, 10 in *R. bonasus* and 5 in *R. brasiliensis*. The occurrence of *R. brasiliensis* outside of its restricted range along the coast of Brazil requires further investigation to clarify its distribution. This research is a crucial first step in understanding the population biology of cownose rays in the western Atlantic and will facilitate the re-assessment of the conservation status of both species.

Keywords: *Rhinoptera*, Cownose ray, ND2, range.

U.S. restrictions on sale and trade of sawfish rostra: Room for improvement

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The fate of sawfishes, now among the most threatened marine species, has long been tied to their characteristic elongated, tooth-studded snouts. These rostra are easily entangled in fishing gear and have been valued around the world for centuries as souvenirs, decorations, weapons, and medicines. Associated, largely incidental fishing mortality has been the primary factor in global sawfish depletion. All five species (*Anoxypristis cuspidata*, *Pristis clavata*, *P. pectinata*, *P. pristis*, and *P. zijsron*) are now classified as Endangered or Critically Endangered on the IUCN Red List of Threatened Species, and Endangered under the United States (U.S.) Endangered Species Act. Although sawfish are legally protected in the U.S., they are still subject to incidental capture and illegal harm. Ending demand for rostra is key to minimizing the incentive to kill sawfish or remove rostra prior to release. Numerous state, federal, and international policies aim to ban or severely restrict sawfish rostra commerce in the U.S. Inter-jurisdictional inconsistencies and confusion surrounding applicable regulations; however, hinder enforcement and allow rostra sales to continue. Current regulations affecting U.S. sale and trade of rostra will be discussed along with recommendations for enhancing sawfish recovery though improved legal guidance and public awareness.

Keywords: trade, endangered, enforcement, conservation.

Estimating individual- and population-level variation in space use of white sharks off Cape Cod, Massachusetts, from passive acoustic telemetry data

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Spatial management practices for coastal shark species are often based on trends in space use inferred from data collected using passive acoustic telemetry arrays. Most acoustic telemetry studies seek to answer population-level questions related to trends in occurrence and abundance, which ideally require the random distribution of tag deployments in proportion to the population's underlying demographic structure. However, this is rarely feasible in practice; logistical constraints often result in tags being deployed in a more opportunistic fashion. There is often also a large degree of variability in residency and space use even among individuals of the same sex and size class. This leads to a disproportionate number of detections logged by certain individuals, which can bias population-level estimates of space use and associations with environmental covariates. Here we develop a model to identify relationships between species' occurrence and environmental covariates from acoustic telemetry data that directly accounts for differences in the spatial distribution of tagged individuals as well as the detection process. Our approach extends the generalized linear modeling framework often used to infer trends from acoustic telemetry data by accounting for individual heterogeneity using spatial random effects. Conceptually, the model treats acoustic detections as the realization of a continuous latent spatial process (i.e. the distribution of individuals in space) which is biased as the result of the observation process (i.e. the location and detection range of individual acoustic receivers). We use simulation testing to compare the performance of the proposed model with spatial models that do not account for individual effects, as well as with the non-spatial generalized linear modeling approaches most frequently used. We fit the models to acoustic detection data collected from 10 tagged white sharks, *Carcharodon carcharias*, in the coastal waters off Cape Cod, Massachusetts, USA, during 2016 and demonstrate how the models can be used to quantify the relationship between environmental covariates and predict both individual- and population-level space use.

Keywords: spatial variation, detection range, mixed effects model, habitat utilization, simulation testing.

Is the protection of sawfish in Queensland working?

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Sawfish (fam. Pristidae) are considered the most threatened family of all sharks and rays. In Australia, 3 species of Pristis are listed as Vulnerable and Migratory on the EPBC (Environmental Protection and Biodiversity Conservation) Act of 1999, while *Anoxypristis cuspidata* is listed as Migratory. A national sawfish recovery plan was created in 2008. The Gulf of Carpentaria in Northern Australia is considered to represent the last global retreat for four species of sawfish. Since October 2015, Sharks And Rays Australia has sampled nine different river systems along Queensland's coast of the Gulf of Carpentaria. Sampling locations include the river mouths, plus various sites extending into the freshwater reaches. Survey methods included gill netting, drum lining as well as hand lining. As this gear is only selective by fish size but not by species, all sharks and rays caught were identified, measured, tagged, DNA sampled and released. The data collected by Sharks And Rays Australia will be compared with previous data sets available on the distribution and abundances of sawfish in both the Gulf of Carpentaria (work done by Sitirling Peverell in the early 2000s) as well as the Great Barrier Reef Marine Park on the east coast of Queensland (sawfish capture data form the Queensland Shark Control Program). Whether these data sets can be used as a baseline for sawfish abundances will be discussed.

A Small Brain and a Big Nose: Comparative Brain Morphology of the Greenland and Pacific Sleeper Sharks

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Broad variability has been documented within cartilaginous fishes regarding the size and complexity of the brain and its major regions (olfactory bulbs, telencephalon, diencephalon, mesencephalon, cerebellum and medulla). This variability is often associated with primary habitat, life history traits, or specific behavior patterns, even in phylogenetically unrelated species that share certain lifestyle characteristics, potentially providing a link between brain form and function. The Greenland (*Somniosus microcephalus*) and Pacific sleeper (*S. pacificus*) sharks are two closely related members of the family Somniosidae. They are two of only a few shark species known to occur in the Arctic. Given their large body sizes and the extreme latitudes at which these animals are found (often occurring under the ice and at depths of 1200-2000 m), many aspects of their behavior, life history, and basic biology are poorly understood in comparison to other species. Among the most distinctive characteristic of *S. microcephalus* and *S. pacificus* is the presence of ocular lesions, generated by the ectoparasitic copepod *Ommatokoita elongate*, which attaches to the cornea of these shark species. Despite the potential visual impairment, these sharks remain capable of capturing active prey, and marine mammal tissue (primarily pinnipeds) is frequently reported as a key dietary component in both species, suggesting there may be an increased reliance on other sensory systems for survival. Therefore, patterns of brain organization of these two unique shark species was examined as a way of predicting the relative importance of different sensory modalities in predatory behavior. Using magnetic resonance imaging (MRI), we assessed relative brain size (encephalization) and brain organization of *S. microcephalus* and *S. pacificus* in the context of a broad range of other cartilaginous fish species (n=152), using phylogenetic comparative techniques. Like other somniosids, these animals have smaller than expected brains for their body mass. Notably, the development of brain regions that receive visual input are relatively reduced in both species, while the olfactory regions of the brain are greatly enlarged, which may indicate the relative importance of these different sensory systems. Results suggest patterns of brain organization might allow us to make predictions about the behavioral ecology, sensory specializations, and predatory habits in these little-known, deep-diving Arctic sharks.

Keywords: brain evolution, brain, olfaction, vision, comparative neuroanatomy.

Sustainable Sharks and Manta Rays Tourism: Estimate Underwater Carrying Capacity in Komodo National Park, Indonesia

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Komodo National Park is one of the best underwater destination in world that have increasing visitors in every year. At least, there were 107.711 visits in 2016 including divers around 78,49% who interested to shark and manta rays as their priority underwater tourism attraction. The top 11 dive sites that have the high intesity of human activities and impact to the marine resources and environtment. This research was conducted between 2015-2017 aims to estimate underwater carrying capacity that useful for responsible tourism management in Komodo National Park. The methodology used to know Tourism Carrying Capacity (TCC) with several correction factors such as social (Cfsos), Damage due to contact (Cfda), Wind (Cfwind), and Fragility (CFfg). Every site will be visited 6 times a day with estimate underwater trails about 160,47 – 1.113,17 meter. Total divers per year estimate 216.984 divers with average per dive site is 54 divers (SE±8.9) per day. This result is assumed with management capacity scoring was 0,73 (2016) with aspects including infrastucture, equipment and personel. The highest number of TCC is Manta Point (*Karang Makassar*) dive site as many as 134 divers per day that presented distance between diver with the sharks, manta rays and other marine life. Based on this result, a number of the management plan of shark and rays tourism has been developed based on the regulatory framework of sustainable marine tourism master plan in TNK. The related strategic management plan are: (1) monitoring/patrol of naturalist sea guide, (2) provision of elasmobranch post, (3) establish a reservation system, (4) develop codes of conduct for visitors and boats (6), interpretation of best practices (7) rules and sanctions, (8) partnership.

Keywords: sharks, manta rays, Komodo National Park, Carrying Capacity, Underwater Tourism.

Species Composition and CPUE of Listed Sharks on Appendix II CITES Were Caught In Indonesian Waters

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Mostly sharks are caught in the Indonesia dominantly as bycatch from any types of gears. The result of bycatch fisheries is one of threat on sharks species, IUCN listed around 66,9% sharks in Indonesia under threat through the conservation efforts. For the last decades, there is an increase of global attention on fisheries operation of sharks species, although sharks just only 2% of total capture of fishery production nationally. Indonesia still be the country named the most catch of sharks around 13% of world production. This cartilaginous fishes have been included in Appendix II CITES listed as international issues since 2013. This research was conducted between 2014-2017 in some landing sites such as PPI Karangsong (Indramayu), PPP Tegalsari (Tegal), PP Muncar (Banyuwangi), dan PPN Brondong (Lamongan). Fisheries Management Area (FMA) include 711, 712, 713, and 573 as fishing ground for the sharks. The total trips that were covered in this research as many as 759 trips with the highest catch composition was *Sphyrna lewini* (5085 individu) and *Carcharhinus falciformis* (1350 individu), whereas other species are only with the small number of individu such as *Alopias pelagicus* (35 individu), *Alopias superciliosus* (21 individu), *Sphrna mokarran* (31 individu), and *Sphyrna zygaena* (25 individu). Muncar Fishing Port is the most productive to catch *C. falciformis* with the total catch that could be covered by enumerator around 47.542 kg while the total catch of *S. lewini* in PPN Brondong (12.973 kg) and PPI Indramayu (8.264 kg). This result of the research expected as basic information to policy decision of sharks management in Indonesia, specially to the vulnerable species and it also one of the way to support how to determine the quote of sharks utilization per each locations based on NDF (Non-detriment Findings) assessment and make sure the population is not harmed and extinct in ecosystem.

Keywords: shark bycatch, catch composition, appendix II CITES, Indonesian Water.

Diet of the blue shark *Prionace glauca* in northern Peru

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The blue shark (*Prionace glauca*) is the most landed shark species in Peru, representing 42% of total national shark landings. Despite its importance for fisheries, the ecological role of *P. glauca* in Peruvian waters remains unknown. Therefore, the present study aimed to assess the feeding and food habits of blue sharks in northern Peru through stomach content analysis. A total of 115 samples of gut contents from individuals measuring 110.0 - 293.0 cm in Total Length (TL) were collected between February and December of 2015. From those individuals, 47 were females (range: 165-293 cm TL) and 68 were males (range: 110-288 cm TL). The results indicate that blue sharks have epipelagic and mesobathypelagic feeding habits, feeding upon a wide number of preys (42 species) but with a diet dominated by 'Unidentified cephalopods' (31.3% PSIRI), Argonauta spp. (16.1% PSIRI), and Ancistrocheirus lesueuri (6.2% PSIRI). Diets differed by size class (ANOSIM: R=0.038, p-value=0.02) and fishing ground-longitude (ANOSIM: R=0.076, p-value<0.01), suggesting longitudinal movements related to increments in body size. In addition, we propose possible scavenging behavior for blue sharks based upon the finding of larvae cyprid (range: 1-200 individuals) and juveniles (range: 1-3 individuals) of the cosmopolitan barnacle Lepas anatifera occurring in stomachs only containing the prey item 'Unidentified cephalopods' (n = 36). Therefore, the present study contributes relevant baseline information on the trophic ecology of blue sharks that can be useful in implementing ecosystem-based fisheries management plans in Peru.

Keywords: Trophic ecology, cephalopods, scavenging behavior, small-scale fisheries.

How shark conservation in the Maldives affects demand for dive tourism

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Shark-diving tourism can create considerable benefits for local economies and communities. This tourism sector depends on healthy shark populations that are, however, in need of conservation actions. We examine the socio-economic value of shark-dive tourism as well as the link between conservation actions and economic returns from shark-diving tourism in the Maldives. We estimated the annual economic revenues of shark-dive tourism as US$42 million which shows that the value of this industry has nearly doubled over the last 25 years. We used, moreover, a combined travel cost and contingent behaviour approach to estimate the dive trip demand under different management and conservation scenarios. Our results show that increasing shark populations could increase dive-trip demand by 15%, raising annual economic benefits for the dive-tourism industry of >US$6 million. Conversely, under scenarios where shark populations decline, where dive tourists observe illegal fishing, or if dive operators lack engagement in shark conservation, dive trip demand could decrease by up to 56%. This potential decline in dive trip demand could cause economic losses of more than US$24 million annually to the dive tourism industry. Our results highlight the increasing importance of shark-diving tourism and the dependence of the shark-diving industry on the creation and enforcement of appropriate long-term management regimes for shark conservation.

Keywords: shark diving, illegal fishing, shark abundance, dive operator engagement, economic benefits.

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