

PROCEEDINGS OF
**INTERNATIONAL MEETING ON AMAZONIAN
SHARKS AND BATOIDS**

ANAIS DO
CONGRESSO INTERNACIONAL SOBRE TUBARÕES E RAIAS DO LITORAL AMAZÔNICO



EDUFMA

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Ana Rita Onodera Palmeira Nunes
Jorge Luiz Silva Nunes
Natascha Wosnick
Rafaela Maria Serra de Brito
Ana Paula Chaves Silva
Keyton Kylson Fonseca Coelho

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São Luís



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EDITORS NOTE

The editors of this publication wish to clarify that the point of view of the authors was respected in the abstracts submitted, following review by the Scientific Committee and standardization by the Editorial Committee according to the standards requested by the organization, to obtain better quality. The information contained in this book regarding Amazonian Chondrichthyes is the first product of the International Meeting on Amazonian Sharks and Batoids (IMASB) and encompasses valuable information about these species. We hope that it will serve as a guide for future evaluations and scientific research into the diverse topics where gaps in our understanding remain to be filled.

PROLOGUE

The International Meeting on Amazonian Sharks and Batoids (Congresso Internacional sobre Tubarões e Raias do Litoral Amazônico) was a scientific event with the objective of integrating research institutions and higher education in the Amazon region to form a research and collaboration network to expand efforts in the conservation of chondrofauna. The meeting was held from the 08th to 12th of September, 2019, with a varied program containing courses, lectures, round table discussions, oral and panel presentations.

The event was supported by work of the Elasmobranch Research Group of Maranhão (GEEM), Elasmobranch Research Group of Paraná (GEEP), Fundación Squalus (Colombia), Wildlife Conservation Society (WCS Colombia / Brazil), Federal University of Maranhão (UFMA) and the Foundation for the Support of Research and Scientific Technological Development of Maranhão (FAPEMA) in funding and promoting the event. Various research and higher education institutions from Brazil and other countries (Colombia, United States, and Venezuela) participated.

On the occasion, the International Meeting on Amazonian Sharks and Batoids (IMASB) paid a beautiful tribute to Professor Maria Marlúcia Ferreira Correa, founder of the Hydrobiology Laboratory - LABOHIDRO, now known as the Department of Oceanography and Limnology at the Federal University of Maranhão.

The department is now on the eve of its fiftieth anniversary, and lends its name to a trophy created to reward professors with recognition in their successful academic careers.

The Professor Maria Marlúcia Ferreira Correa trophy was presented to professors Dr. Rosângela Lessa from UFRPE, Dr. Ricardo Rosa from UFPB and Dr. Zafira Almeida from UEMA.

Dr. Rosângela Lessa's pioneering spirit in the state of Maranhão was highlighted, as well as her legacy of building a base of knowledge for the Amazon region. Dr. Ricardo Rosa was highlighted for his importance in the creation of the Brazilian Society for the Study of Elasmobranchs and the Brazilian Society of Ichthyology, as well as the importance of his work on our understanding of Amazonian freshwater rays. Finally, the great achievements of Dr. Zafira Almeida in the population dynamics of elasmobranchs, conservation studies and the creation of the Study Group of Elasmobranchs in Maranhão were recognised.

Dr. Jorge Luiz Silva Nunes
Elasmobranch Research Group of Maranhão (GEEM)
Federal University of Maranhão, Brazil

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International meeting on amazonian sharks and batoids

www.amazonianelasmobranchs.online

September 8th - 12th / 2019
SÃO LUIS - MA / BRAZIL

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Elasmobranch Research Group of Maranhão – GEEM

Renata Daldin Leite

Universidade Federal do Paraná – UFPR



HONORED RESEARCHERS



**“PROFESSORA MARIA MARLÚCIA
CORREIA FERREIRA AWARD”**

DR. LESSA (UFRPE)

Rosangela Paula Teixeira Lessa has degrees in Oceanography from the Federal University of Rio Grande Foundation (1977), a doctorate in Biological Oceanography from the University of Western Brittany, Brest (France), and postdoctoral studies at RRAG, Imperial College (UK) in 1988. She was a Regional Scientific Development Scholar at the Hydrobiology Laboratory (LABOHIDRO) and professor at the Department of Biology at the Federal University of Maranhão between 1983 and 1985, followed by time as a CNPq Research Scholar from 1989 to the present (Pq 1b). She is currently a professor at the Department of Fisheries and Aquaculture at the Federal Rural University of Pernambuco (UFRPE), where she is responsible for the DIMAR Laboratory, working in population dynamics and evaluation of elasmobranch and teleosteous fish stocks. Rosangela is a representative of the Population Dynamics and Inventory Assessment area of the SCORE_NE of the REVIZEE Program, and was President of the Brazilian Society for the Study of Elasmobranchs - SBEEL between 2002 and 2004. She was coordinator of the extinction risk assessments promoted by ICMBio in 2011 and 2018 for the taxon Chondrichthyes and the President of the State Shark Incident Committee-CEMIT / SDS (2012-2014). She is also a permanent member of the graduate programs in Fisheries and Aquaculture (UFRPE), Animal Biology (UFPE) and Aquatic Resources and Fisheries (UEMA), and collaborates in Biometrics (UFRPE). The themes of her research include: age and growth, elasmobranchs, conservation, fisheries management, otoliths, embryonic development, fish life history, artisanal fishing, nursery areas. She is an honored researcher of the IX SBEEL Meeting held at UFAL in 2016 in Penedo (AL) and a full member of the Board of APA Costa dos Corais - CONAPACC.



DR. ROSA (UFPB)

Ricardo de Souza Rosa graduated in Biological Sciences at the University of São Paulo. He holds a doctorate in Marine Science (Biological Oceanography) from the Virginia Institute of Marine Science, College of William and Mary (1985), and completed a postdoctoral internship in zoology at the University of Alberta (1990). He is currently a retired professor at the Federal University of Paraíba. He has experience in the area of Vertebrate Zoology, working mainly in systematics and biology of fish conservation, with an emphasis on South American elasmobranchs. He coordinated the Graduate Program in Biological Sciences (Zoology) at UFPB (1985-1988, 1996-1999, 2013-2015). He is a member of the Shark Specialists Group (Species Survival Commission, IUCN) and is associated with the American Society of Ichthyologists and Herpetologists, American Elasmobranch Society, Brazilian Society of Ichthyology - SBI (founding partner) and the Brazilian Society for the Study of Elasmobranchs - SBEEEL (founding partner). He is a member of the Deliberative Council of SBEEEL and SBI (2016-2018). He has contributed over 40 years in research and extension projects in systematics, ecology and conservation of marine and freshwater fish, while mentoring over 90 students in the area of Zoology, and taught various disciplines, thus exercising a fundamental role in structuring and strengthening undergraduate and graduate courses in Biological Sciences at UFPB.



DR. ALMEIDA (UEMA)

Zafira da Silva de Almeida holds a PhD in Zoology from the Federal University of Pará / Museu Emilio Goeldi (2009) and a master's degree in Oceanography from the Federal University of Pernambuco (1996). She graduated in Biological Sciences at the Federal University of Maranhão (1991). She was founder and Director of the UEMA Biological Sciences Course from 2009 to 2012, founder and coordinator of the Specialization Course in Environmental Education in 2001, Environmental Management Advisor (AGA) from 2015 to 2018. She is currently a Member of the Maranhão Academy of Sciences, Dean of Undergraduate Studies (PROG / UEMA), adjunct professor IV at the State University of Maranhão and head of the Laboratory of Fisheries and Aquatic Ecology (LabPEA), from the same institution. She is a lecturer and advisor of the Animal Science Post-Graduate Programs, academic master's program in Aquatic Resources and Fisheries (PPGrap), and Biodiversity and Biotechnology Network of the Legal Amazon / (BIONORTE) and a lecturer, professor and supervisor of the Undergraduate Biological Science Course. She has experience in the area of Zoology with emphasis on fishes, working in Management and Population Dynamics of Fisheries Resources. Her main research topics include: management of fisheries resources in Maranhão, trophic dynamics, fish reproduction, benthos (malacofauna, polychaetes and crustaceans), elasmobranchs, and environmental education.





SUNDAY - SEPTEMBER 8th, 2019

SHORT COURSES

CCBS Postgraduate Building
Orla Viva (Araçagy Beach)
DEOLI (Oceanography and Limnology Department)
8:30 a.m. – 5:30 p.m.



1. Physiological analyzes for Elasmobranch Conservation.

Natascha Wosnick (UFPR) and Rayone Wesly Santos de Oliveira (UFMA)

2. DNA to the sea: principles and molecular methods for the Conservation of Elasmobranchs.

Luís Fernando Carvalho Costa (UFMA)

3. Microchemistry techniques applied to Elasmobranch Conservation studies.

Kaio Lopes de Lima (UEMA) and Leonardo Manir Feitosa (UFPE)

4. Baited remote underwater video (BRUV) – a non invasive tool for the study of aquatic life.

Kurt Schmid (UFPA)

5. Field and Laboratory Techniques and Methods for Fishes studies (Spanish).

Oscar Miguel Lasso Alcalá (Fundación La Salle de Ciencias Naturales)

OPENING CEREMONY

Central Auditorium (Rectory) – 6:00 p.m.



“Update on sharks and batoids of the Brazilian Amazon Coast”

Rosangela Paula Teixeira Lessa (UFRPE) and Jorge Luiz Silva Nunes (UFMA/ GEEM)

Awards “Prof. Maria Marlúcia Ferreira Correa”, in celebration of Labohidro - UFMA's 50th anniversary.

HONORED

Rosangela Paula Teixeira Lessa (UFRPE)

Ricardo de Souza Rosa (UFPB)

Zafira da Silva de Almeida (UEMA)

OPENING COCKTAIL

Rectory's Hall

7:30h p.m.

Musical Presentation

Choro Brazilian music of Maranhão

MONDAY - SEPTEMBER 9th, 2019

PLENARY KEYNOTE 1

Central Auditorium (Rectory)
8:30 a.m. – 10:00 a.m.



CONFERENCE 1

Central Auditorium (Rectory)
2:00 p.m. – 4:00 p.m.

“Sclerorhynchidae and Hybodontiformes of the Cretaceous from Maranhão”

Manuel Alfredo Medeiros (UFMA)

“Amazonian Elasmobranchs Conservation (Biodiversity Conservation: elasmobranchs of the Brazilian North Coast, Guyana’s sharks and batoids, freshwater stingrays)”

Jorge Luiz Silva Nunes (UFMA), Oscar Miguel Lasso Alcalá (Fundación La Salle de Ciencias Naturales) and Getulio Rincon Filho (UFMA)

COFFEE BREAK

Central Auditorium’s Hall (Rectory)
10:00 a.m. – 10:15 a.m.

POSTER SESSION

CCBS Postgraduate Building
4:00 p.m. – 6:00 p.m.

ORAL PRESENTATIONS 1

Central Auditorium (Rectory)
10:15 a.m. – 12:00 p.m.

TUESDAY - SEPTEMBER 10th, 2019

PLENARY KEYNOTE 2
Central Auditorium (Rectory)
8:30 a.m. – 10:00 a.m.



**“Environmental Education for Conservation:
a tool for all”**
Rafaela Maria Serra de Brito (GEEM) and Keyton Kylson
Fonseca Coelho (UFMA)

**“Biodiversity and distribution of Mixini and
cartilaginous fishes (Chondrichthyes) of Venezuela and
adjacent waters”**
Oscar Miguel Lasso Alcalá (Fundación La Salle de Ciencias
Naturales)

COFFEE BREAK
Central Auditorium’s Hall (Rectory)
10:00 a.m. – 10:15 a.m.

ORAL PRESENTATIONS 2
Central Auditorium (Rectory)
10:15 a.m. – 12:00 p.m.

WORKSHOPS 1 and 2
Amazônia Classroom (Biology Building)
Classroom of Oceanography and Limnology Department
(DEOLI)
2:00 p.m. – 6:00 p.m.

“Painting workshop: art in favor of marine life”
Environmental educator and visual artist Alexandre Huber
(Huber Arte Marinha)

WORKSHOP 1 (Invited Specialists)
Data Processing Technology Center - NTI
4 p.m. – 7 p.m.

**Part I - Freshwater Stingrays Workshop: “Ecological
Risk Evaluation and Vulnerability of Freshwater
Stingrays of South America”**
Orgs.: Paola Andrea Mejía Falla (Fundación Squalus/
Wildlife Conservation Society - WCS), Andrés Felipe Navia
(Fundación Squalus) and Guillermo Estupiñán (WCS)

WORKSHOP 2 (Invited Specialists)
Cabana do Sol Restaurant
8:00 p.m. – 10 p.m.

**“Plans and goals for Amazonian Elasmobranch
Conservation”**
Orgs.: Jorge Luiz Silva Nunes (UFMA), Getulio Rincon Filho
(UFMA), Ana Rita Onodera Palmeira Nunes (UFMA) and
Natascha Wosnick (UFPR)

WEDNESDAY - SEPTEMBER 11th, 2019

PLENARY KEYNOTE 3

Central Auditorium (Rectory)
8:30 a.m. – 10:00 a.m.



ART EXPOSITION AND PHOTOGRAPHY

Odylo Costa Filho Gallery (Downtown)
4:00 p.m. – 7:00 p.m.

“Detective” DNA as a method to reveal the hidden diversity of batoids from the Brazilian Amazon Coast
João Bráullio de Luna Sales (UFPA)

Cinema “Jaws” and Environmental education: Demystifying shark image.
Natascha Wosnick (UFPR)

ORAL PRESENTATIONS 3
Central Auditorium (Rectory)
10:15 a.m. – 12:00 p.m.

Alexandre Huber’s arts and elasmobranchs photographs “The beauty behind the beast”, with artistic, technical and scientific jury evaluation.
Rosangela Lessa (UFRPE), Salvatore Siciliano (FIOCRUZ - IOC), Maurício Araújo Mendonça (UFMA), Cláudio Pinheiro (Odylo Costa Filho Gallery) and Alexandre Huber (Huber Arte Marinha)

PLENARY KEYNOTE 4
Central Auditorium (Rectory)
2:00 p.m. – 3:30 p.m.

WORKSHOP 1 (Invited Specialists)
Data Processing Technology Center - NTI
4:00 p.m. – 7:00 p.m.

“Calcium and Chemistry: an overview of hard-part Microchemical techniques with application to Sawfish and other Amazonian Species”
Jens Hegg (University of Idaho)

Parte II - Freshwater Stingrays Workshop: “Ecological Risk Evaluation and Vulnerability of Freshwater Stingrays of South America”
Orgs.: Paola Andrea Mejía Falla (Fundación Squalus/ Wildlife Conservation Society - WCS), Andrés Felipe Navia (Fundación Squalus) and Guillermo Estupiñán (WCS)

THURSDAY - SEPTEMBER 12th, 2019

PLENARY KEYNOTE 5

Auditorium of Postgraduate Building CCBS
8:30 a.m. – 10:00 a.m.



“Advances and challenges of methods for research in trophic ecology applied to elasmobranchs”

Viviana Márquez Velásquez (UFPB/ Fundación Squalus)

COFFEE BREAK

Hall of Postgraduate Building CCBS
10:00 a.m. – 10:15 a.m.

CONFERENCE 2

Auditorium of Postgraduate Building CCBS
10:15 a.m. – 12:00 p.m.

“Methods Applied to Elasmobranch Research (Baited remote underwater video - BRUV, Molecular tools and Physiology)”

Kurt Schmid (UFPA), Luís Fernando Rodrigues Filho (UFRA) and Natascha Wosnick (UFPR)

PLENARY KEYNOTE 6

Auditorium of Postgraduate Building CCBS
2:00 p.m. – 3:30 p.m.

“Conservation status of Colombian sharks and batoids”

Andrés Felipe Navia (Fundación SQUALUS) and Paola Andrea Mejía Falla (Fundación SQUALUS/ Wildlife Conservation Society - WCS)

COFFEE BREAK

Hall of Postgraduate Building CCBS
3:30 p.m. – 3:45 p.m.

WRAP UP

Auditorium of Postgraduate Building CCBS
4:00 p.m. – 5:30 p.m.

**Best presentations awards and special auction
Final considerations and acknowledgment
Folkloric-cultural presentation of Bumba Meu Boi
Folk dance group Boi de Sonhos**



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- 2 - BIBLIOTECA CENTRAL
- 3 - MU - UNIDADE DE ATENDIMENTO
- 4 - BIOLÓGIA I
- 5 - BIOLÓGIA II
- 6 - MELIPONÁRIO
- 7 - OCENOGRÁFIA
- 8 - LABORÓRIO
- 9 - ANEXO DA PÓS-GRADUAÇÃO DO CCBS
- 10 - PÓS-GRADUAÇÃO DO CCBS
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- 12 - ENSINO INTEGRADO II
- 13 - ENSINO INTEGRADO III
- 14 - NERBÁRIO
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- 16 - BIOTERIO CENTRAL
- 17 - ODONTOLOGIA
- 18 - CEB VELHO
- 19 - ANATOMIA
- 20 - PÓS-GRADUAÇÃO EM POLÍTICAS PÚBLICAS E EDUCAÇÃO
- 21 - IML
- 22 - PREFEITURA DE CAMPUS
- 23 - NÚCLEO DE TECNOLOGIA DA INFORMAÇÃO - NTI
- 24 - NÚCLEO DE EDUCAÇÃO A DISTÂNCIA - NEAD
- 25 - CENTRAL TELEFÔNICA
- 26 - EDIFÍCIO CASTELO BRANCO - RETORIA E PRÓ-REITORIAS
- 27 - QUADRA
- 28 - AMFITEATRO
- 29 - PAVILHÃO TECNOLÓGICO
- 30 - LABORATÓRIO DE PESQUISA
- 31 - ALMOXARIFADO CENTRAL
- 32 - GARAGEM
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- 34 - CASA DA JUSTIÇA
- 35 - GRÁFICA E EDITORA - EDUFMA
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- 68 - ESPAÇO MULTICULTURAL MULTIUSO
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A UNIVERSIDADE QUE CRENCE COM INOVAÇÃO E INCLUIÇÃO SOCIAL. PROJETO EM EDUCAÇÃO



**I'M COMING
TO
INTERNATIONAL MEETING
ON AMAZONIAN
SHARKS AND BATOIDS**

SÃO LUÍS 2019



@geem.2020





SHORTCOURSES

SHORTCOURSE 1

“PHYSIOLOGICAL ANALYZES FOR ELASMOBRANCH CONSERVATION”

Dr. Wosnick (UFPR)



Natascha Wosnick holds a PhD degree in Zoology from the Federal University of Paraná. She is a collaborating Researcher at the Mar Brasil Association and the Top Predator Laboratory at the University of Haifa (Israel). She is also a member of the Elasmobranch Research Group of Maranhão (GEEM) and Paraná (GEEP) where she conducts non-lethal research seeking the conservation of the group.

Me. Oliveira (UFMA)

Rayone Wesley Santos de Oliveira has a Master's degree in Oceanography. He is a PhD student at BIONORTE Legal Amazon Biodiversity and Biotechnology Network, a member of the Laboratory of Aquatic Organisms (Labaqua), also the Elasmobranch Research Group of Maranhão (GEEM) and the Technical Research Team of the Laboratory on Physical-Chemical and Microbiological Analysis of Food and Water (PCQA).

The course “Physiological analyzes for elasmobranch conservation” addresses the concepts of physiology as a tool to auxiliary the managements plans. As part of the content we show how to obtain responses to the vulnerability of critically endangered species through analyzes of biological processes. In a practical approach we discuss the use of non-lethal techniques for plasma material collect, analysis and interpretation of the results based on information about the stressful conditions in which the animals can be exposed.

Dr. Wosnick



Me. Oliveira

SHORTCOURSE 2

“DNA TO THE SEA: PRINCIPLES AND MOLECULAR METHODS FOR THE CONSERVATION OF ELASMOBRANCHS”



Dr. Costa (UFMA)

Luís Fernando Carvalho Costa holds a Doctorate degree in Sciences (Ecology and Natural Resources) from UFSCar, where he participated in the sandwich doctoral program (CAPES) at the University of Nebraska (USA) with Dr. Guillermo Ortí's group. Dr. Costa is currently an adjunct professor at the Federal University of Maranhão and a collaborating professor in the Postgraduate Program in Aquatic Resources and Fisheries at the State University of Maranhão. He has experience in the field of Animal Genetics with an emphasis on Population Genetics, Molecular Phylogenies, Molecular Systematics and Molecular Ecology; acting mainly on the following topics: hydrographic basins, molecular markers, phylogeography and fishing resources.



The use of new molecular DNA-based methodologies has revolutionized the knowledge about our biodiversity, especially in the case of those endangered species that need basic information to support management actions. This is the case of Elasmobranchs, which have 25% of their species threatened with extinction, in which the use of DNA-based methods has helped to resolve cases of taxonomic uncertainties, to resolve forensic cases, to delimit evolutionarily significant units, to delimit fish stocks, to unveil complex population structures, reveal mating systems, among others. The application of the principles of Conservation Genetics and, more recently, Conservation Genomics provide the theoretical-conceptual basis for the use of these methods, which in the end can translate into the adoption of practical measures for the conservation of these animals. In addition, the revolution in genomics has enabled an unprecedented ability to generate information that can be converted in favor of shark and ray conservation, such as the use of environmental DNA to detect rare species, relative density estimates, location and recruitment rate estimates, etc. In this way, DNA provides a powerful tool for the conservation science of elasmobranchs, as it is able to answer questions beyond the reach of other methods, and which would otherwise be left unanswered. The objective of the short course “DNA to the sea: molecular principles and methods for the conservation of elasmobranchs” was to address the panorama of theoretical methods and principles behind the use of DNA for the purpose of conservation of sharks and rays, and thus promote the dissemination of this practice among research groups focused on this theme.

SHORTCOURSE 3

“MICROCHEMISTRY TECHNIQUES APPLIED TO ELASMOBRANCH CONSERVATION STUDIES”

Dr. Lima (UEMA)

Kaio Lopes de Lima is a professor in the Fisheries Engineering Bachelor course at the State University of Maranhão, coordinator of the Laboratory of Dynamics and Ecology of Fisheries Populations - LADEPP. He holds a PhD degree in Fishery Resources and Aquaculture from the Federal Rural University of Pernambuco. He has experience in the area of Fisheries Resources and Fisheries Extension, having also acted in the prevention of incidents with sharks in Pernambuco.

Me. Feitosa (UFPE)

Leonardo Manir Feitosa holds a Bachelor degree in Biological Sciences at the Federal University of Maranhão (UFMA), and a Master's degree at the Graduate Program in Animal Biology (UFPE). He has experience in studies of ecology and biology of shark and rays conservation through molecular methods and micro-chemistry of vertebrae.



Dr. Lima

Nowadays, methods that produce data about how sharks and rays use their environment are increasingly used by scientists. The microchemistry of vertebrae allows us to analyze the chemical signatures of the environment in which individuals have been throughout their lives. It is the new frontier of research with elasmobranchs and promises to bring crucial information for its conservation such as the existence of nurseries, the analysis of connectivity between populations and the establishment of priority areas for one or more species. It is a relatively simple analysis with an immense response power.



Me. Feitosa



SHORTCOURSE 4

“BAITED REMOTE UNDERWATER VIDEO (BRUV) – A NON INVASIVE TOOL FOR THE STUDY OF AQUATIC LIFE”

**Dr. Schmid
(UFPA)**



Kurt Schmid holds a PhD degree in Aquatic Ecology and Fisheries at the Federal University of Pará. He works with underwater filming methods in ecological studies of fishes with BRUV (Baited Remote Underwater Video) and stereo-video in different marine aquatic ecosystems and habitats and continental regions of Brazil. He developed research on the Xingu River in the Amazon region, at the Banco de Abrolhos (BA) and Baía de Todos os Santos (BA) and works with the occurrence of microplastic in fish from the North coast of Brazil.



The non-lethal BRUV method eliminates the need to catch and fish sacrifice, overcomes disadvantages, risks and limitations of the visual census, and still produces valuable permanent records. The use of these independent video systems, baited for fish attraction, is specifically advantageous in research with large predatory fish such as sharks and rays. Recent methodological advances increasingly outweigh its biggest limiting factor - water visibility. In the face of logistical challenges on the research in the Amazon region, the efficient and economical BRUV method become a valuable tool for studies with elasmobranchs, both in clear water rivers and streams, and in the marine environment, such as in the Amazon reefs or in the Parcel of Manoel Luís (MA).

SHORTCOURSE 5

“FIELD AND LABORATORY TECHNIQUES AND METHODS FOR FISHES STUDIES”

Me. Lasso-Alcalá
(Fundación La Salle de Ciencias Naturales)



Oscar Miguel Lasso-Alcalá currently performing as Researcher and Curator of the Fish collection in Museo de Historia Natural La Salle (MHNLS), Caracas, Venezuela. He possesses a degree in Oceanography and Fisheries from the Instituto Universitario de Tecnología del Mar, Fundación La Salle de Ciencias Naturales. He has also postgraduate studies in Agricultural Zoology from the Universidad Central de Venezuela, and Estuary Ecology from the Universidad Nacional Experimental Francisco de Miranda. For around 30 years, he has worked on more than 60 projects in various areas such as taxonomy, biodiversity, biology, ecology, fisheries, management and conservation of freshwater, estuarine and marine fishes from Venezuela, Colombia, Brazil, Costa Rica, Ecuador and the Dominican Republic, always in association with numerous colleagues, research's centers, and countries.

This course describes the physical environment of the different ecosystems where the fishes live. Next, the objectives and levels of approach required by the different types of studies and / or projects for the evaluation of the ichthyofauna are clarified. Special emphasis is placed on theoretical knowledge about the different practical tools and field (technical) skills for studying fish in coastal (freshwater) and marine ecosystems, through the detailed description of different procedures or methodologies. In the same way, the main techniques and laboratory methods for studying fish are emphasized. For this, in a practical laboratory session, it is expected, on the one hand, to impart theoretical knowledge, tools and practical skills for the recognition, identification, and classification of different species.





KEYNOTE SPEAKERS

OPENING CONFERENCE



“UPDATE ON SHARKS AND BATOIDS OF THE BRAZILIAN AMAZON COAST”

**Dr. Lessa
(UFRPE)**

Rosangela Lessa is a professor at the Department of Fisheries and Aquaculture Engineering at UFRPE, where she is coordinator of the DIMAR Laboratory, working in Population Dynamics and Assessments of Elasmobranch and Teleost Fish stocks.

Dr. Lessa



Dr. Nunes

**Dr. Nunes
(UFMA/GEEM)**

Jorge Luiz Silva Nunes is a professor at the Department of Oceanography and Limnology at UFMA, where he coordinates LabAqua (Laboratory of Aquatic Organisms) and GEEM (Elasmobranch Research Group of Maranhão (GEEM)). Currently he develops research in the areas of Biology and Ecology of Aquatic Animals.

The status of knowledge about elasmobranchs in Maranhão in the past 40 years and changes in their focus for future studies

The last 40 years of research on elasmobranchs in Maranhão has been configured through countless studies that aimed to get to know the Amazonian chondrofauna, mainly in the mangroves and flooded areas, and in the Golfão Maranhense, places of great importance due to the presence of numerous important environments at different stages of the life cycle. In the second moment, the studies focused on information on aspects of population dynamics (food, reproduction, age, growth, etc.) of the most abundant species in the first twenty years, 1980s and 90s. In the third part of the lecture, all the information obtained about the shark and rays community of the state of Maranhão was discussed, when it was possible to verify the differences in abundances over time and the current conservation status. Finally, the lecture illustrates the last 5 years of research and changes in the focus of current research related to the use of DNA barcode, e-DNA, phylogeography, ultrastructures, production chain approaches, emphasis on conservation status, physiology, environmental pollution and sex hormone studies. Furthermore, it was mentioned the need for a larger Amazonian researchers' interaction in order to join efforts for a greater understanding of distribution patterns and their biological and ecological characteristics for the region.

KEYNOTE SPEAKER 1

“SCLERORHYNCHIDAE AND HYBODONTIFORMES OF THE CRETACEOUS FROM MARANHÃO”

**Dr. Medeiros
(UFMA)**



Manuel Alfredo Medeiros has a Doctorate degree in Geosciences from the Federal University of Rio Grande do Sul. He is currently an associate professor at the Federal University of Maranhão. He has experience in Zoology, with emphasis on the Paleontology of Vertebrates, and acting on the following subjects: Itapecuru and Alcântara Formations (Albiano and Cenomaniano), Cretaceous of Maranhão.



In the northeast of Brazil, the Cretaceous Period is well registered in the sediments of the Alcântara Formation, a set of layers deposited in an estuarine environment about 97 million years before the present. Fossils of plants and animals were collected in the Alcântara region, mainly at the fossiliferous site Laje do Coringa, on the Cajual Island. Trunks of conifers, giant ferns and stalks of Equisetales, along with skeletal remains of fish, crocodiles, pterosaurs and dinosaurs document a Mesozoic ecological community. Among the remains of fish, rostral sclerorinoid teeth (swordfish rays *Atlanticopristsis* and *Onchopristsis*) and cephalic and dorsal spines of *Tribodus* (freshwater shark of the group Hybodontiformes) indicate that these elasmobranchs were an important component of that extinct fauna.

KEYNOTE SPEAKER 2



“BIODIVERSITY AND DISTRIBUTION OF MIXINES (MYXINI) AND CARTILAGINOUS FISHES (CHONDRICHTHYES) FROM VENEZUELA AND ADJACENT AREAS”

Me. Lasso-Alcalá
(Fundación La Salle de Ciencias Naturales)

Oscar Miguel Lasso-Alcalá currently performing as Researcher and Curator of the Fish collection in Museo de Historia Natural La Salle (MHNLS), Caracas, Venezuela. He possesses a degree in Oceanography and Fisheries from the Instituto Universitario de Tecnología del Mar, Fundación La Salle de Ciencias Naturales. He has also postgraduate studies in Agricultural Zoology from the Universidad Central de Venezuela, and Estuary Ecology from the Universidad Nacional Experimental Francisco de Miranda. For around 30 years, he has worked on more than 60 projects in various areas such as taxonomy, biodiversity, biology, ecology, fisheries, management and conservation of freshwater, estuarine and marine fishes from Venezuela, Colombia, Brazil, Costa Rica, Ecuador and the Dominican Republic, always in association with numerous colleagues, research's centers, and countries.



Due to the large information gaps and the various threats that possess the fishes from Venezuela, which have intensified abruptly in recent years, with the collaboration of colleagues such as Elena Quintero-T (MHNLS) and Jorge D. Carrillo B. (University of Zurich), as well as in association with other colleagues from Brazil, Colombia and the USA, he is developing various research projects with cartilaginous fishes and in lesser stand with mixines. Initially, the current quantification of biodiversity, the description of new species, the taxonomic reviews, as well as the analysis of the geographical and ecological distribution of these groups have been considered. In this presentation through exhaustive documentary research, scientific collections and unpublished data, he shows us a detailed situation regarding the knowledge that we have of these groups of fishes, from XVII century to the nowadays. With a view to analyzing the distribution of species, it performs the quantification of the biodiversity, and classification of species, due to their ecological habits (marine, estuarine and freshwater) and use of habitat in the water column (Pelagic) or the bottom (dermersal and benthic). Although his research is located in a certain geographical and political area (Venezuela), he shows an innovative approach where the distribution of species cannot be explained by these artificial and arbitrary limits, but for ecological and biogeographical reasons. In this way, he emphasizes how the information of the species registered in “adjacent areas” of the marine waters or hydrographic basins shared with the neighboring countries of Colombia, Trinidad and Tobago, Guyana and Brazil, as well as the Netherlands Antilles of Aruba, Curacao and Bonaire. Likewise, and based on biogeographic, environmental and ecological evidence, he presents a new proposal for marine ecological regions to explain the distribution of species, which it calls marine ichthyoregions. Finally, the study shows a series of recommendations on the next steps to be followed in terms of the research that must be carried out since a conservation and management point of view from sharks, rays, chimeras and mixines in Northern South America.

KEYNOTE SPEAKER 3

“SEARCHING FOR THE ENIGMATIC: DNA DETECTIVE AS A METHOD TO INVESTIGATING THE HIDDEN DIVERSITY OF BATOIDS IN THE BRAZILIAN AMAZONIAN COAST”

**Dr. Sales
(UFPA)**



João Bráullio de Luna Sales is professor at the Federal University of Pará, and guides masters and PhD students at the Postgraduate Program in Aquatic Ecology and Fisheries in the same Institution. He works with Animal Genetics, with emphasis on Phylogeny and Population Genetics of aquatic organisms.



For many years, the number of species that inhabit the planet has always intrigued the scientific community, as well the real age Earth. Elasmobranch were dated from Late Devonian were the species group has a long and successful evolutionary history were the actual number of living species are about 1.100. However, anthropogenic actions in the last 30 century like habitat degradation and overfishing has lead a large number of species to a populational decline having a hising number of species became threatened every year. For the Amazon Coast the comercialization of endangered species still frequent as recent molecular studies has showed. Additionally, the recent described Amazon Reef System, regions that still hasn't his biodiversity cataloged and is a target region for fishing vassel's in the region make more studies on the elasmobranch fauna more urgent from the region. One of the major problems for elasmobranch studies is the correct identification of species that in general, shows a very conservated morphology which can make the correct identification quite difficult. In the recent years, molecular tools have proven to be very usefull for aid morfology in the descrimination os cryptic lineages and helping to describe new species. For Amazon Coast, ongoing molecular studies are indicating the presence of cryptic linaeges in rays of the genera *Gymnura*, *Rhinoptera* and *Myliobatis*. The Next generation Sequences techniques have also been proven as a very promissing tools for integrate studies of species detection on the environment as well, the investigatio of trophic ecology of the especies.

KEYNOTE SPEAKER 4

“CALCIUM AND CHEMISTRY: AN OVERVIEW OF MICROCHEMICAL TECHNIQUES IN RIGID STRUCTURES, WITH APPLICATIONS FOR SAWFISHES AND OTHER AMAZONIAN SPECIES”

Dr. Hegg
(University of Idaho)



Jens Hegg is affiliated with University of Idaho and has worked in Brazil as a Fulbright postdoctoral researcher in Belém do Pará. He is fascinated by fish migration and how the ecological aspects of movement can be elucidated through the analysis of rigid structures. Using chemical records of scales, otoliths and rostral teeth, Jens elucidated migration patterns of several species, including the Pacific salmon and the large Amazonian catfish.



Large fish move long distances, but despite their size, these fish are often difficult to track and study. Using chemical movement records embedded in scales, otoliths and rostral teeth, Dr. Hegg has discovered details of migration in several species, including Pacific salmon, and the large migratory catfish from the Amazon, using isotopic techniques. He is a Fulbright postdoctoral researcher working in Belém do Pará. Dr. Hegg is fascinated by the ecology of fish migration and the ways in which these movements are recorded in hard structures (e.g. - vertebrae, otoliths and rostral teeth). In this presentation, he discussed uses and techniques of microchemistry, with special attention to habitat use in Amazonian species, and presented new works showing evidence of movements recorded in the rostral teeth of sawfish.

KEYNOTE SPEAKER 5

“ADVANCES AND CHALLENGES OF RESEARCH METHODS IN TROPHIC ECOLOGY APPLIED TO ELASMOBRANCHS”

Me. Velásquez
(UFPB/ Fundación Squalus)



Viviana Márquez Velásquez has a Master in Zoology and she is currently a PhD student in Biological Sciences (Zoology) at the Federal University of Paraíba, Brazil. She is a member of Fundación Squalus (Colombia) and she works with the functional and structural roles of fishes in tropical marine food webs and their consequences for biodiversity conservation.



Predator-prey interactions are one of the main structural forces of communities, being influenced by several factors such as morphology, ontogeny, physiology, behavior, among others, from the individual level to the community level. These complex processes change in ecological and / or evolutionary time scales. Thus, Trophic Ecology becomes an area of interdisciplinary research, supported by a broad scope of methodological and analytical tools, which has advanced considerably in recent years. This diversity of methods allows a wide exploration of the role that different species of elasmobranchs play in marine and freshwater ecosystems and the consequences of their loss.

KEYNOTE SPEAKER 6

“CONSERVATION STATUS OF SHARKS, SKATES AND RAYS FROM COLOMBIA”

Dr. Navia (Fundación SQUALUS)

Andrés Felipe Navia has a PhD in Marine Sciences from Centro Interdisciplinario de Ciencias Marinas, Mexico, and he is founder member of Squalus Foundation, Colombia. His main research focuses on ecological role of predators in marine ecosystems and the study of macro-ecological patterns of elasmobranchs.

Dr. Mejía-Falla (Fundación SQUALUS/ WCS)

Paola Andrea Mejía Falla has a PhD in Biological Sciences from Universidad del Valle, Colombia. She is founder of Squalus Foundation, Colombia, and currently is marine leader of Wildlife Conservation Society, WCS Colombia. Her main research focuses on life history, demography and population ecology of elasmobranchs, aiming to contribute to their management, sustainable use and conservation.



For Colombia, the presence of 155 species of elasmobranch, 144 marine and 11 freshwater, has been recorded. The knowledge status of this group has increased significantly from 2005 to date. For the Potamotrygonidae family, knowledge has been consolidated on topics such as taxonomy and systematics, life history, commercial use, distribution and abundance, as well as animal welfare for management in captivity. For the Pacific basin, the advances in life history, fisheries, ecological importance and anthropic effects on these species stand out. For the Colombian Caribbean, the most significant advances are related to the use of elasmobranchs in ecotourism activities, while at the national level, significant information on the distribution of species has been consolidated. Regarding conservation status, 38 marine species and 6 freshwater species are in some category of threat according to IUCN criteria, and 10 marine species and 8 species of freshwater stingrays have been included in Appendix II of CITES. Although Colombia has regulations that prohibit the finning and directed capture of sharks and batoids, most of the fisheries are developing with low standards of sustainability and therefore, joint work between authorities, scientists and users is required to advance towards the sustainable use and conservation of these species.



Dr. Navia



Dr. Mejía-Falla



CONFERENCE 1

“CONSERVATION OF AMAZONIAN ELASMOBRANCHS (BIODIVERSITY CONSERVATION: ELASMOBRANCHS FROM THE NORTH BRAZILIAN COAST, SHARKS AND RAYS OF GUIANAS, FRESHWATER STINGRAYS)”



Dr. Nunes (UFMA/ GEEM), Me. Lasso-Alcalá (Fundación La Salle de Ciencias Naturales) and Dr. Rincon (UFMA/GEEM)

Getulio Rincon Filho is a professor of Fisheries Engineering at Universidade Federal do Maranhão (Campus Pinheiro) and a member of Elasmobranch Research Group of Maranhão (GEEM). He has experience in taxonomy and elasmobranch biology and develops research on morphology and ecology of freshwater stingrays and fisheries biology in the Baixada Maranhense region.

Jorge Luiz Silva Nunes is a professor at the Department of Oceanography and Limnology at Universidade Federal do Maranhão- Brazil, where he coordinates the Aquatic Organisms Laboratory (LabAqua) and Elasmobranch Research Group of Maranhão (GEEM). His research focuses on Biology and Ecology of aquatic animals.

Oscar Miguel Lasso-Alcalá currently performing as Researcher and Curator of the Fish collection in Museo de Historia Natural La Salle (MHNLS), Caracas, Venezuela. For around 30 years, he has worked in various areas such as taxonomy, biodiversity, biology, ecology, fisheries, management and conservation of freshwater, estuarine and marine fishes from Venezuela and others countries.

Dr. Nunes



Me. Oscar-Lasso

Dr. Rincon





“CONSERVATION OF AMAZONIAN ELASMOBRANCHS (BIODIVERSITY CONSERVATION: ELASMOBRANCHS FROM THE NORTH BRAZILIAN COAST, SHARKS AND RAYS OF GUIANAS, FRESHWATER STINGRAYS)”

Dr. Nunes - The Amazonian Coast is an environment full of mystery and richness, as it consists of a wide area of exuberant mangroves, estuaries formed by the multiple rivers that flow into the ocean, an extensive continental shelf and a reef formation in mesophotic environments not yet understood. In Brazil, the Amazonian coast comprises the states of Amapá, Pará and Maranhão, with its limit extended to the Delta of Parnaíba. The typically estuarine fish community of the Amazonian Coast contrasts with the northeastern Brazil coastal fauna, being unique and perfectly adapted to estuarine fluctuations. The Amazonian fauna is classified as an intermediary between the Caribbean and the Brazilian fauna, emphasizing the importance of the area as a biodiversity hotspot. Unfortunately, management failures increase the threats in the region, imposing an extra challenge for the conservation of endangered and endemic species. In this presentation, key points about the challenges for the management and conservation of the Amazonian coastal fauna were discussed. How much is a species worth? For many endemic species in the Amazonian coast there is little or no knowledge – on the other hand, some species are already Critically Endangered making conservation measurements a urgent need.

Dr. Rincon - The Amazonian sharks and rays of Brazil represent components of a diverse group of fishes including species of obligated freshwater stingrays, euryhaline sharks and sawfishes and a myriad of coastal species, particularly of myliobatoid rays. Freshwater stingrays have been under review through the past two decades with multiple new species descriptions in the genus *Potamotrygon*, two new species in the genus *Plesiopotrygon* and the description of a new genus *Heliopotrygon* with two species. These stingrays play important roles in their respective environments and make part of the artisanal and industrial captures, both in freshwater and saltwater fisheries. The high tides of the Amazonian Coast allow multiple tide-related fisheries, which pressures particular populations to the rim of sustainability. Recent threats such as surface mining, deforestation, ornamental fishery, water pollution, uncontrolled tourism, hydroelectric damming, and a series of other threats have added a higher concern over these species due to the risk of local extinctions and loss of punctual morphological variants. Thus, the Amazonian Coast is a promising area for the study of sharks and rays along the Brazilian coastline as well as the development of new conservation methods and approaches on the human populations in close contact to these animals or under dependency of their consumption

Me. Lasso-Alcalá - The name Guiana comes from the indigenous group of Karibe origin, the Wayanas (= Apairi), inhabitants of certain regions of northern South America (Suriname, French Guiana and the northern state of Pará in Brazil). In the Karibe language, Guiana means Land of Waters and it is called a very old continental region (Guiana Shield) more than 2,500 million years old and with an area of 2.3 million square kilometers, present in Venezuela (Amazonas, Bolívar and Delta Amacuro States), Colombia (part of the departments of Guainía, Vichada, Vaupés, Caquetá and Meta), Guiana, Suriname, and French Guiana, Brazil (Amazonas, Pará and Amapá states). Hydrographically, it includes several sub-basins south of the Orinoco River and north of the Amazon River, and at least eight other main basins that drain their waters to the Atlantic coast. Due to these hydric contributions as well as the regime of marine currents with an East-West direction, this region also includes the insular Republic of Trinidad and Tobago. Although in terms of biodiversity, its ichthyofauna is relatively well known, there are still large information gaps in reference to the biology, ecology and status of populations, information of great importance for the assessment of conservation status. Regarding sharks and rays, only around 10% of the species have been evaluated in each country or region. Although recently (2018) an international group of IUCN experts, have made efforts to assess the conservation status of a large part of the cartilaginous fish throughout the Atlantic coast of South America, most of the species were included in the “*Data Deficient*” category, because of the lack of base information. Likewise, this evaluation approach may not be adequate, since it does not consider separately the conservation status of the species in each country or region, whose ecological, environmental, social, economic and political realities are different, and therefore the degree of incidence of the different threats and finally the conservation status of each species. Finally, urgent conservation and management measures of the sharks and rays fauna must be taken among all the countries that are part of the Guianas, because they share the same threats as overfishing, bycatch, habitat destruction, pollution of the biota, urban development, the hydrocarbon industry, maritime transport, aquaculture, the introduction of species, climate change, and the multifactorial combination of several of these factors.

CONFERENCE 2



“METHODS APPLIED TO ELASMOBRANCH RESEARCH (BAITED REMOTE UNDERWATER VIDEO - BRUV, MOLECULAR TOOLS AND PHYSIOLOGY)”

Dr. Schmid (UFPA), Dr. Rodrigues-Filho (UFRA) and Dr. Wosnick (UFPR)

Kurt Schmid holds a PhD in Aquatic Ecology and Fisheries at the Federal University of Pará. He works with underwater filming methods in ecological studies with fish, in different aquatic ecosystems and habitats. Currently, he develops research on the Xingu River in the Amazon region, on the Banco de Abrolhos (BA) and in the Baía de Todos os Santos (BA). His research also focuses on the interaction between fish species and aquatic contamination by microplastics.

Luís Fernando da Silva Rodrigues Filho is a professor at the Federal Rural University of the Amazon (UFRA) - Campus Capanema (PA) and a researcher at the Institute of Coastal Ecosystems (IECOS) at the Federal University of Pará (UFPA). His research focuses on Animal Genetics, with emphasis on Phylogeny, Phylogeography and Population Genetics of marine species.

Natascha Wosnick is a collaborating professor in the Postgraduate Program in Zoology at the Federal University of Paraná, a collaborating researcher at the Mar Brasil Association and a member of the Elasmobranch Research Group of Maranhão (GEEM) and Paraná (GEEP). Her research focuses on elasmobranch physiology as tool for fisheries management and conservation.

Dr. Rodrigues-Filho



Dr. Wosnick



Dr. Schmid



CONFERENCE 2

“METHODS APPLIED TO ELASMOBRANCH RESEARCH (BAITED REMOTE UNDERWATER VIDEO - BRUV, MOLECULAR TOOLS AND PHYSIOLOGY)”



Dr. Schmid
(Núcleo de Ecologia Aquática e Pesca
da Amazônia – UFPA)

Baited Remote Underwater Video (BRUV) to study sharks and rays

This non-lethal method eliminates the need to catch and sacrifice fish, overcomes disadvantages, risks and limitations of visual census, and still produces valuable permanent records. The use of these independent video systems is advantageous in research with sharks and rays. Recent methodological advances increasingly outweigh its biggest limiting factor - water visibility. Facing the logistical challenges of research in the Amazon region, this method can become a valuable tool for studies both in clear water rivers and streams, and in the marine environment, such as the Amazonian reefs or the Parcel Manoel Luís (MA).

Dr. Rodrigues-Filho
(UFRA- Campus Capanema/PA and
Instituto de Ecossistemas Costeiros
IECOS - UFPA)

Molecular tools

Fishing is the main factor linked to elasmobranch population reduction, causing imbalance in the ecosystems where these animals are inserted. In addition, there is a lack of knowledge about elasmobranchs on the Amazon coast, being one of the least studied regions in the world. An important step to increase knowledge about elasmobranchs is the identification of species and the genetic characterization of stocks. Molecular research is of great relevance as another source of information for management and conservation and can assist in the construction of more appropriate management programs, ensuring the restoration of compromised stocks in the region, such as the sharks *Isogomphodon oxyrinchus* and *Sphyrna tudes*.

Dr. Wosnick
(Zoology Program - UFPR)

Physiology

Among the different tools applied for elasmobranch research, physiology has stood out in recent years. With methodologies of wide applicability, it is possible to understand how sharks and batoids are affected by environmental stressors and also those of anthropogenic origin, such as the stress caused by fishing. These data are extremely important for the improvement of management plans, generating essential information to elucidate how evolution shaped biological responses at the species level. The lecture aimed to show studies that are being carried out in Brazil, with an emphasis on the data generated for endangered and/or endemic species. Research methods and different technologies were presented, in order to show the audience study opportunities for elasmobranchs, not only to understand the impacts of fishing, but also the effects of climate change and environmental contamination on species survival and resilience.



WORKSHOP 1

“CANVAS PAINTING: ART IN FAVOR OF MARINE LIFE”

**Educator and artist Alexandre Huber
(Huber Arte Marinha)**



Alexandre Huber is graduated in Social Communication at the Catholic University of Santos and he currently works as a visual artist. His work is focused on the importance of environmental conservation. In 2015, he received the international seal by the American entity Ocean Artists Society, and his name was inserted in the hall of the greatest artists defending the oceans.



WORKSHOP 2

“ENVIRONMENTAL EDUCATION FOR CONSERVATION: A TOOL FOR EVERYONE”

**Me. Brito
(GEEM)**

Rafaela Maria Serra de Brito is an Oceanographer with a degree from the Federal University of Maranhão and a master's degree in Ecology and Conservation from the State University of Paraíba (UEPB). She is a member of the Tropical Fish Study Group (CAPES), Amares Institute and Elasmobranch Research Group of Maranhão (GEEM).



Me. Brito



Me. Coelho



**Me. Coelho
(UFMA)**

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SPECIALISTS WORKSHOPS

SPECIALIST WORKSHOP 1

“FRESHWATER STINGRAYS WORKSHOP: ECOLOGICAL RISK EVALUATION AND VULNERABILITY OF FRESHWATER STINGRAYS OF SOUTH AMERICA”



Orgs.: Dr. Navia (Fundación SQUALUS), Dr. Mejía-Falla (Fundación SQUALUS/ WCS) and Me. Estupiñán (Wildlife Conservation Society)

Andrés Felipe Navia has a PhD in Marine Sciences from Centro Interdisciplinario de Ciencias Marinas, Mexico, and he is founder member of Squalus Foundation, Colombia. His main research focuses on ecological role of predators in marine ecosystems and the study of macro-ecological patterns of elasmobranchs.

Paola Andrea Mejía Falla has a PhD in Biological Sciences from Universidad del Valle, Colombia. She is founder of Squalus Foundation, Colombia, and currently is marine leader of Wildlife Conservation Society, WCS Colombia. Her main research focuses on life history, demography and population ecology of elasmobranchs, aiming to contribute to their management, sustainable use and conservation.

Guillermo Estupiñán has a master's degree in Freshwater Biology and Inland Fisheries from the Instituto Nacional de Pesquisas da Amazônia. He works in management of fishery resources and creation and implementation of conservation units, and he has professional experience in non-governmental and governmental institutions.

Dr. Navia



Dr. Mejía-Falla

Me. Estupiñán



SPECIALIST WORKSHOP 1

FRESHWATER STINGRAYS WORKSHOP: “ECOLOGICAL RISK EVALUATION AND VULNERABILITY OF FRESHWATER STINGRAYS OF SOUTH AMERICA”



Due to the difficulty of obtaining data that allows a quantitative assessment of fish stocks (for example, analysis of stock recruitment, demographic models, among others), alternative methods have been developed to qualitatively or semi-quantitatively assess the effects of fishing on exploited populations, thus creating basic elements for the management of these resources. The Ecological Risk Assessment for the Effect of the Fisheries consists of three hierarchical levels of assessment, beginning with a qualitative risk analysis, moving to an intermediate or semi-quantitative analysis (Productivity and Susceptibility Analysis-PSA) and ending with fully quantitative methods (inventory evaluation). Considering the economic, ornamental and fishing importance of freshwater stingrays in South America, this workshop was held to initiate the assessment of ecological risk and vulnerability to anthropogenic pressures of freshwater stingrays in the basins where these species inhabit. . Thirteen researchers representing Brazil, Venezuela, Ecuador and Colombia participated in the workshop. Progress was made in gathering information on the biological productivity attributes of 19 species and in defining the susceptibility attributes for freshwater stingrays, based on the pressures they present in the different basins. Finally, a work schedule was established to complete the APS in 2020.

SPECIALIST WORKSHOP 2

“PLANS AND GOALS FOR AMAZONIAN ELASMOBRANCH CONSERVATION”



Orgs.: Dr. Nunes (UFMA), Dr. Rincon (UFMA), Me. Palmeira-Nunes (UFMA) and Dr. Wosnick (UFPR)

Jorge Luiz Silva Nunes is a professor at the Department of Oceanography and Limnology at Universidade Federal do Maranhão- Brazil, where he coordinates the Aquatic Organisms Laboratory (LabAqua) and Elasmobranch Research Group of Maranhão (GEEM). His research focuses on Biology and Ecology of aquatic animals.

Getulio Rincon Filho is a professor of Fisheries Engineering at Universidade Federal do Maranhão (Campus Pinheiro) and a member of Elasmobranch Research Group of Maranhão (GEEM). He has experience in taxonomy and elasmobranch biology and develops research on morphology and ecology of freshwater stingrays and fisheries biology in the Baixada Maranhense region.



Dr. Nunes



Dr. Rincon



Me. Palmeira-Nunes



Dr. Wosnick

Natascha Wosnick is a collaborating professor in the Postgraduate Program in Zoology at the Federal University of Paraná, a collaborating researcher at the Mar Brasil Association and a member of the Elasmobranch Research Group of Maranhão (GEEM) and Paraná (GEEP). Her research focuses on elasmobranch physiology as tool for fisheries management and conservation.

Ana Rita Onodera Palmeira Nunes has a master's degree in Zoology from the Universidade Federal da Paraíba (UFPB). She developed research on reproductive biology and conservation using monitoring fishing landings by the artisanal fleet in Northern Brazil. She is currently PhD student at the BIONORTE Legal Amazon Biodiversity and Biotechnology Network (UFMA) and a GEEM's member.

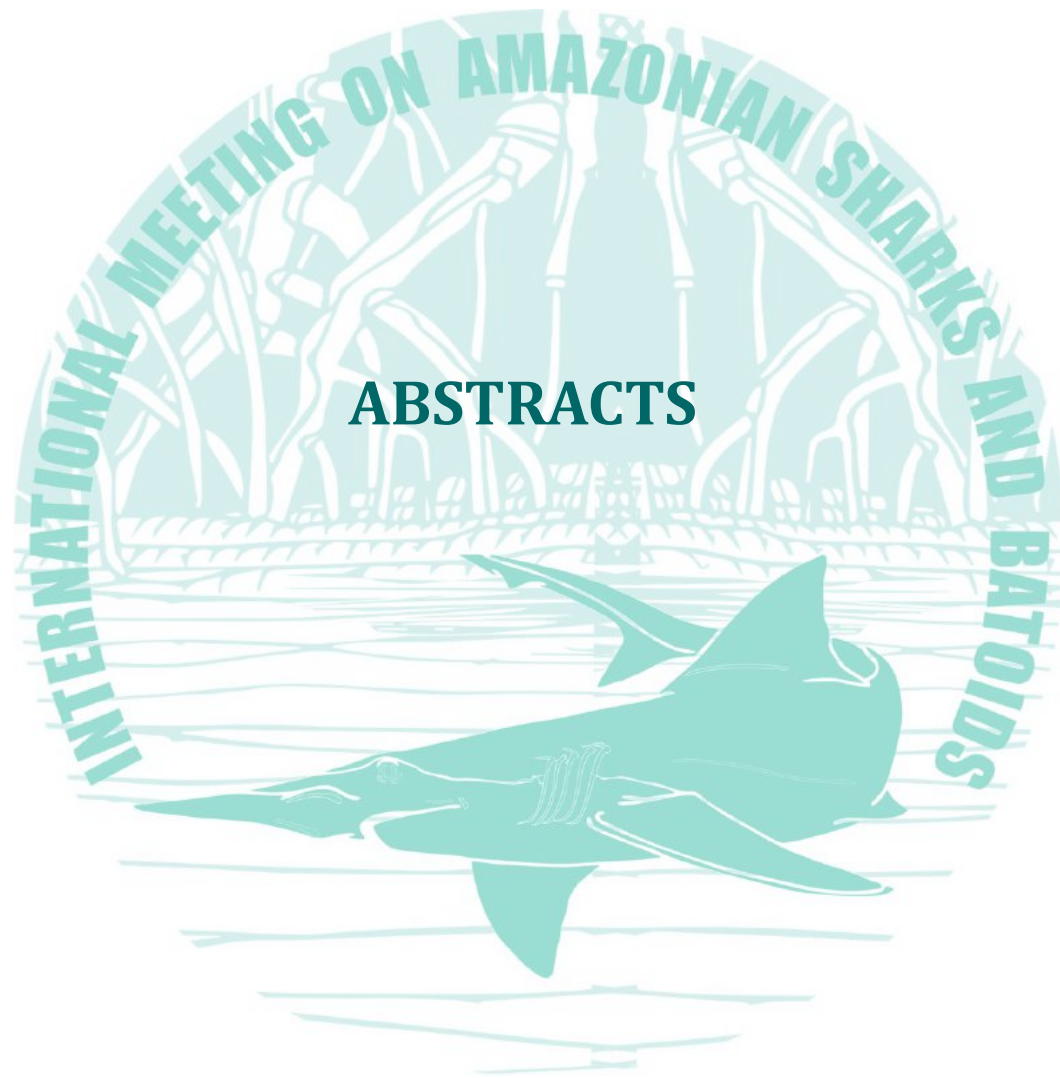
SPECIALIST WORKSHOP 2

“PLANS AND GOALS FOR AMAZONIAN ELASMOBRANCH CONSERVATION”



The Amazon region is considered a great hotspot of diversity and endemism for elasmobranchs, however some knowledge gaps still represent a great challenge for researchers. Therefore, the first Workshop for research on the Amazonian elasmobranchs conservation was held as an initiative to bring together the efforts of researchers from institutions located in the Amazon region, different research lines and committed to carrying out collaborative studies on Amazonian elasmobranchs. Thus, ideas for optimizing studies and partnerships between researchers and research institutions were formally presented. The first point discussed was about the creation of a database composed of information about researchers and their research lines. The second step discussed the search for a thematic project that could support all researchers and enable research proposals for funding of various kinds and promote the production of knowledge about local elasmobranchs and strategies for their conservation. We ended the workshop with proposals on the metrics for evaluating the progression of activities with the organization of periodic and rotating local scientific events between the localities involved and the manufacture of products that will initially be a book on local diversity.







GUARDIÕES DO MAR: ESCOTEIRISMO E EDUCAÇÃO AMBIENTAL A SERVIÇO DA CONSERVAÇÃO DE TUBARÕES E RAIAS

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O movimento escoteiro é conhecido como maior movimento mundial de jovens e ao mesmo tempo pioneiro no desenvolvimento de ações ecológicas como ferramentas educacionais por meio do método próprio: aceitação da lei e promessa escoteira; aprender fazendo; vida em equipe; atividades atraentes, progressivas e variadas; e desenvolvimento pessoal com acompanhamento individual. Atividades ao ar livre são as características que distinguem o escoteirismo da educação formal, portanto a relação de atividades com a natureza é intrínseca desde a sua concepção. Baseado em ações do Plano de Ação Nacional de Conservação de Tubarões e Raias várias atividades de educação ambiental foram trabalhadas durante três meses na formação dos escoteiros do mar na faixa etária de 10 a 15 anos, que envolveu aspectos sobre a conservação dos Elasmobrânquios: diversidade, endemismo, características morfológicas, órgãos do sentido, pesca e *finning*, prevenção de acidentes e conservação. Por fim, o resultado mais consistente foi a criação de um novo distintivo de especialidade no ramo de Ciência e Tecnologia: Conservação de Raias e Tubarões. No primeiro momento, a criação da especialidade deve seguir o trâmite exigido pela União dos Escoteiros do Brasil, que consiste na definição da especialidade na Unidade Escoteira Local, caracterizada como especialidade de tropa. O passo seguinte é o envio da proposta para ser avaliada pelo Grupo de Trabalho que julgará a relevância da especialidade e a sua adequação na progressão dos jovens no contexto nacional.

Financiamento: 13º Grupo Escoteiro do Mar Norberto Pedrosa.

Palavras-chave: Pan tubarões, Elasmobrânquios, Escoteiros.



WOMEN IN AMAZONIAN ELASMOBRANCH RESEARCH: A TRIBUTE TO THE BRAZILIAN RESEARCHERS

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In Brazil, although the number of women in science and technology is growing, the representativeness is still low. Still, within the areas of natural science, marine biology has been standing out by the number of women developing research. The elasmobranch research community on the other hand, follows a more promising path, with many women who are references in their fields of study being in the spotlight and several young women following their steps. Here we highlight a range of women who have worked or still work with elasmobranchs, to showcase the great work being done to improve our knowledge and understanding of Amazonian species. As women in elasmobranch research we come from a proud lineage of strong women who have made incredible contributions, most of the time under challenging circumstances. These women have paved the way for those of us who have come after them and provided inspiration to all of us: Zafira da Silva de Almeida, Rosangela Paula Teixeira Lessa, Victoria Judith Isaac Nahum, Patrícia Charvet, Maria Lúcia Góes de Araújo, Akemi Shibuya, Flavia Lucena Fredou, Raimunda Nonata Fortes Carvalho Neta, Georgia Aragão, Cecile de Souza Gama, Ana Paula Barbosa Martins, Rafaela Maria Serra de Brito, Héllida Negrão Dias and Viviana Márquez Velásquez. This selection is only a small part of our scientists and we know that the number of women who have fought and continue to fight in defense of elasmobranchs is much bigger. Many of them may have been unnoticed by the academy, but they certainly are fundamental for their fields, even though they didn't receive honors and trophies. With so many examples of hardworking and obstinate women, we encourage all girls who initiate their research on elasmobranchs to continue this list of Brazilian women in science by blooming their work on this fertile Amazonian terrain left by all the *Victoria amazonica* above. The legacy of each one has already been sown, although they still have very much to contribute. It is up to the new generations to find what they can best offer, with originality and without losing their identity wherever they come from.

Keywords: Brazilian scientists, girl power, empowerment, Amazonian scientists.

WOMEN IN AMAZONIAN ELASMOBRANCH RESEARCH: A TRIBUTE TO THE BRAZILIAN RESEARCHERS

Natascha Wosnick and
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ONCE UPON A TIME IN THE AMAZONIAN COAST: HOW THE DAGGERNOSE SHARK CAN PROMOTE ELASMOBRANCH CONSERVATION AS A FLAGSHIP

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Flagship species act as an ambassador, raising awareness and reminding people on the importance of wildlife conservation. Normally, flagships are chosen based on cultural, historical and social importance. To be considered an effective flagship, the symbol needs to be charismatic enough to generate sympathy, being birds and mammals the most commonly used. The choice of a national symbol is often a challenge, since it must represent the country, disregarding social, political, economic and religious differences. Brazil is one of the countries with the greatest wealth of fauna and flora on the planet and the Amazonian coast is one of the most iconic biomes worldwide. Currently, the Maranhão state flagship is the Tropical mockingbird, classified as Least Concern according to the IUCN. Here we propose the Daggernose shark as flagship, if not as Umbrella species, since it is highly endemic and classified as Critically Endangered, being conservation measures urgent for the species. Its use may be a promising strategy since it can help raise funds for research and to educate the general public on the urgency for Daggernose shark conservation. Also, since mangroves are extremely important to the life cycle of the species, conservation strategies involving this species can also help to promote the preservation of this environment, considered one of the most endangered nowadays.

Financial support: FAPEMA.

Keywords: Endemic species, sharks, estuaries, tropical environmental, critically endangered.



ESTADO DE CONSERVAÇÃO DO GÊNERO *Pristis* (CHONDRICHTHYES: RHINOPRISTIFORMES: PRISTIDAE) NA COSTA DO ESTADO DO PARÁ, BRASIL

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O peixe-serra (sawfish), conhecido como espadarte no estado do Pará, possui, como sua principal característica, um rostro alongado com dentes laterais pontiagudos semelhantes a uma serra que justifica a denominação do peixe ao redor do mundo. São pertencentes à família Pristidae, possuem grandes nadadeiras dorsais e um grande tamanho corporal, podendo chegar até 7m de comprimento, fazendo com que esses peixes sejam confundidos com tubarões. Entretanto esse grupo é pertencente a subordem Batoidea (raias), pois, como elas, possuem as fendas branquiais e a boca na região ventral do corpo. Esses peixes são considerados eurihalinos e ocupavam, anteriormente, diversos habitats no Brasil, desde rios e estuários, abrangendo desde a costa dos estados da região norte à região sudeste do país. Porém devido a morfologia de seu rostro, esses peixes ficam facilmente presos em redes de pesca, e geralmente não sobrevivem. No Brasil, ocorrem duas espécies do gênero (*P. pristis* e *P. pectinata*) com poucas ocorrências notificadas recentemente no estado, principalmente a *P. pectinata*, que não é registrada desde a década de 1970. Ambas as espécies são classificadas como criticamente ameaçadas de extinção e são protegidas por lei, entretanto relatos de venda da “katana” (rosto do animal) e da carne salgada ou como “filé de cação” já foram registradas. Desse modo, novos estudos revelam que a distribuição desses animais, atualmente, está limitada a três estados brasileiros: Amapá, Pará e Maranhão. Contudo a distribuição desses peixes no nosso estado é incerta devido ao conhecimento limitado acerca desse grupo na região. Portanto esse trabalho teve como objetivo fazer um estudo sobre o estado atual de conservação do peixe-serra. O presente estudo está sendo realizado em 6 RESEXs paraenses: RESEX de Soure, Mãe Grande Curuçá, Maracanã, Cuinarana, Caeté-Taperaçu e Gurupi-Piriá. Nos municípios trabalhados foi observado, por meio de conversas com os pescadores e mapeamentos participativos com as comunidades, uma drástica diminuição das populações de espadarte ao longo dos anos na costa do Pará, ao ponto de os pescadores falarem em extinções locais. Em toda a área de estudo o peixe-serra era abundante, principalmente próximo à costa, porém, durante o estudo, não foi registrado nenhuma ocorrência recente no estado, as ocorrências relatadas datam de 20 a 30 anos atrás, portanto, foi observado que o estado de conservação do gênero *Pristis*, em uma avaliação local, é de Criticamente Ameaçado. O projeto continua em andamento, financiado pela Fundação Grupo Boticário de Proteção à Natureza, que visa, além de obter mais dados dessas espécies no estado do Pará, realizar palestras de educação ambiental na região do salgado paraense.

Financiamento: CNPq; Fundação Boticário de Proteção à Natureza.

Palavras chave: Peixe-serra, espadarte, conservação.



INTERNATIONAL SAWFISH DAY AS A CONSERVATION STRATEGY TO AMAZONIAN SAWFISHES



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On 17th October 2018 Maranhão hosted the first International Sawfish Day in Brazil, an international conservation initiative to increase awareness on these emblematic and critically endangered elasmobranchs. In Brazil the event aimed to expose to the general public the need for conservation strategies, as well as the importance of the Amazon coast as a beacon of hope for these animals. The action was developed by the Maranhão Elasmobranch Study Group (GEEM), inspired by the International Sawfish Day sponsored by the Sawfish Conservation Society which holds events worldwide since 2017. In International Sawfish Day in Brazil was occurred during the most important scientific event in the region – the National Week of Science and Technology (Semana Nacional de Ciência e Tecnologia). Parallel actions were also developed by the Brazilian Society for Elasmobranch Studies (SBEEL) and by environmental education team of the National Action Plan (Pan-Tubarões). With the support of artist Alexandre Huber, the commemorative date received an official logo, which was used in all activities developed in 2018. The event featured conversations circles and monitoring activities to educate participants about the biological and ecological aspects, as well as the importance of sawfish conservation, and reached approximately 1000 people. The success of the event demonstrates the importance of continuing these efforts as an integral part of the national action plan and conservation in national waters.

Financial support: FAPEMA.

Keywords: Environmental education, awareness, endemic species, critically endangered species, international initiative.



LOSING HEAD 2.0 – THE IMPORTANCE OF ARTISANAL FISHERMEN PARTICIPATION IN ELASMOBRANCH CONSERVATION

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Brazil has the largest consumption of shark meat, being one of the most representative nations in the elasmobranch trade. 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 ordinance was updated by the Normative Instruction 14, prohibiting landing of animals without the fins attached to the body (i.e., finning) (I.N. MPA/MMA 14/2012), however allowing decapitation before/prior to landing. Such practice becomes harder to correctly identify species that are protected by national regulation (i.e., MMA Ordinance n.445/2014), since some of them (e.g., hammerhead sharks and guitarfishes) are difficult to identify without heads. To understand how this practice affects fishing statistics, the landings of the artisanal community of Matinhos in Southern Brazil was monitored monthly from March 2018 to March 2019 with observations. In this period, *Squatina* spp. (5), *Pseudobatos* spp. (101), *Rhinoptera* spp. (10), *Rhizoprionodon* spp. (52), *Sphyrna* spp. (11) and *Carcharhinus* spp. (24) were landed, caught mainly by gillnets. Of these, only the following species were landed beheaded: *Squatina* spp. (2), *Pseudobatos* spp. (56), *Sphyrna* spp. (5) and *Carcharhinus* spp. (1). In a previous survey conducted between 2015 and 2018, *Rhizoprionodon* spp. and *Pseudobatos* spp. were landed without head 70% of the time, currently this number has dropped to 0 and 55%, respectively. *Squatina* spp. and *Sphyrna* spp. were always landed beheaded, currently, it has dropped to 40 and 45%, respectively. In addition, massive landings occurred with hundreds of other elasmobranch specie that were not counted, but all were landed with heads attached to the body. The reduction in landings of beheaded animals is a consequence of the awareness-raising work carried out by the Elasmobranch Studies Group from Paraná. This attitude of fishermen demonstrates the importance of the partnership with the group's researchers. Besides contributing for elasmobranch conservation, allows the correct identification of the species, as well as the collection of extremely important biological data for studies in the region. Additionally, through this work, species with low commercial interest that are caught alive, have been released immediately by fishermen, demonstrating their commitment.

Keywords: artisanal fishing, elasmobranch, evisceration, beheading.



OVERVIEW OF ENDEMIC AND THREATENED WITH EXTINCTION ELASMOBRANCH FISHING ALONG THE BRAZILIAN COAST

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Rays and sharks are among the most endangered vertebrates today, with population declines of up to 90% in some regions. Despite ongoing government efforts, the incidental and/or targeted capture of elasmobranchs on the Brazilian coast is growing by the day. This fact, coupled with the lack of fishing estimates in the country, make management and conservation plans inefficient and difficult to implement. Based on this scenario, the present study aimed to characterize the fishing of elasmobranchs in coastal Brazilian states. Through bibliographic survey, this study determined the catch patterns, characterizing the commercial fishing profile in each Brazilian state. The results show that despite the high degree of regionalism in elasmobranch fisheries, most commonly caught species are classified at some threat level and the capture and marketing of endemic species and therefore more vulnerable to extinction is a reality of most of the states. Thus, regional recovery plans as well as local red lists for proper management of threatened and/or endemic species, are urgent and necessary as an integral measure for elasmobranch conservation in Brazilian waters.

Keywords: Endemic species, Threatened with Extinction species, Fishing, Brazil.



USE OF A SOFTWARE FOR ANALYSIS OF BIBLIOMETRIC INDICATORS OF ELASMOBRANCH RESEARCH

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Bibliometric Indicators (BI) are important sources for understanding and improving scientific advancement and are directly related to the number of documents published about a specific subject. BIs from elasmobranchs from Maranhão state's coast published the last four decades were obtained using theses, dissertations, monographs, technical reports, books, book chapters and periodicals. In the BI analysis, the IRAMUTEQ (*Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*) tool, a free software that enables classic textual statistics, group specificity search, descending hierarchical classification, similarity and word cloud analysis was used. From the Initial Context Units (ICU), in which BIs are inserted, 5 classes of Elementary Context Units (ECU) were generated in a dendrogram based on similar vocabulary and on the grouping of statistically significant words. Class 1 (13.7%) and class 2 (22.9%) corroborated the class 5 (20.0%), about the studies already done on the Maranhão Elasmobranch Biodiversity (56.6%). Then, class 3 (23.4%) and class 4 (20.0%) corroborated the studies regarding reproductive aspects (43.4%). Although data from research on diet, conservation, age and growth and sexual dimorphism were inserted in the software, these were not significant as to similarity degree and therefore were not evidenced. Thus, IRAMUTEQ demonstrates that more studies of other aspects on elasmobranch populations are required, such as species distribution, demographics, functional morphology, taxonomy, histology, biomarkers, mortality and congenital malformation.

Keywords: IRAMUTEQ, Bibliographic Data, qualitative research, Chondrichthyes.



ANÁLISE DO NASCIMENTO PRÉ-TERMO EM RAIAS DE ÁGUA DOCE, *Potamotrygon motoro* (Família Potamotrygonidae) DO LAGO DE VIANA-MA

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A América do Sul apresenta um grande número de espécies de peixes tropicais de água doce, sendo as raias da família Potamotrygonidae exemplo dessa riqueza de espécies, principalmente em território brasileiro. Com o objetivo de analisar o processo abortivo/nascimento pré-termo em raias de água doce *Potamotrygon motoro*, foram acompanhados os processos abortivos de exemplares dessa espécie através de pescaria científica. A área de estudo foi o sistema estuarino lacustre de Viana em três saídas de campo com as localidades: Ponto 1. 3°13'59"S-44°59'13"O (10/07/2018), Ponto 2. 3°13'02"S-45°00'41"O (16/11/2018), e Ponto 3. 3°12'57"S-44°58'56"O (15/06/2019). Em todas as coletas ainda foram medidas a temperatura de superfície da água e pH no início, meio e final das coletas. Os animais foram capturados com dois espinhéis de fundo iscados com peixes juvenis da região (*Hoplias malabaricus*, *Hassar wilderi*, *Serrasalmus rhombeus*, *Pygocentrus nattereri*, *Astyanax bimaculatus*, dentre outros). Normalmente, a captura começava ao final da tarde (17:00 h) e se estendia até 1:30 horas da manhã. Os animais foram identificados e a análise de todas as fêmeas foi realizada desde o momento da saída da água até o término do aborto/nascimento pré-termo. Os animais foram condicionados em sacos plásticos mantidos abertos de forma a permitir a oxigenação. No total foram analisadas 9 fêmeas, dentre essas somente uma não estava grávida, mas todas as outras apresentaram nascimentos de pré-termos em um total de 33 filhotes em diferentes graus de desenvolvimento embrionário, registrando apenas 1 aborto com ovos e somente uma fêmea com um embrião. Considerando que todos os filhotes nasceram vivos, entende-se que não ocorriam abortos e sim nascimentos prematuros ou pré-termo. O comportamento após a captura envolveu sequencialmente ou concomitantemente a resistência à contenção na embarcação, respiração profunda, contração abdominal, abertura do útero com liberação de líquido intrauterino e posteriormente a liberação dos filhotes. Apesar dos resultados obtidos, não é possível afirmar que os nascimentos ocorrem em decorrência do estresse da captura, podendo estar vinculado ao estresse da permanência da mãe fora da água e sua consequente diminuição nas taxas de oxigenação própria e dos embriões.

Financiamento: FAPEMA Edital Universal 02/2018.

Palavras chave: Chondrichthyes, Batoidea, Reprodução.



NOTES ON THE REPRODUCTION OF *Styracura schmardae* IN THE AMAZON COAST

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The Atlantic Chupare stingray (*Styracura schmardae*) is found from Mexico to Amazon River mouth. Although considered a shallow water stingray, the records are rare and the species is currently listed as Data Deficient (DD) in the global and Brazilian red lists. This study aims to present biological data on the reproduction of *Styracura schmardae* caught by artisanal fisheries in the Amazon Coast. In 2011, nine specimens were obtained by artisanal fleet landings in the municipality of Marapanim, one of the largest fishing producers in the state of Pará. Males were represented by three young specimens with discs width (DW) range between 244 and 275mm DW (Mean \pm S.D. = 253.3 DW \pm 16.4) and three subadults with 677, 796mm and 934mm DW. The largest male had an inner margin length of the clasper about 9.5% of DW, while for the others subadults this measure was 5.9 and 6.6% of DW, respectively. The hepatosomatic (HSI) and gonadosomatic (GSI) indexes for the largest male were 3.64 and 0.24, respectively. With respect to females, a neonate with 168mm DW, one young specimen with 270mm DW and one subadult with 790mm DW were recorded. The subadult female was cut by the fishermen, but the ovaries did not show any vitellogenic follicles. The neonate female was caught in a fishing weir located on the shallower and more protected part of the estuary, the young ones of both sexes were caught in floating gillnets outside of the protected bay, and subadults by longline in a deeper channel (~20m) extending to one of the nearest rivers. There is a well-marked period of rain and drought in the Amazon region and adult specimens of both sexes were captured in the transition from wet to dry season, when salinity is still low due to the high rainfall of the previous months and the freshwater runoff. The neonate had a ventral yolk sac scar and was found predated near the rostrum. It was caught at the beginning of the drought, while the young ones were all captured on the same day, in midst of the dry season. This information highlights a possible birth size for the species based on the DW of the neonate and indicates that the size of sexual maturation is over 934mm DW for males, and over 790mm DW for females.

Keywords: size of birth, maturity, Atlantic Chupare Stingray, salinity, artisanal fisheries.



SAWFISH ROSTRAL TEETH AS ENDOGENOUS CHEMICAL RECORDS OF MOVEMENT AND LIFE-HISTORY IN A CRITICALLY ENDANGERED SPECIES

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The ecology of endangered and rare species can be difficult to study due to their low abundances and legal limits on the ability of scientists to catch, sample, and track them. This is particularly true of sawfish (family Pristidae) whose numbers have declined precipitously, placing all five species on the CITES list of critically endangered species worldwide. Best known for their distinctive, toothed rostrum, the ecology, movement, and life-history of sawfish are poorly understood. Sawfish rostral teeth are modified placoid scales, which grow continuously throughout the life of the fish. This continuous growth, combined with their stable calcified makeup, makes sawfish teeth a potential source of temporal records of chemical and isotopic changes through the life of the fish. Rostral teeth can be removed non-lethally from living animals and are also often preserved in rostra housed in museums and as curios, potentially allowing both contemporaneous and historical sources of life-history data. However, study of the potential for sawfish rostral teeth as endogenous chemical and structural records is extremely limited. Using archived samples of largetooth sawfish (*Pristis pristis*) we show that multiple chemical tracers can be recovered from sawfish teeth, and that these tracers can be used to understand movement across salinity gradients and between freshwater and ocean environments. We further show that sawfish teeth contain repeated structures and indistinct banding that could potentially be used for fish aging or growth analyses.

Financial support: Fulbright Commission Brazil.

Keywords: microchemistry, migration, sawfish, salinity, rostral teeth.



ACCIDENTS CAUSED BY MARINE STINGRAYS IN ARTISANAL FISHERMEN

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Artisanal fishermen are exposed to numerous forms of injuries and traumas caused by aquatic organisms due to direct contact with these animals during their daily activities. Stingray accidents are of most concern due to their necrotic properties and venom neurotoxins. The data collected consisted of a cross-sectional and epidemiological descriptive analysis of accidents caused by marine stingrays in 37 artisanal fishermen in the municipality of São José de Ribamar, Maranhão. Accidents occurred at different times - during animal's removal from the fishing apparatus (45.9%), during fishing apparatus trimming and withdrawal at low tide - step on animals (37.8%), when handling fish (10.8%) and when operating/steering vessel (5.4%). *Hypanus guttatus* was the main one involved in the accidents (81,1%), followed by *Aetobatus narinari* (13,5%), *Urolophus sp.* (2,7%) and *Urotrygon microphthalmum* (2,7%). Tissue necrosis was observed in 51.4% of the cases. All accidents were followed by pain and erythema. The treatments used were the most diverse, from homemade (64.9%), medicinal (16.2%) to no treatment at all (18.9%). Most fishermen (56.8%) did not seek medical attention, and in 67.2% of the occurrences, the fishermen were removed from their duties. These accidents are a major public health problem due to their severity and consequences. Educational actions in fishing communities on preventive and early care measures are essential to reduce their occurrence and minimize complications.

Keywords: Workplace accident, Stingrays, Necrosis, Public health, Accident prevention.



CONHECIMENTO ECOLÓGICO LOCAL COMO FERRAMENTA PARA CONSERVAÇÃO DA CONDRIFAUNA EM MUNICÍPIOS DO MARANHÃO

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O Estado do Maranhão apresenta uma das maiores taxas de captura incidentais de elasmobrânquios do país e planos de manejo ou avaliações de risco para a região são inexistentes. Nessa perspectiva, esse estudo utilizou o Conhecimento Ecológico Local (CEL) de pescadores artesanais nos municípios de Paço do Lumiar e São José de Ribamar para caracterizar a composição, o uso de habitat e mapear as áreas de ocorrência de tubarões e raias na região. Foi usado álbum de fotos de tubarões e raias do Maranhão, mapas do litoral e questionário semiestruturado durante as entrevistas. De acordo com o CEL dos pescadores artesanais, foram evidenciados nos mapas as áreas de ocorrência para cada espécie de tubarões e raias, sendo as espécies de raias comuns para as duas regiões: *Aetobatus narinari*, *Hypanus guttata*, *Rhinoptera bonasus*, *Gymnura micrura* e *Mobula hypostoma*, geralmente capturadas até 5 metros de profundidade próximo da costa. Para os tubarões as espécies comuns foram: *Ginglymostoma cirratum*, *Sphyrna lewini*, *Rhizoprionodon porosus*, *Carcharhinus acronotus* e *Carcharhinus leucas* sendo capturadas até 15 metros de profundidade em mar aberto. Entretanto, os relatos também indicaram que ao longo dos últimos anos essas espécies (e outras, tais como *Fontitrygon geijskesi*, *Pseudobatus percellens*, *Pristis pristis*, *Carcharhinus porosus* e *Isogomphodon oxyrhynchus*) diminuem cada vez mais devido a pesca excessiva, destruição dos habitats, poluição nos ambientes aquáticos e a falta de boas práticas. Assim, as informações geradas a partir do CEL sobre as espécies locais de elasmobrânquios, seus ambientes e seus processos ecológicos são fundamentais para subsidiar planos de ações para fins de conservação.

Keywords: Conhecimento Tradicional, Pescadores artesanais, Conservação, Condrofauna.



INJURIES CAUSED BY THE OCELLATE FRESHWATER STINGRAY *Potamotrygon motoro* IN LACUSTRINE COMMUNITIES: EPIDEMIOLOGY, CLINICAL ASPECTS AND PREVENTIVE MEASURES

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Accidents caused by aquatic animals are common amongst amateur and professional fishers. Wounds can be disabling and keep victims away from work for weeks or months. This study aimed to analyse the records of accidents caused by *Potamotrygon motoro* in the municipalities of Penalva and Viana (Maranhão) using an epidemiological descriptive analysis. In total, 40 artisanal fishermen were interviewed, and detailed descriptions of the accidents were recorded for analysis. The symptomatology was diverse. All respondents reported pain and edema. Tissue necrosis was reported for 75% of accidents in Penalva and 76.9% in Viana. Both traditional/homemade and specialized treatments were adopted for pain relief. However, traditional measures were used more often by fishers in both study sites (Penalva - 74%, Viana - 69.2%). In Penalva, 59.3% of the interviewed fishers sought medical attention when early symptoms set in. On the other hand, the majority of Viana fishermen (61.5%) did not seek any type of hospital assistance. The combination of poor healthcare treatment, misinformation regarding preventive and prophylaxis measures, and the use of highly infectious traditional treatments are the main causes of extremely painful and long recovery. Thus, it is necessary that public health agencies in Brazil develop preventive educational actions and better prepare health professionals to provide appropriate care and treatment for those injured by freshwater stingrays.

Keywords: Freshwater stingrays, venomous animals, Toxins, Fishermen.



INTERAÇÃO ENTRE A PESCA ARTESANAL E AS RAIAS DE ÁGUA DOCE (POTAMOTRYGONIDAE) NOS LAGOS DE VIANA – MARANHÃO

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As raias potamotrigonídeas são os únicos elasmobrânquios exclusivos de água doce com distribuição neotropical nas bacias dos rios Amazonas, Paraná- Paraguai, Parnaíba e Pindaré-Mearim. Acidentes com raias são comuns, geralmente causados pelo movimento de defesa da cauda após o toque acidental. A cauda possui de um a três ferrões localizados após a linha de espinhos. As raias não possuem importância econômica no município de Viana, sua captura normalmente é acidental por meio do enovelamento nas redes de emalhe. O único uso conhecido da raia nessa região é a utilização do fígado desses animais na medicina popular. As interações negativas entre pescadores e raias são comumente registradas como ferroadas nos membros inferiores e superiores dos pescadores e mutilações e morte de vários exemplares de raias. O presente estudo foi desenvolvido no lago de Viana, integrante da bacia do rio Pindaré, localizado no município de Viana na microrregião da Baixada Maranhense, por meio de espinhel de fundo. Foram analisados 33 exemplares de *Potamotrygon motoro*, 21 fêmeas (63,63%) e 12 machos (36,36%), a largura média do disco foi de 426,3 mm ($s = 88,2$ mm) para fêmeas e 283,3 mm ($s = 112,2$ mm) para machos. Dentre eles 5 (15,15%) apresentaram algum tipo de mutilação, sendo 80% destes com mutilação na cauda e 20% com mutilação nos olhos. Além disso, dos 27 estômagos analisados, 14,82% apresentaram a presença de resto de rede de pesca, evidenciando a forte interação que essas raias têm com a atividade pesqueira. Esses resíduos oriundos da atividade pesqueira são problemáticos, já que podem causar sensação de falsa saciedade, fazendo com que o animal reduza a sua alimentação ou pare de comer. Dessa forma, faz-se urgente a elaboração de políticas públicas que procurem diminuir o impacto decorrente dessa interação, com ações educativas em diferentes níveis, com o objetivo de informar a população e desmistificar questões envolvendo esses animais.

Palavras-chave: Elasmobrânquios, Pindaré-Mirim, Pesca.



A ECOLOGIA DE ELASMOBRÂNQUIOS SOB A ÓPTICA DOS PESCADORES ARTESANAIS

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O Conhecimento Ecológico Local dos pescadores tem sido estudado sob o enfoque teórico da Etnoictiologia, que é o estudo das interações e inter-relações que os grupos humanos estabelecem com os peixes. No presente estudo foram entrevistados 54 pescadores, todos do sexo masculino e com idade média de 44 anos, atuantes no município de Raposa-MA e que possuem interação com a captura de elasmobrânquios somente como fauna acompanhante da pesca da pescada amarela (*Cynoscion acoupa*) ou do peixe serra (*Scomberomorus brasiliensis*). Quanto à distribuição espacial dos elasmobrânquios os pescadores descreveram que geralmente estes são capturados longe da costa (52,26%), e 5,56% diferiram o comportamento de tubarões em mar aberto e das raias próximos da região costeira. Para a distribuição vertical os entrevistados descreveram a presença de elasmobrânquios, principalmente, em “meia água” (24,07%) e “águas profundas” (48,15%). Quanto a sazonalidade, 44,44% não soube responder quanto ao hábito dos elasmobrânquios durante o dia, já 35,19% afirmaram que estes permanecem em mar aberto. Por outro lado, 40,73% afirmaram que os elasmobrânquios se aproximam da costa a noite, enquanto em relação aos períodos do ano 37,04% afirmaram que os elasmobrânquios se aproximam da costa no período chuvoso (dezembro a junho). Os pescadores em 70,37% das respostas afirmaram que todos os animais menores fazem parte da dieta dos elasmobrânquios, 3,70% diferiram a alimentação de tubarões (peixes) e raias (crustáceos e sardinha), enquanto 16,67% listaram espécies da família Engraulidae, Clupeiformes e Mugilidae, além de crustáceos, moluscos, mamíferos e outros tubarões e raias. No que se refere ao tipo de habitat utilizado por estes animais, 3,70% relataram a presença de raias sobre banco de mariscos e tubarões em águas profundas, 14,81% não souberam descrever, 22,22% afirmaram apenas em ambientes profundos e 55,56% descrevem que o habitat ideal para os elasmobrânquios é próximo a recifes e pedras. Como compreensão sobre o ciclo de vida dessas espécies, cerca de 70% responderam que no período chuvoso (dezembro a junho) são encontrados mais indivíduos jovens e recém-nascidos, porém 11,11% afirmaram ser no período de estiagem (julho a novembro) a maior ocorrência de neonatos e 16,67% não souberam responder. Quanto a incidência de ventos, 85,19% dos entrevistados consideram o primeiro semestre mais favorável a pesca, tendo em vista que no segundo semestre os ventos são mais fortes e dificultam a navegação. Observa-se que os pescadores mais antigos possuem informações específicas sobre a captura e a condição dos estoques de elasmobrânquios. Assim, ressalta-se que, enquanto detentores de amplo conhecimento sobre a dinâmica do ambiente, o conhecimento ecológico local é uma importante ferramenta para a gestão, o manejo e a conservação dos recursos pesqueiros.

Palavras-chave: conhecimento ecológico local, gestão participativa.



SHIFTING BASELINE SYNDROME CONCERNING GOLDEN HAMMERHEAD SHARK (*Sphyrna tudes* VALENCIENNES, 1822) FISHERIES ON THE CENTRAL BRAZILIAN COAST

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Despite its Vulnerable status, studies on the Golden Hammerhead shark *Sphyrna tudes* (Valenciennes, 1822) are rare. This species presents coastal habits, low reproductive capacity and has been intensively fished. In this context, this study aimed to evaluate Fisher Ecological Knowledge (FEK) in southern Bahia, Northeastern Brazil, for evidence of Shifting Baseline Syndrome (SBS) in *S. tudes* fishery activities. Semi-structured interviews were conducted with 195 fishermen from five municipalities between March 2012 and December 2014, associated to a projective test where photos of the assessed species were shown to the respondents. The non-parametric Mann-Whitney U test indicated a significant difference ($p < 0.001$) between the age of fishermen who caught the species at least once during their fishing career and the age of those who did not capture the species. A higher number of records of older fishermen catching *S. tudes* was observed compared to the high numbers of young fishermen who have never caught the species. In addition, fishermen between the ages of 60 and 90 mostly cited fishing heavier golden hammerhead sharks. Fishermen understand that *S. tudes* abundance declines are related to the following aspects: (i) regional predatory fishing; (ii) the development of new local fisheries technologies and equipment in recent decades; (iii) marine environment pollution; and (iv) siltation of local rivers. Given these indications of SBS occurrence in the local Golden Hammerhead shark fishery, FEK should be considered in the establishment of appropriate *S. tudes* conservation strategies, mainly by controlling net fishing efforts (zoning and/or fishing exclusion areas).

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Keywords: Elasmobranchii; Smalleye hammerhead; Sphyrnidae; Bahia.



CYTOGENETIC AND MOLECULAR CHARACTERIZATION OF *Potamotrygon motoro* AND *P. hystrix* (CHONDRICHTHYES, POTAMOTRYGONIDAE) FROM THE AMAZON RIVER BASIN: TAXONOMIC IMPLICATIONS FOR THE GENUS

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Chromosomes of the freshwater stingrays *Potamotrygon motoro* and *P. hystrix* from the Amazon River basin collected near Manaus, Brazil were analyzed by conventional cytogenetic techniques using Giemsa-staining, C-banding, silver-staining and by Fluorescent in situ hybridization (FISH) using ribosomal DNA probes. *P. motoro* presented variation in the diploid number of $2n=66$ in females and $2n=65$ in males, characterizing a sex determination system XX/X0 and *Potamotrygon hystrix* presented a karyotype with 68 chromosomes in females and males, and no heteromorphic chromosomes were detected. C-banding revealed the presence of heterochromatic blocks accumulated in the centromeric region of all chromosomes in both species analyzed. The nucleolus organizer regions (NORs) identified by Ag- and confirmed by FISH with 18S DNA probes were located in the terminal region of three to four chromosome pairs in *P. motoro* and in seven chromosomes in *P. hystrix*. The rDNA 5S sequences were found in only one chromosomal pair in both species. Through of gene COI, the interspecific genetic distance found between *P. motoro* and *P. hystrix* in the Amazon River was 10.8%, between *P. motoro* (Amazon River) and *P. aff. motoro* (Paraná River) was 2.2%, and between *P. hystrix* and *P. aff. motoro* was 11.8%. Besides adding new cytogenetic data concerning the species studied the results obtained also corroborate the occurrence of heteromorphic chromosomes associated to sex in *P. motoro* and suggests the necessity of a taxonomic review of *P. motoro* since the presence of cryptic species cannot be discarded.

Financial Support: FAPESP, CAPES e CNPQ.

Keywords: stingrays, COI, fish chromosomes, cytogenetic markers.



DNA BARCODING REVELA ESPECIAÇÃO CRÍPTICA DENTRO DO GÊNERO *RHINOPTERA* van HASSELT, 1824 ATLÂNTICO SUL OCIDENTAL

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As raias da família Rhinopteridae Bonaparte, 1835 são altamente migratórias e estão distribuídas em águas mornas em mares tropicais e temperados com exceção da região ao redor das ilhas do Pacífico. O litoral brasileiro registra a ocorrência de 2 espécies, *Rhinoptera bonasus* e *Rhinoptera brasiliensis*, as quais, devido ao grande tamanho corpóreo são alvo fácil de captura acidental como fauna acompanhante de pescarias de arrasto, como as de camarão marinho. Nos últimos, o advento de ferramentas moleculares tem elucidado tanto a presença de espécies novas quanto, limites de distribuição de elasmobrânquios. O presente estudo, através da utilização do gene COI elucidar a posição filogenética das espécies de Rhinoptera que ocorrem no litoral brasileiro, em especial, a região do litoral amazônico. Indivíduos das duas espécies foram coletados ao longo da costa brasileira, e posteriormente sequenciados. Sequências adicionais de outras espécies do gênero foram baixadas no Genbank e adicionadas ao banco de dados. Os resultados demonstram a presença de *R. brasiliensis* no litoral amazônico, demonstrando a ampliação da área de ocorrência da mesma. Adicionalmente, 3 linhagens de *R. bonasus* foram recuperadas, demonstrando que a espécie não é monofilética. A morfologia conservada dos indivíduos, torna a correta discriminação das espécies do gênero Rhinoptera muito difícil fato que reforça a necessidade da implementação de métodos moleculares para correta discriminação de novas espécies ainda não descritas. O gênero Rhinoptera deve passar por revisões sistemáticas mais apuradas para correta elucidação de quantas espécies compõem o gênero no litoral brasileiro, em especial, na costa amazônica a qual possivelmente, apresenta uma nova linhagem endêmica de elasmobrânquio.

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Palavras chave: Elasmobrânquios, Rhinoptera, Espécies Cripticas, COI, Litoral Amazônico.



DIVERSIDADE GENÉTICA DA ESPÉCIE CRITICAMENTE AMEAÇADA TUBARÃO PATO: *Isogomphodon oxyrinchus*

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O cação Pato (*Isogomphodon oxyrinchus*, Muller e Henle, 1839) é um dos maiores exemplos sobre os efeitos da exploração pesqueira nos elasmobrânquios, sendo uma espécie endêmica do litoral amazônico, enquadrado na categoria de espécie criticamente ameaçada de extinção. Os tubarões estão entre os peixes mais vulneráveis à ação da sobre-pesca em todo o mundo, e muitas populações estão tendo seus estoques reduzidos severamente pela alta pressão exercida pela frota pesqueira mundial. Logo, se faz necessária a caracterização genética e avaliação destes estoques. O objetivo foi avaliar a variabilidade genética da espécie *I. oxyrinchus*, através de marcadores mitocondriais, gerando informação sobre o status da diversidade genética desta espécie na Costa Norte do Brasil. Em nossas análises, detalhamos os sítios variáveis para 12 espécimes, utilizando três fragmentos do DNA mitocondrial: região controle (RC - 738 pb), Citocromo oxidase subunidade I (COI - 638 pb) e Citocromo b (Citb - 568 pb). Nossos resultados indicam que, para os dois últimos fragmentos não foi detectada nenhuma variação nucleotídica. Para a RC, apenas três sítios variáveis, que compreendem uma região de 249 pb entre os sítios 176-425, onde se concentra toda a variação intraespecífica, que resultou apenas cinco haplótipos, onde o haplótipo 4 foi o mais frequente, compartilhado por oito indivíduos, seguido dos haplótipos únicos. De acordo com os índices de diversidade genética, encontramos valores moderados de diversidade haplotípica ($h = 0,5758 \pm 0,1634$) e baixos valores de diversidade nucleotídica ($\pi = 0,000348 \pm 0,000292$). Os testes de neutralidade apresentaram valores negativos, contudo apenas o teste de Fu's F_s foi significativo (Tajima's $D = -0,27845$ $P > 0,05$; Fu's $F_s = -2,14438$ $P < 0,05$). A ausência de diversidade genética em COI e Citb, assim como a baixa diversidade genética em RC, reflete o pesado evento de declínio populacional sofrido por esta espécie. A busca de mais informações pela diversidade genética nos condrites são necessárias para um monitoramento genético, já que são vistos como informações extremamente necessárias para assegurar a continuidade do processo de exploração, assim como, para o re-estabelecimento de estoques que possam estar comprometidos, o caso do tubarão Pato.

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Palavras-chave: Variabilidade genética, Declínio populacional, monitoramento genético.



POPULATION STUDY OF THE RAY *Rhinoptera bonasus* (CHONDRICHTHYES: BATOIDEA) USING GENETIC MARKERS

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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, and currently are insert in the IUCN (International Union for Conservation of Nature) red list as “near threatened”. *R. bonasus* occurs from United States of America (EUA) to the south of Brazil, being considered to be a highly migratory species. The development of researches involving genetic markers provide a molecular tool that addresses aspects of genetic variability, population structure and is of fundamental importance in species conservation programs. The aim of this work was to analyze the population structure of *R. bonasus* collected I different localities of the Brazilian coast (Santa Catarina, São Paulo, Rio de Janeiro, Pernambuco, Pará), in La Guajira (Colombia) and in the Gulf of Mexico (EUA), in a total of 68 samples using the molecular markers cytochrome b gene of mtDNA (Cyt b) and microsatellites (SSR). Technical procedures involved the removal of muscle tissue fragments from the animals to obtain total DNA samples, the Polymerase Chain Reaction (PCR) of Cyt B gene and identification of SSR, and sequencing of the samples. The programs Geneious, DNAsp 5.1, Pop Art and ARLEQUIN 3.01 were used for editing and perform statistical analysis of the obtained sequences of Cyt b, and the programs GENEMAPPER 4.3, Genalex 6.1, and ARLEQUIN 3.01 were used for the analysis of SSrs. The analysis of Cyt b revealed 10 different haplotypes, with values of haplotypic diversity of 0.1179 and nucleotide diversity of 0.1428. Lastly, the AMOVA analysis revealed that 74.81% of the genetic variation is found between the Mexico Gulf and Colômbia samples, with the Brazilian samples presenting two different populations. The analysis of four loci of SSR markers resulted in a total of 31 alleles, and FST fixation index in the analyzed populations was 0.05. The observed heterozygosity ($H_o = 0.349$) was lower than the expected heterozygosity ($H_e = 0.443$), indicating a deficit of heterozygosity in the populations. It is considered that a more extensive sampling of different locations could form a better view of the real situation and thus enriching information about the species, as it presents a wide distribution.

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Keywords: Cyt b, microsatellite, conservation, rays.



REVISÃO MOLECULAR DO GÊNERO MONOTÍPICO *Isogomphodon* GILL, 1862

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Dentre os estudos que envolvem o gênero *Isogomphodon*, pouquíssimos abordam diretamente as relações filogenéticas deste gênero com os demais gêneros da família Carcharhinidae. Este gênero monotípico foi criado em 1862 por Theodore Gill, tornando-se posteriormente sinônimo de *Carcharhinus*, até ressurgir com Stewart Springer em 1950, para abrigar a espécie *Isogomphodon oxyrinchus*, Muller e Henle, 1839, anteriormente *Chacharhinus oxyrinchus* (hoje sinônimo!). *I. oxyrinchus* é uma espécie de elasmobrânquio endêmica do litoral Amazônico, possuindo uma das menores áreas de ocorrência dentre os tubarões, tendo seus estoques sofrido grande declínio populacional nos últimos anos devido à ação de captura descontrolada. Esta espécie foi retirada de *Carcharhinus* por apresentar características peculiares, como: um focinho longo, triangular e estreito dorso-ventralmente, olhos muito pequenos, etc. Contudo, as demais características desta espécie são de um típico membro do gênero *Carcharhinus*: ausência de espiráculos, presença de sulco précaudal, a segunda nadadeira dorsal bem menor que a primeira e vivíparo. Acarretando algumas controvérsias ao longo dos anos sobre o posicionamento filogenético desta espécie. O objetivo do presente estudo foi avaliar as relações filogenéticas do gênero monotípico *Isogomphodon*, com os demais gêneros da família Carcharhinidae, através de fragmentos nuclear (RAG 1 - 1110 pb) e mitocondriais (12S-16s, Citb, ND2 e ND4 - 3315 pb). Nossos resultados colocam dois gêneros monotípicos, *Isogomphodon* e *Prionace*, dentro de *Carcharhinus*. Segundo a literatura, o posicionamento taxonômico de *Prionace glauca* é problemático e bem reportado, pois, já se observava o agrupamento deste tubarão com membros de *Carcharhinus*. Para *Isogomphodon*, o presente estudo fornece evidências, como o alto suporte estatístico nas árvores filogenéticas (90% *bootstrap* e 0.9 de Índice de credibilidade) para o clado formado por *I. oxyrinchus*, *P. glauca* e espécies de *Carcharhinus*, nas análises mitocondriais e para o clado entre *I. oxyrinchus* e *Carcharhinus*, nas análises com o marcador nuclear. Além disso, semelhantemente ao observado em *Prionace*, o *I. oxyrinchus* apresenta uma distância genética compatível as observadas entre as espécies de *Carcharhinus*, com valores entre 7,6 e 10,2% (mitocondrial) e 0,6 - 1,2% (nuclear). Diante destes resultados, as características diagnósticas desta espécie, que contribuíram para criar o gênero, são mudanças em decorrência do tipo de habitat em que a espécie se encontra. Portanto, de acordo com a taxonomia atual, nosso estudo demonstra o parafiletismo do gênero *Carcharhinus*, que forma um clado politômico, que inclui as espécies *I. oxyrinchus* e *P. glauca*. Assim, este estudo, não só, reafirma a necessidade de revisão do gênero *Prionace*, mas também, propõe uma alteração na classificação da espécie *I. oxyrinchus*, que provavelmente pertencem ao gênero *Carcharhinus*.

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Palavras chave: Filogenia, validação, *Carcharhinus oxyrinchus*.



A IMPORTÂNCIA DE MÉTODOS MOLECULARES EM ESTUDOS DE ELASMOBRÂNQUIOS: *Myliobatis freminvillei* (LESUEUR, 1824), UM NOVO CASO DE ESPECIAÇÃO CRÍPTICA NO ATLÂNTICO SUL OCIDENTAL

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O gênero *Myliobatis* é composto por 11 espécies válidas distribuídas ao redor do mundo, destas, três são ocorrentes na costa do Brasil, onde a taxonomia das raias da família Myliobatidae permaneceu por muitas décadas inalterada. Contudo, recentemente vários estudos vêm redefinindo a presença de novas espécies dentro deste grupo. O presente estudo, realizou uma filogenia molecular do gênero *Myliobatis*, testando a eficiência do *DNA barcode* na resolução das espécies do gênero. Indivíduos foram coletados nos estados do Pará e São Paulo, tendo um fragmento do gene COI amplificado para estes indivíduos. Os resultados das amostras revelaram que das nove espécies utilizadas no presente estudo, sete (7) foram recuperadas de forma monofilética em todas as inferências realizadas. As exceções foram *M. freminvillei* e *M. chilensis*. No caso da primeira, as amostras obtidas da Litoral amazônico e do sudeste do Brasil, se mostraram geneticamente distintas em relação as sequências de indivíduos provenientes dos EUA. As linhagens de *M. freminvillei* foram recuperadas mais proximamente relacionadas a *M. californicus*, espécie restrita a região do Oceano Pacífico (México e Califórnia), enquanto *M. goodei* foi recuperada como espécie irmã de *M. chilensis* e finalmente, a última espécie descrita do gênero (*M. ridens*) foi recuperada mais próxima a *M. peruvianus*. Adicionalmente, os resultados também indicam a existência de ao menos duas novas linhagens genética de *M. freminvillei* no Brasil, uma presente no litoral amazônico e outra na região do litoral sudeste. Tal presença de novas linhagens de *Myliobatis* confirma a necessidade de estudos mais apurados em relação a fauna de elasmobrânquios que ocorrem no Atlântico Sul Ocidental. Uma amostragem mais robusta, bem como inferências sistemáticas irão auxiliar na delimitação de ocorrência destas novas linhagens no litoral brasileiro.

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Palavras chave: Elasmobrânquios, *Rhinoptera*, Espécies Cripticas, COI, Litoral Amazônico.



DNA *BARCODING* PARA IDENTIFICAÇÃO DE ESPÉCIES DO GÊNERO *Sphyrna* EM PORTOS DE PESCA DO LITORAL AMAZÔNICO

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Tubarões-martelos pertencentes ao gênero *Sphyrna* estão globalmente sob intensa exploração pesqueira e são classificados, segundo a IUCN, como espécies em risco de extinção. A costa norte do Brasil é classificada como um dos *hotspots* de conservação de elasmobrânquios no mundo. Estudos realizados citam a ocorrência de quatro espécies do gênero *Sphyrna* para essa região, sendo duas costeiro-oceânicas (*Sphyrna lewini* e *Sphyrna mokarran*) e duas de pequeno porte costeiro-estuarinas (*Sphyrna tiburo* e *Sphyrna tudes*). Porém, devido à dificuldade de identificação específica durante o desembarque, uma vez que são processados como “cartucho”, a maior parte dos registros apenas relatam o gênero *Sphyrna*. Para avaliar a efetividade do DNA barcoding na identificação de espécies de tubarão-martelo, bem como determinar quais espécies são mais frequentemente capturadas, usamos sequências parciais do gene mitocondrial citocromo oxidase subunidade I (COI) e comparamos estas sequências com as disponíveis no Barcode of Life Database (BOLD) e NCBI GenBank. Foram obtidas 46 sequências, indicando a ocorrência de *Sphyrna mokarran* (67%), *Sphyrna lewini* (15%), *Sphyrna tudes* (3%) e *Sphyrna tiburo* (15%), listadas como espécies ameaçadas de extinção pela IUCN e protegidas legalmente pela Portaria 445/2014 (Em perigo/Criticamente em Perigo). A análise filogenética utilizando COI revelou clados bem apoiados para cada uma das quatro espécies descritas para a costa norte do Maranhão. Para *S. lewini* e para *S. tiburo*, observou-se estruturação genética intra-específica. Podemos afirmar que o DNA barcoding é uma ferramenta de identificação eficiente e precisa para espécies de *Sphyrna*. Dessa forma, a identificação molecular pode contribuir para fiscalização, controle e monitoramento da pesca do litoral amazônico.

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Palavras-chave: COI; Elasmobrânquios; Identificação.



IDENTIFICATION AND MOLECULAR DELIMITATION OF SHARK SPECIES OF THE GENUS *SQUALUS* LINNAEUS, 1758 (CHONDRICHTHYES; SQUALIDAE)

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The genus *Squalus* is a large group of sharks with 26 known species with worldwide distribution. The taxonomic identification of the species in this group is quite problematic, mainly due to the high morphological similarity found among the species, which are classified in the IUCN (International Union for the Conservation of Nature) as insufficient data. In order to collaborate with information about this group of sharks, the work aimed to use the DNA-barcode (COI) technique for molecular identification with species delimitation analysis to verify the number of evolutionary units. This is the first work of delimitation of species in the genus *Squalus*. We analyzed the molecular characteristics of the species *S. acanthias*, *S. suckleyi*, *S. cubensis*, *S. megalops*, *S. raoulensis*, *S. blainville*, *S. brevirostris*, *S. crassispinus*, *S. hemipinnis*, *S. albifrons*, *S. edmundsi*, *S. japonicus*, *S. hawaiiensis*, *S. nasutus*, *S. griffini*, *S. grahami*, *S. montalbani*, *S. mitsukurii*, *S. clarkae*, *S. formosus* and *S. chloroculus*. 72 sequences were obtained from samples collected in different locations distributed along the Atlantic Ocean, being them in the United States Coast region (n = 11), in the Brazilian coast in the states Pernambuco (n = 13), Rio de Janeiro (n = 15) and on the Argentinian coast (n = 33). In addition, 497 sequences were taken from the Barcode of Life Data System (BOLD) database and entered into the species delimitation analyzes in this study. Initially, the sequences were aligned in the Geneious 4.8.5 program, generating a consensus matrix of 21 species, and using the MEGA 7 program a Maximum Likelihood tree (ML) was obtained. The delimitation analyzes were performed with the Automatic Barcode Gap Discovery (ABGD), Poisson Tree Processes (PTP) and Bayesian implementation of the General Mixed Yule-Coalescent (bGMYC) programs. The results of the delimitation analysis with ABGD and PTP revealed the existence of 18 distinct evolutionary groups. Among these, three units presented taxonomic conflicts, being that *S. japonicus* + *S. nasutus* + *S. hawaiiensis* + *S. mitsukurii* (samples from Japan) were considered a single taxonomic unit; in the same way, *S. hemipinnis* + *S. edmundsi* and *S. mitsukurii* (Atlantic samples) + *S. clarkae* were also considered as single taxonomic units. It is considered that these results may indicate the occurrence of a species complex in the genus *Squalus*. The information obtained in this study also suggests that the evolutionary units that presented taxonomic conflicts could be involved in recent processes of speciation.

Financial Support: FAPESP, CAPES e CNPQ

Keywords: COI, barcode, *Squalus*, conservation, species complex.



MOLECULAR TOOLS FOR IDENTIFICATION OF SHARKS AND BATOIDS AND THEIR IMPLICATIONS FOR THE CONSERVATION OF BIODIVERSITY

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The exploitation of natural fish resources is an increasing activity in tropical waters, leading to overfishing, depletion of natural genetic variation and biodiversity loss. Seafood mislabeling is widespread, which is harmful to the economy, consumer rights, public health and species conservation. Sharks and rays (Elasmobranchii) have 30% of its species at the IUCN Red List of Threatened Species, which highlights the need for an increase in conservation efforts for this subclass. In Brazil, fishing and marketing activities of threatened marine species (VU; EN; CR) are forbidden. However, inspection is poor due to the difficulty of morphological identification (post-processing landing) and the paucity of DNA sequences. Here, we report the expansion of the molecular database and the development of PCR-based assays for species identification of the seafood sold as “caçõ” (generic term for shark meat) and guitarfish. DNA sequences of species from Brazil coast, including endemic species, were obtained using Sanger sequencing. Whole mitochondrial genomes were also obtained by targeted-enrichment using RNA baits in a single MiSeq run resulting in 10 fully circular annotated mitogenome sequences. A PCR multiplex approach and a series of species-specific primers were designed to allow time- and cost-efficient identification. Our PCR approach successfully identified one superorder, three orders and 18 species, including species of the Amazonian coast (e.g. *Rhizoprionodon lalandii*, *R. porosus*, *Pseudobatos percellens* and others) and Brazilian endemic species (e.g. *Atlantoraja castelnaui*, *Pseudobatos horkelii*, *Squatina guggenheim*, *S. occulta* and *Zapteryx brevirostris*). We detected 32.5% and 20% of mislabeling and 32.5% and 80% of threatened species distributed as “caçõ” and guitarfishes, respectively. Endemic species such as *Atlantoraja castelnaui* (17.9%) were present in the sold products, including species critically endangered such as *P. horkelii* (2.9%) and *Squatina occulta* (1.7%). Among the species that can be legally sold (sharks and guitarfishes of LC and NT in the IUCN RedList) only three were detected in this study: *Prionace glauca* (28%), *Pseudobatos percellens* (2.9%) and *R. porosus* (2.2%). We conclude that despite legislation, endangered elasmobranchs are commercialized in high numbers and the rate of mislabeling is elevated, threatening their conservation, especially of endemic species. This work highlights the need for the development of molecular tools to inform legislators and foster regulations that are more effective for elasmobranch conservation and Brazilian endemic species.

Financial support: CAPES.

Keywords: conservation genetics, elasmobranchii, PCR multiplex, NGS, forensic genetics



ONDE ESTAMOS E PARA ONDE VAMOS? A GENÉTICA DAS RAIAS DE ÁGUA DOCE (POTAMOTRYGONINAE, MYLIOBATIFORMES)

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As raias de água doce neotropicais se destacam dentre os elasmobrânquios por comporem o único grupo de peixes cartilaginosos predominantemente dulcícola. O grupo contém cerca de 35 espécies viventes distribuídas em rios e estuários na América do Sul. A maioria das espécies está presente na região amazônica (~77% das espécies). Assim como as demais raias Myliobatiformes, as de água doce também possuem baixa fertilidade, maturação tardia e longo período de vida. Estas características de sua história de vida a tornam suscetíveis a um declínio populacional quando submetidas a exploração. Por isso, preocupa o fato de que a pesca para uso ornamental e alimentar são ameaças para estas raias. Além disso, os ambientes dulcícolas, habitat destas raias, são muito vulneráveis a fragmentação (barragens) e degradação (defensivos agrícolas, mineração). Devido a estes fatores, a criação de estratégias de manejo e conservação adequadas para estas espécies se fazem urgentemente necessárias. Dentro deste contexto, o presente estudo teve como objetivo realizar uma revisão sistemática da literatura pertinente à genética destas raias e apontar lacunas e direcionamentos para futuros estudos. Para tal, foi feita uma busca em plataformas de busca acadêmica (Google Scholar, Web of Knowledge) por trabalhos acadêmicos (artigos, dissertações e teses) relacionadas à genética e ao grupo de estudo. Os resultados obtidos foram compilados por: (1) ano de publicação/ defesa; (2) espécies estudadas; (3) área de amostragem, (4) área de conhecimento (i.e. taxonomia, evolução, citogenética e prospecção) e (5) técnicas aplicadas. Um total de 31 trabalhos acadêmicos abordando a genética de raias de água doce foram produzidos ao longo de 21 anos (1998-2019). Estes estudos abordaram 18 espécies (51% do total). Estas espécies foram distribuídas por todos os quatro gêneros do grupo: *Heliotrygon*, *Paratrygon*, *Plesiotrygon* e *Potamotrygon*. As conclusões inéditas obtidas e as lacunas de pesquisa identificadas serão apresentadas no evento e discutidas no contexto da sistemática e da conservação das raias de água doce neotropicais.

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Palavras chave: DNA, RNA, microssatélite, sequenciamento, citogenética.



EVIDENCE OF HYBRIDIZATION IN COWNOSE RAYS

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Cownose rays have an extremely similar external morphology, with dental plaque counting and specific morphometric traits being the most used characters for species differentiation. There are two species currently described in Brazilian coast, *Rhinoptera bonasus* and *Rhinoptera brasiliensis*. Besides overlap in areas of occurrence, there are records of coexistence in schoolings in southern and southeastern Brazil. The present work points to the possible existence of hybrid individuals. Both individuals analyzed in this study were incidentally caught by artisanal fishermen in the municipality of Matinhos Paraná State, southeastern Brazil. Both were photographed (dorsal view and dental plaque), measured (total length, disc width and head length) and weighed. The animals were captured on separate days, with specimen 01 captured along with *R. bonasus* individuals, and specimen 02 captured along with *R. brasiliensis* individuals. Both individuals have 9 rows of teeth, being the central row larger than the adjacent parallel rows, which may cause confusion in quick identification. Still, possible hybrid dentition has an intermediate shape between *R. brasiliensis* and *R. bonasus*. Regarding external morphology, the animals analyzed also exhibit an intermediate form of the cephalic lobes, as well as the pectoral fins. Regarding the reproductive aspects of cownose rays in Brazilian waters, little is known about copulation behavior, but there is a record of neonate's joint occurrence. When genetically distinct species coexist, reproduction between them might occur, which may lead to hybridization or even to speciation. In elasmobranchs, there are six records of hybrids, all with similar species that cohabit the same locality. Since both species differ in conservation status (*R. bonasus* listed as Data Deficient and *R. brasiliensis* listed as Endangered), it is imperative to confirm if it is in fact a hybridization case or if it might be a new species, thus updating national management plans for the genus.

Keywords: Cohabitation, Taxonomy, *Rhinoptera*, Species identification, Morphological Variations.



DENTITION OF BATOIDS ON THE AMAZON COAST

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Batoids inhabit several environments and have their morphology adapted to each one of them. This diversity is reflected in dentition, which also has many shapes and functions, and it is important to establish phylogenetic relationships and determine species. The aim of this study is to provide qualitative and quantitative analyses of the dentition of five batoid species (*Hypanus guttatus*, *Hypanus americanus*, *Fontitrygon geijskesi*, *Gymnura micrura* and *Pseudobatos percellens*) according to sex and stages of maturity. Forty one jaws were obtained of specimens caught in 2018 by artisanal fisheries from the coast of Maranhão, except four specimens caught in the state of Pará. The teeth rows in each jaw were counted and the teeth were analyzed on their shape and jaw position, using Zeiss stereomicroscope. Twenty jaws of *H. guttatus* were counted (males upper jaw range / lower jaw range and females upper/lower = immature: 32-42/ 39-47 and 36-44/42-48; mature: 34-42/43-53 and 41/48); one of *H. americanus* (male mature: 47-53); 8 of *F. geijskesi* (immature: 50-55/63-70 and 48-58/53-74; mature: 51-55/52-62 and 60/67); 11 of *G. micrura* (immature females: 79-89/70-80; mature: 65-85/60-72 and 115-152/99-100) and 2 of *P. percellens* (mature females: 72-92/75-100). Except *G. micrura* and *P. percellens*, the other species of this study exhibits monognathic and dignathic heterodonty, varying from the symphysis to the jaw commissures. The dentitions of *H. guttatus* and *F. geijskesi* showed ontogenetic variation and sexual dimorphism, although three specimens of large adult males of *H. guttatus* exhibit dentition of young stages, without a sharp cusp. This variation was not observed in *H. americanus* and *P. percellens* due to the absence of young specimens in the sample. One adult female specimen of *G. micrura* had teeth with two cusps, although the species haven't showed ontogenetic or sexual variation. All analyzed species indicated an increasing teeth number related to the size growth.

Keywords: teeth, heterodonty, jaws, elasmobranch.



ASPECTOS MORFOLÓGICOS DA DENTIÇÃO DA RAIAS DE ÁGUA DOCE *Potamotrygon motoro* DO LAGO DE VIANA-MA

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As raias de água doce *Potamotrygon motoro*, popularmente conhecidas como raias de fogo, pertencem à família Potamotrygonidae com ampla distribuição ao longo das bacias hidrográficas da América do Sul. A espécie é encontrada nas bacias dos rios Pindaré-Mearim em especial o Lago de Viana. O presente estudo foi desenvolvido com exemplares coletados no lago de Viana e capturados com espinhel de fundo entre agosto de 2017 e julho de 2018. Foram analisados os dentes de 17 exemplares de *Potamotrygon motoro*, 11 fêmeas (64,70%) e 6 machos (35,29%), com variações de largura do disco de 272 mm a 613 mm. *P. motoro* da bacia Pindaré-Mearim apresenta heterodontia monognática e dignática, dimorfismo sexual e números dentários expressivos que aumentam com o crescimento da espécie. O número de dentes da arcada superior teve média de 42,29 ($s = 6,02$), variando de 32 a 56 e o número de dentes da arcada inferior teve média de 45,24 ($s = 8,47$), variando de 32 a 64. Os dentes em exemplares adultos analisados apresentaram coroas relativamente pequenas e maciças, arranjadas em mosaicos em quincunx, imbricados com leve sobreposição. As fêmeas mostram dentes relativamente uniformes e semi-lisos ligeiramente arredondadas nas angulosidades que variam de tamanho e forma ao longo da arcada, apresentando coroas hexagonais e losangulares se alternando em três regiões distintas em cada lado da arcada. Por sua vez, os machos apresentam uma heterodontia monognática com dentes relativamente menores que os das fêmeas, com cúspides pronunciadas e pontiagudas, evidenciam diversificação no tamanho dos dentes ao longo da mesma arcada, mas não apresentam variabilidade na forma das coroas como observado em fêmeas.

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Palavra-chave: Chondrichthyes, Taxonomia, Endemismo.



TERATOGENIC ABNORMALITIES IN *Aetobatus narinari* AND NOTES ON ELASMOBRANCH MALFORMATION OVER THE LAST DECADE

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The characterization of teratogenic abnormalities in elasmobranchs is important since it allows the identification of frequency and severity, increasing our knowledge about this phenomenon for the group. Malformations can be lethal or only reduce an individual's capacity and are observed in both batoids and sharks. The aim of the present study was to report abnormalities observed in a female neonate of *Aetobatus narinari* incidentally caught by artisanal fishermen in Maranhão state, northern Brazil. In order to better understand the morphological changes observed, a survey of studies published in the last decade on congenital malformation was performed, with a total of 40 scientific articles that reported 65 malformation cases, excluding albinism. Radiographic images of the X-ray were made, as well as analysis of external and internal morphology. Results showed non-fused pectoral fins in the cephalic region and a pronounced thoracic curvature, characterizing kyphosis near the thoracolumbar synarcual and precaudal vertebrae. Considering the bibliographic survey, the most common malformations were in the cephalic region (craniofacial deformation - 69%), followed by fin abnormalities (pectoral fin not fused to the head - 52%). Females are more affected than males, and there are more reports of malformations in adults. To conclude, although both malformations observed in the Eagle ray are the most common among elasmobranchs, monitoring is needed as increased occurrences can be an efficient indicator of increased pollution in the region.

Financial support: FAPEMA.

Keywords: Malformation; Teratogenesis; Batoids; Southwestern Atlantic Ocean.



VARIABILIDADE MORFOLÓGICA E DENTIÇÃO DA RAIÁ DE ÁGUA DOCE *Potamotrygon rex* PARA O ALTO RIO TOCANTINS

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A espécie de raia de água doce recentemente descrita *Potamotrygon rex* ocorre exclusivamente no alto e médio rio Tocantins e não está distribuída de forma abundante quando comparada a outras espécies daquela região, como *P. orbignyi*, *P. henlei* e *P. scobina*. As coletas foram realizadas entre os anos de 2000 e 2013, em dois pontos, o rio Paranã, afluente do alto Rio Tocantins, no qual foram capturados 12 exemplares e o reservatório da hidroelétrica de Serra da Mesa, com mais 3 exemplares. Entre os aspectos que distinguem esta espécie das demais, sua coloração dorsal se destaca com um fundo marrom escuro a quase preto com manchas laranja amareladas, formando agrupamentos concêntricos ao redor de spots compostos em forma de coroa ou em arranjo vermicular se estendendo até as laterais da cauda. Espinhos surgem no dorso posterior à cintura pélvica aumentando rapidamente em número e tamanho de uma a três fileiras paralelas de espinhos que se estendem até a base do ferrão, estes são recurvados e amplos na base. Os dentes dessa espécie diferem em sua estrutura, a arcada dentária não é tão larga comparada a outras espécies da região, sua forma lembra a de uma parábola cuja abertura está para dentro da boca. Algumas linhas de dentes ficam expostas com a boca fechada, os dentes são achatados e hexagonais, em geral mais largos que longos; nas fêmeas os dentes são mais achatados, enquanto que em machos possuem coroas mais elevadas sem cúspides muito afiadas ou pontiagudas, mantendo o mesmo formato. Essa espécie possui aspectos bem distintos das espécies da região e um alto grau de endemismo, necessitando de cuidados precautórios, pois ocorre em áreas de forte represamento e pesca predatória.

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Palavras-chave: Taxonomia, Chondrichthyes, Endemismo.



Pseudobatos percellens SEXUAL DIMORPHISM: A CONSERVATION ALERT

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Pseudobatos percellens occurs all over the Brazilian coast, being commonly caught as bycatch in large volumes. Although currently listed as Data Deficient on the national list, if fishing pressure is not reduced, the species might soon be moved to threat categories. Since biological data are needed to determine its real conservation status, this work aimed to verify the existence of sexual dimorphism in the body shape of *P. percellens* caught by the artisanal fleet, in order to determine the biological patterns for each sex. Ten females and eight males were photo recorded in dorsal views. After digitalization of 15 anatomical landmarks and semi-landmarks, the coordinates were superimposed through Generalized Procrust Analysis to remove the effect of position, size (static) and orientation. To remove the influence of allometric size on the configurations, a Multivariate Regression of the shape components was performed in relation to the centroid size logarithm. Sexual dimorphism was tested by a cross-validated Discriminant Analysis using Multivariate Regression residuals. Our results demonstrate a significant variation in shape between sexes. Males have a thinner body than females (disc, scapular girdle, dorse and tail). In addition, the influence of allometric size was verified only for females, which indicates that their shape changes differently from males throughout the growth. Currently, there is no minimum catch size established for the species but considering the predetermined for the congener *P. horkelli*, gender differences regarding disc width are not taken into account, demonstrating a flaw in legislation as body size is directly related to sexual maturation and fertility. In view of our results, we emphasize the need to implement specific gender measures of minimum catch size for elasmobranchs in general. Finally, ontogenetic differences are also required, as nothing is known about the influence of body shape in the legal determination of size limits for capture.

Keywords: Geometric morphometry; Legislation; Minimum catch size; Brazilian guitarfish; Sexual dimorphism.



CATCH RECORD OF THE LARGETOOTH SAWFISH *Pristis pristis* (Linnaeus, 1758) IN BRAZILIAN AMAZON COAST

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The Brazilian Amazon Coast comprises a hotspot for elasmobranch conservation, due to its importance of richness and endemism. The Largetooth sawfish seems to be common in Amazonian coast but is considered a Critically Endangered cartilaginous species around the world. On the other hand, the artisanal fisheries contribute to the species population decrease in Brazilian waters, mainly due to the use of drift nets and non-compliance of the legislation. This study records an incidental catch of the Largetooth sawfish in Maranhão Gulf by artisanal fisherman. One exemplar was captured by fixed net localized at Perizes river mouth in February 2019, but only the rostrum was analyzed in the Laboratório de Organismos Aquáticos of Universidade Federal do Maranhão. The specimen was identified as *Pristis pristis* by the counting of the teeth and then the Total Length was estimated using the Standard Rostrum Length based on linear relationship to family Pristidae. The rostrum has 382 mm and the estimated Total Length attained approximately 151mm. This record highlights the presence of Largetooth sawfish near to urban zones, its continuous habitat loss and remaining captures.

Financial support: FAPEMA.

Keywords: Critically endangered, Pristidae, Maranhão Gulf, Arraial bay, conservation.



EVIDENCE OF CAPTURE-INDUCED DYSTOCIA IN A FREE-RANGING COWNOSE RAY, *Rhinoptera bonasus* (Mitchill, 1815)

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Capture and handling may impose sub-lethal consequences to elasmobranchs, even those that are quickly released to comply with regulations or voluntary conservation ethic. Dystocia is characterized by the physical inability to deliver the fetus even when ready for birth. So far, it has been reported only in captive cownose rays. Here we present data compatible with capture-induced dystocia in a free-ranging cownose ray. The pregnant female was incidentally caught by artisanal fisherman and landed already dead; by its dimensions the estimated age was around 17 years. The fetus was a male and was held in expected birth position. Both female and fetus had no *rigor-mortis* and blood was not coagulated, indicating a recent death. We believe that the dystocia was related to the stress caused by capture, indicating that his death was probably related to the lack of oxygenation caused by maternal death. In elasmobranchs, capture-induced abortion and premature birth are commonly observed in stressful situations. Here, probably due to advanced maternal age and fetus size, the female was not able to abort/release the fetus prematurely, leading both to death. Taken together, abortion and dystocia pose an extra challenge to conservation and species recruitment, with older females being even more vulnerable. That said, the assessment of sub-lethal effects of capture are necessary, since the efficiency of conservation measures such as compensatory release may be reduced.

Financial support: This study received financial support from Petrobras, through REBIMAR program.

Keywords: Capture stress; population recruitment; difficult birth; Myliobatiformes.



INFLUENCE OF MATERNAL STRESS ON HOMEOSTATIC MAINTENANCE AND OFFSPRING SURVIVAL IN *Zapteryx brevirostris*

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In elasmobranchs, sublethal reproductive effects caused by incidental capture such as abortion and premature birth are poorly understood and overlooked in management plans. The effects of abortion on captured pregnant *Zapteryx brevirostris* females were recently characterized, with all-embryo loss within 48 hours and subsequent maternal mortality after abortion. For reasons still unexplored, some females to perform premature birth, characterized by the expulsion of live neonates still not ready for extrauterine life. The present study aimed at verifying the effects of incidental capture on aborted or prematurely born offspring in order to understand the mechanisms and consequences of stress-induced uterine expulsion. Embryonic physiological changes are expected to be a consequence of maternal physiological challenges. Furthermore, individuals in better physical and metabolic conditions are expected to be more resistant to uterine expulsion and subsequent mortality. Live and dead pregnant females and their offspring caught incidentally by the artisanal fleet will be collected. In dead pregnant females, blood, uterine fluid and muscle samples as well as dead embryos will be taken. Live pregnant females will be monitored in the laboratory for 48 hours. In case of abortion, dead embryos will be sampled (blood and muscle tissue). In case of maternal mortality after trauma of fishery, blood and uterine fluid will also be collected. Females who survive abortions will have their blood collected and will be returned to nature. In order to evaluate the physiological status of females, secondary stress markers (urea, lactate, pH, osmolality, potassium, phosphorus) and indicators of physical and energetic condition (Fulton's condition factor, triglycerides and total cholesterol) will be analyzed in female's plasma, uterine fluid and muscle tissue. A pilot study was conducted in September 2018, and two pregnant females and ten dead embryos were sampled (five from each female). Average plasma urea in pregnant females was 366 mm, in uterine liquid was 440 mm and in the plasma of the embryos it was 640 mm. Average plasma triglycerides in pregnant females was 5.56 mm, in uterine liquid it was 14.2 mm and in plasma of the embryos it was 16.9 mm. These results indicate that, although the development is internal, the offspring may respond to stress differently than the mother, with uterine fluid being a possible isolation for physiological changes, acting as a buffer and keeping the litter in a more stable environment. However, the results are still preliminary and speculative, requiring further evaluation.

Keywords: physiology, abortion, embryo, reproduction.



SPECIES-SPECIFIC VULNERABILITY OF CAPTURE STRESS IN ENDEMIC AND/OR THREATENED WITH EXTINCTION CONGENER SPECIES

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Management measures proposed to reduce bycatch impacts, such as compensatory release, are promising tools for elasmobranch conservation. However, the stress of capture and handling may reduce the efficiency of these practices. On the coast of Paraná, incidental capture by artisanal fleet has great impact on local populations. An aggravating fact is the occurrence of endangered and/or endemic species in the region. Still, congeneric species with different conservation status are regularly caught, posing an extra challenge for conservation, since differences in stress responses may occur among congeners species. In that way, this study aimed to determine the physiological responses on the congeners *Rhinoptera bonasus*/*R. brasiliensis* and *Pseudobatos percellens*/*P. horkelii*. Sampling was performed in the municipality of Matinhos. The stress markers analyzed in plasma were urea, phosphorus, lactate, chloride and pH. For *Rhinoptera* spp., only *post-mortem* samples were analyzed. *R. brasiliensis* presented higher concentrations of phosphorus and lower concentrations of chloride compared to *R. bonasus*, but none of the analyzed parameters showed a significant difference, indicating that both respond to lethal stress similarly. For *Pseudobatos* spp. dead and live animals were analyzed. For dead animals of *P. horkelii*, higher plasma phosphorus concentrations were detected when compared to *P. percellens*. Among live *Pseudobatos* spp., no significant differences were found. *P. horkelii* showed higher concentrations of urea, chloride and lactate, while *P. percellens* showed greater variation in phosphorus, lactate and pH values, indicating greater tolerance and survival. When compared live and dead animals, *P. percellens* showed significantly higher lactate concentrations in dead animals. However, *P. horkelii* showed higher values in dead animals for phosphorus. These data indicate that there is specificity of stress responses, *P. horkelii* showed higher sensitivity than *P. percellens*, and this should be further considered in management plans, e.g. when fished by bycatch, *P. horkelii* must be released immediately, to avoid serious physiological damage that could lead to irreversible loss of homeostatic balance.

Keywords: Bycatch; Endemism; Endangered species; Capture Stress.



SUBLETHAL EFFECTS OF CAPTURE STRESS ON REPRODUCTION AND NUTRITIONAL STATUS IN *Zapterix brevirostris* MALES

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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 exhibits great representability in the bycatch of artisanal fishing, and it is currently classified as "Vulnerable" both in the national and in the IUCN red lists. 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 at evaluating the effects of capture during the reproductive period (RP) in males of *Z. brevirostris*. The animals were purchased at the disposal of artisanal fishing in Matinhos, State of Paraná, southern Brazil. Three experimental groups were established: control (21 live males outside the RP: NRP), condition 1 (26 live males inside the RP: LRP), and condition 2 (24 dead males inside the RP: DRP). Injuries, Fulton's condition factor (K), blood triglycerides, as well as plasma osmolality, Na⁺, Cl, urea, lactate, P₃₊ and K⁺ were assayed. Semen osmolality was also determined. Morphological alterations, such as intestinal eversion and flaring, were more common in RP groups. Low post-capture survival (39%) was observed during RP compared to the high survival rates reported outside RP (100%). Fulton's condition factor (K) and triglycerides were higher in males inside RP, with animals ~ 300 g leaner than those outside RP. Plasma urea and osmolality were lower in LRP than in other groups. In contrast, sodium and chloride concentrations were higher in LRP than in NRP and DRP. Lactate, phosphorus and potassium were higher in DRP than in NRP and LRP; values compatible with cell rupture and death. In DRP, semen was hyposmotic to plasma (p <0.001), indicating possible seminal alteration. Stress of capture during RP hamper survival capacity of males, inducing high mortality rates, morphological alterations, and metabolic/homeostatic imbalance. Management plans based on compensatory release should thus be adapted for this period. Still, stress during RP is different between males and females, indicating that management plans should consider sex, at least for the Lesser guitarfish. Last but not least, seasonal closures should be considered, since population recovery needs to be ensured for this endemic and threatened batoid, not only in the coast of Paraná, but in all its areas of occurrence.

Keywords: fisheries, bycatch, batoids, mortality, conservation.



THERMAL SIGNATURE OF NURSE SHARKS EXPOSED TO FISHING STRESS: EVIDENCE OF LINK BETWEEN HEAT DISPERSION AND PLASMA LACTATE CONCENTRATIONS

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The nurse shark (*Ginglymostoma cirratum*) is primarily a benthic, slow-moving, species found in the tropical and subtropical Atlantic Ocean. Due to its relatively sedentary habits and ability to respire while resting on the bottom via buccal pumping, this species exhibits the lowest metabolic rates among sharks. So, based on such peculiar metabolic profile facing capture, the present study aimed to determine heat dissipation from metabolic production for the assessment of fishing stress. Using thermal imaging we documented a consistent heat signature at nurse shark's lateral region independent of the environmental conditions at the day of capture. Allied to thermal data, we provide plasmalactate concentrations of each shark experimentally exposed. Our thermal results pointed to thermal differences related to body size and sex, both correlated with the time of exposure to air and direct solar radiation. Additionally, thermal profiles suggested the potential for nurse sharks to employ an enhanced muscular response detected by dissipation of heat in the region of greater muscular insertion (lateral portion). The low lactate levels assessed here indicate a link between the enhanced aerobic activity by the red musculature and a delayed anaerobic response, a feature that may help to characterize the robustness of the species facing capture. This data is imperative for comparative purposes, since the study of sedentary species can enhance understanding of stress responses that may help in the understanding of fishing impacts across shark's species.

Keywords: Conservation Physiology; Fishing Stress; Benthic Stress.



DAGGERNOSE SHARK: EVIDENCE OF HIGHER PHYSIOLOGICAL VULNERABILITY TO FISHING COMPARED TO OTHER SHARK SPECIES

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Isogomphodon oxyrinchus population status points to loss of up to 90% in the last decade, with declines at 18.4% per year and due to its biological traits, site fidelity and historical high representativeness as bycatch in artisanal fisheries, the species is listed as Critically Endangered (CR), both in the IUCN and the Brazilian Red Lists. When considering resilience, the species exhibit low scores, being classified as extremely vulnerable to fishing, a fact aggravated by the low genetic diversity observed. Such is the vulnerability that the chances of population recovery in the Brazilian Amazonian coast are only significant in a scenario in which fishing pressure is absent. In order to understand the high mortality rates exhibited by the species, this study aimed to evaluate the stress of capture in the Daggernose shark in a comparative analysis with other shark species - *Carcharhinus limbatus*, *C. porosus*, *C. leucas*, *Rhizoprionodon porosus*, *Ginglymostoma cirratum*, *Sphyrna lewini* and *Sphyrna tiburo*. Sharks incidentally caught by the artisanal fleet were measured, weighed and sexed. Blood samples were obtained and centrifuged for analysis of stress markers and systemic health on plasma. *Postmortem* approach already validated to sharks was used and only recently deceased individuals were sampled (e.g., no *rigor-mortis*, no blood coagulation and no ocular retraction). The results show that there are significant differences in homeostatic capacity for urea, creatinine, ALT/GTP, total cholesterol and triglycerides, indicating that the Daggernose shark has lower health scores. It is possible that this difference is related to the reduced ability to cope with the stress caused by capture and onboard handling. That way, management plans for the species need to consider this species-specific vulnerability in order to improve conservation actions to this Critically Endangered and endemic coastal shark.

Financial support: FAPEMA.

Keywords: Conservation Physiology; Stress Physiology; Endemic species; Critically; Endangered species.



METAL BIOACCUMULATION ESTIMATES IN AMAZONIAN COASTAL SHARKS

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Elasmobranchs are extremely vulnerable to anthropic activities due to their biological traits such as low fertility, long gestation periods and slow growth. Among the biggest threats, stand out overfishing, habitat degradation and pollution. Biomagnification observed in top predators makes sharks particularly vulnerable to trace metals exposure and toxicology studies are still scarce for the group. Therefore, the objective of this work was to quantify aluminum (Al), calcium (Ca) and phosphorus (P) in muscle samples of eight sharks from the Amazonian coast *Galeocerdo cuvier* (Perón e Le Sueur, 1822) (n=01), *Carcharhinus limbatus* (Valenciennes, 1839) (n=02), *Carcharhinus porosus* (Ranzani, 1839) (n=03), *Carcharhinus leucas* (Müller e Henle, 1839) (n=03), *Rhizoprionodon porosus* (Poey, 1861) (n=03), *Isogomphodon oxyrinchus* (Müller e Henle, 1839) (n=03), *Sphyrna lewini* (Griffith e Smith, 1834) (n=02) and *Ginglymostoma cirratum* (Bonnaterre, 1788) (n=03) incidentally caught by the artisanal fleet in São Luís, Maranhão, northeastern Brazil were donated to our research group and estimate metal concentrations across size classes (neonate, juvenile and adult), considering size at birth and size at maturity of each species. Muscle samples were digested by analytical techniques and metals were quantified by inductively coupled plasma optical emission spectrometry. Our results show that different than expected, in some species, the concentrations of Al (*C. porosus*, *I. oxyrinchus*, *G. cirratum*), Ca (*C. porosus*, *C. leucas*) and P (*C. leucas* e *G. cirratum*) are higher in juveniles compared to adults. For *G. cuvier*, *R. porosus* and *S. lewini*, the concentrations of all metals were lower in neonates, intermediate in juveniles and higher in adults. Neonates of all species had the lowest concentrations compared to juveniles and adults. These results indicate that juveniles may be more vulnerable to contamination, being necessary to take this difference into consideration in management plans. Still, results show that the biomagnification process does not always occur as expected.

Keywords: Elasmobranchs, Pollution; Anthropic activities, Ontogeny.



NEGATIVE IMPACTS OF BIOMAGNIFICATION ON AMAZONIAN SHARK'S SYSTEMIC HEALTH

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Environmental contamination by trace metals is among the most representative anthropogenic inputs nowadays. Marine contamination significantly compromises health, resilience and permanence of organisms in impacted areas, affecting ecological interactions and ecosystem dynamics. Despite the ecological importance of apex predators, the negative impacts of bioaccumulation and biomagnification in higher trophic levels remain unclear. Based on the hypothesis that the higher the trace metals concentration in shark tissues, the higher will be the imbalances observed, the present study aimed to analyze the concentrations of cobalt, copper, iron, mercury, molybdenum and nickel in four tissues (gill, muscle, liver and rectal gland) and their relationship with shark general health, through the assessment of plasma markers used to evaluate homeostatic capacity and systemic health. Additionally, the relationship was also tested to general physical condition (Fulton's condition factor) on juveniles versus adults and males versus females. Our results showed that high trace metal concentrations are directly related to alterations in the parameters tested. Also, differences between sexes and life stages were detected, indicating that biomagnification affect sharks at diferente physiological levels. Taken together, our results demonstrate that biomagnification does affect shark health and growth, and it is imperative that management plans consider the influence of pollution on coastal species conservation.

Keywords: Conservation Physiology; Ecotoxicology; Biomagnification; Sharks.



POST-MORTEM APPROACH AS AN ALTERNATIVE TO LETHAL SAMPLING FOR ELASMOBRANCH RESEARCH

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Traditionally, physiology studies on animal models require lethal sampling, as the tissue to be analyzed must be functional. In non-mammal aquatic animals, osmo-ionic balance as well as respiratory dynamics are sustained through the proper functioning of gills, kidneys, intestine, and rectal glands in elasmobranchs. Elasmobranchs are among the most endangered vertebrates today, so it is reasonable to use alternative methodologies that do not involve lethal sampling for scientific purposes. Still, despite promising reports in the literature, *post-mortem* studies are still scarce, with a knowledge gap regarding systemic functions after the moment of death. Based on this, the aim of this study was to test the use of gills of recently deceased elasmobranchs incidentally caught by artisanal fisheries in order to validate the *post-mortem* approach to evaluate the activity of Carbonic Anhydrase (CA), an enzyme of great importance for respiratory, acid-base and osmoregulatory balances. The samples were collected in Matinhos in Southern Brazil from January 2019 to May 2019. For *Pseudobatos percellens*, were analyzed 3 samples of individuals recently dead and 6 individuals approximately 6 hours after death. For *Hypanus guttatus* were analyzed 4 samples approximately 6 hours after death and 7 individuals approximately 12 hours after death. *P. percellens* individuals exhibited high enzymatic activity ~ 1 hour (26,8/mg) and 6 hours (24,9/mg) after dead, with no significant differences between times. Curiously, another species, *H. guttatus*, exhibited CA activities of 22.7/mg in 6 hours after death, and higher activity 12 hours after death: 29.4/mg. These results suggest that CA remains in its native and active state, even hours after the death of these animals, as previously noted also for other studies with plasma constituent. Besides that, physiological responses in dead animals are deeply related to the time necessary to dissipate stored energy.

Keywords: elasmobranch; physiology; enzymatic activity; *post-mortem*.



ENTEROBACTERIA ASSOCIATED TO LONGNOSE STINGRAY *Hypanus guttatus* FROM BRAZILIAN AMAZON COAST

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Microorganisms are naturally present in the marine environment, and their ecological relationship with another organisms is inherent. The aim of this study is isolate and identify enterobacteria associated to the Longnose stingray *Hypanus guttatus*. Specimens were obtained directly from fishing landing in July 2019 and taken to Laboratório de Organismos Aquáticos da Universidade Federal do Maranhão. After smearing cloacal samples of 13 individuals, the material was sent to Laboratório de Referência Nacional para Enteroinfecções Bacterianas of Fundação Oswaldo Cruz according to their own methodology. The results showed presence of the follow enterobacteria: *Klebsiella pneumoniae*, *Citrobacter freundii*, *Aeromonas caviae*, *Serratia sp.*, *Pseudomonas aeruginosa*, *Aeromonas veronii* bv. *veronii*, *Proteus mirabilis*, *Aeromonas sobria* e *Vibrio gazogenes*. *Klebsiella pneumoniae* was present in all samples following *C. freundii* (38,5%), *A. caviae* (15%), *Serratia sp.* (46%), *P. aeruginosa* (46%), *A. veronii* bv.*veronii* (23%), *P. mirabilis* (23%), *A. sobria* (30%) and *V. gazogenes*, were found in only one sample. For all samples, the results were negative to *Salmonella* spp. and pathotypes of *Escherichia coli*. Thus, this is the first study that presents an analysis of the enterobacteria diversity of the *H. guttatus* from Amazonian Coast.

Financial support: FAPEMA.

Keywords: Microbiota, digestive tract, ecological relationship.



FROM HEAVEN TO HELL? INSIGHTS ABOUT CAPTURE STRESS IN SPINY ANGELSHARK (*Squatina guggenheim*, MARINI 1936) AND HIDDEN ANGELSHARK (*Squatina occulta*, VOOREN & SILVA, 1991)

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Squatiniformes sharks are considered relics, having more than 120 million years in their evolutionary history. However, their successful historical background has not prevented their present insertion in the list of animals threatened with extinction, being currently listed as “Critically Endangered”. These sharks are highly threatened due to their historical overexploitation coupled with the high appreciation of their meat by fishing communities, as in Paraná (i.e. Matinhos, Pontal do Paraná, Guaratuba). Also, due to their benthic habit and site fidelity, these animals become particularly vulnerable to incidental capture. Post-capture survival rates as well as stress responses and sublethal effects of capture are unknown to angelsharks, so these data are necessary for the creation of management plans. That said, the present work aimed at characterizing the stress caused by the capture with gillnets in two species commonly captured by the artisanal fleet. Four dead *Squatina guggenheim* and one live *Squatina occulta* were landed between May and September 2018. These animals were weighed, measured and sexed. Also, plasma samples were collected for physiological analysis (phosphorus, magnesium, chloride, glucose, urea, lactate, triglycerides, total cholesterol). All sharks were females; total length average (TL) was 66.40 cm (SD±10.48 cm), and weight average was 2,486 g (SD ± 1.040). Results showed that plasma concentrations of phosphorus, magnesium and chloride averaged 0.5 mM, 4.6 mM and 502 mM in both species. Plasma concentrations of glucose, urea, lactate, triglycerides and total cholesterol were 134 mM, 571 mM, 14.8 mM, 510 mM and 47mM, respectively. The live animal (*S. occulta*) presented values close to the dead (*S. Guggenheim*) for these parameters and for the ions. However, the high lactate value observed in the living individual, of 24 mM, indicated that the live *Squatina occulta* was moribund and near death. This species appears to be more resistant to capture stress than its congeneric *S. guggenheim*. Thus, further samples need to be obtained in order to understand the capture stress response and the basic biology of angelsharks so that management plans can be established for the genus.

Keywords: elasmobranch, conservation, stress physiology, fishery.



METANÁLISE DE CONCENTRAÇÕES TOTAIS DE MERCÚRIO EM TECIDOS MUSCULARES DE TUBARÕES E SEUS EFEITOS NA SAÚDE HUMANA

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O mercúrio é um elemento químico não-essencial e sem função fisiológica conhecida, podendo causar danos mesmo em baixas concentrações. Considerando a persistência e toxicidade desse metal no ambiente, torna-se de extrema preocupação a bioacumulação e/ou biomagnificação ao longo da cadeia trófica. Os tubarões, além de predadores de topo, apresentam algumas características que favorecem o processo de biomagnificação, tais como: crescimento lento e grande porte. Assim, o consumo desses animais representa uma das principais vias de exposição humana ao mercúrio (Hg). Diante essa problemática, este estudo objetivou destacar as concentrações totais de Hg em tecidos de tubarões analisados entre 2009 a 2019. Foram realizadas buscas nas bases de dados *Pubmed* e *Bireme*, pelos descritores “mercúrio em tubarões” e “mercury in sharks”. 24 artigos científicos foram selecionados, sendo identificadas 54 espécies de tubarões com mercúrio no tecido muscular. As concentrações variaram de 0,09 mg/kg a 1556,77 mg/kg. Destacamos as concentrações de Hg das espécies que apresentam ocorrência no Litoral Amazônico brasileiro: *Carcharhinus porosus* (1556,77 mg/kg), *Sphyrna lewini* (326,1 mg/kg), *Carcharhinus obscurus* (10 mg/kg), *Carcharhinus limbatus* (6,85 mg/kg), *Carcharhinus obscurus* (5,86 mg/kg), *Carcharhinus falciformis* (5,26 mg/kg), *Carcharhinus plumbeus* (5,1 mg/kg), *Galeocerdo cuvier* (4,17 mg/kg) e *Carcharhinus leucas* (3,09 mg/kg). Os resultados demonstram que o consumo representa um risco a saúde humana. Assim, esforços na redução das emissões de mercúrio para o ambiente e a redução de consumo de tubarões são fundamentais para a prevenção de intoxicação alimentar.

Keywords: Metal pesado, Intoxicação, Litoral Amazônico, Bioacumulação.



IMMATURE SHARKS AND RAYS, AN IMPORTANT COMPONENT OF THE ARTISANAL ELASMOBRANCH COASTAL FISHERY OF MARANHÃO

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The artisanal coastal fishery along the state of Maranhão has been the subject of studies since the decade of 1980's, but most recently has presented an increased alarming concerned the high number of endangered species. In order to evaluate the composition of the catches by artisanal medium sized boats, four cruises by a local artisanal boat with 10 meters long, an engine with 75 Hp (horse power) and fishing with nets for *Scomberomorus brasiliensis* were followed in 2018. The total elasmobranch catches consisted of 34 specimens in 8 different species with sexual proportions not significantly different from the expected 50-50% for each species. The catch composition was significantly different in all four cruises; first cruise with predominance of *Hypanus guttatus* (n = 7; 330-723 mm disc width-DW, four immature and three mature) and *Rhizoprionodon porosus* (n = 4; 689-798 mm total length-TL, three mature males and one immature female); second cruise with only two specimens, one *H. guttatus* (580 mm DW, mature male) and one *Sphyrna mokarran* (103 mm TL, immature female); third cruise with *Rhinoptera bonasus* (n = 7; 814-836 mm DW, all mature); and fourth cruise with *Carcharhinus porosus* (n = 11; 330-780 mm TL, only one mature male). Other species such as *Carcharhinus leucas* (1640,0 mm TL, immature female), *Mobula hypostoma* (106,9 mm DW, immature female) and *Hypanus americanus* (710 mm DW, mature male) presented occasional singular records. The total number of immature specimens represented 55% of the catch, with higher proportions in *C. porosus* and *H. guttatus*, where immature specimens represented 91 and 57%, respectively. These high rates of immature specimens bring concern on the future conservation of these species along the Amazonian coast.

Keywords: Risk, Depletion, Chondrichthyes



DIAGNÓSTICO DA ESTRUTURA POPULACIONAL DE *Rhizoprionodon porosus* NA COSTA AMAZÔNICA MARANHENSE NOS ÚLTIMOS 20 ANOS

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A captura acidental de espécies de elasmobrânquios ocorre historicamente ao longo do litoral amazônico devido a intensa atividade da frota pesqueira artesanal, principalmente direcionada ao peixe-serra (*Scomberomorus brasiliensis*) e à pescada amarela (*Cynoscion acoupa*). O presente estudo objetivou avaliar a estrutura populacional de *Rhizoprionodon porosus* a partir do desembarque da frota pesqueira que tem como alvo o peixe-serra no município de Raposa, estado do Maranhão. Um total de 303 exemplares foi capturado entre janeiro e dezembro de 1998 e entre maio a novembro de 2002, configurando no primeiro e segundo períodos de pesquisa deste estudo, enquanto 106 espécimes foram capturados entre setembro de 2010 e maio de 2012, correspondendo ao terceiro período estudado. Os resultados mostraram capturas de 229 machos (75,57%) e 74 fêmeas (24,42%) nos primeiro e segundo períodos, e 100 machos (94,34%) e 06 fêmeas (5,66%) no terceiro período. Destes, foram observados machos 37,8% jovens e 62,2% adultos e fêmeas 55,4% jovens e 44,6% adultas, nos primeiro e segundo períodos, e machos 7% jovens e 93% adultos e fêmeas 83,3% jovens e 16,7% adultas, no terceiro período. A proporção sexual (machos: fêmeas) encontrada foi de 3,09:1, nos primeiro e segundo períodos, e 16,67:1, no terceiro período. Quanto a amplitude de comprimento, observou-se os tamanhos máximos dos machos de 104 cm, no primeiro e segundo períodos, e 90,5 cm, no terceiro período, enquanto para as fêmeas foi registrado 96,3 cm e 89,4 cm, respectivamente. Os valores do Índice Hepatosomático começam a aumentar a partir do mês de julho, enquanto o Índice Gonadosomático tende a aumentar a partir do mês de setembro em todos os períodos amostrais, configurando que o período reprodutivo da espécie *R. porosus* ocorre durante o segundo semestre. O fator de condição reduziu proporcionalmente ao longo do tempo, apresentando valores menores e variações ao longo do ano semelhantes.

Keywords: fauna acompanhante, dinâmica populacional, elasmobrânquios. 105



FROM PLENTIFUL TO CRITICALLY ENDANGERED: DEMOGRAPHIC EVIDENCE OF THE FISHERIES IMPACT ON THE SMALLTAIL SHARK (*Carcharhinus porosus*) FROM NORTHERN BRAZIL

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The smalltail shark, *Carcharhinus porosus*, was the most abundant species of elasmobranch in fisheries on Brazil's northern coast in the 1980s, but its population has been declining since the 1990s. For this reason, a demographic analysis is necessary to determine the reasons for this decline. Here, we perform a demographic analysis of the population in its global center of abundance. Specimens of *C. porosus* ($n = 1,128$) were collected with gillnets in Maranhão state during in the 1980s with sizes ranging between 29.6 and 120 cm total length. Most individuals (90.6%) captured were juveniles (< 6 years-old), and the mortality and exploitation rates demonstrated that the species was overexploited (97.6% above the sustainable fishing mortality threshold). The biological characteristics of *C. porosus*, such as slow growth and low fecundity, show that it is one of the least resilient species among similar sized coastal sharks. All these factors yielded a decrease of -0.282 in the intrinsic population growth rate, resulting in a population decline of more than 90% in just 10 years, and much higher than this for the current period. With the fishing recruitment occurring upon juveniles, the population could not sustain the fishing pressure and biological recruitment was severely hampered, thus causing this severe population decline. Furthermore, several local extinctions for this species in the northeastern and southeastern regions of Brazil highlight its concerning conservation scenario. Therefore, *C. porosus* fits the IUCN red list criteria for a critically endangered species and urgent conservation measures are needed to prevent its extinction in the near future.

Keywords: Coastal shark; demographic analysis; fisheries; shark conservation.



HABITAT USE OF THE SMALLTAIL SHARK *Carcharhinus porosus* (RANZANI, 1839) FROM NORTHERN BRAZIL INFERRED FROM VERTEBRAE MICROCHEMISTRY ANALYSIS

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Sharks are among the most endangered and data poor vertebrates in the world. The lack of information regarding their habitat use is especially concerning since these are crucial for the elaboration of management measures and establishment of priority areas for species conservation. Investigating the trace elements present in shark vertebrae has become an interesting tool to analyze species habitat use patterns over individual's lifetimes. Therefore, the present study aimed at using vertebrae microchemistry to investigate the habitat use patterns of *Carcharhinus porosus* in Brazil's Northern Coast (BNC) – its global center of abundance. Vertebrae from seventeen individuals sampled in the 1980s (n=8) and in between 2017 and 2018 (n=9) were analyzed through laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Five elements known to reflect environmental characteristics (Ba, Ca, Mg, Mn, and Sr) were read and analyzed by sex and life stages. Significant differences in element concentration were found solely between sexes. Furthermore, when evaluating the multi-element neonate signature between individuals, four major clusters were obtained, thus suggesting that the species has at least four birthing grounds in the area. In addition, the occurrence of adult individuals with different neonate signatures throughout Maranhão state's coast corroborates the existence of a single population in the area. Finally, the results reinforce the hypothesis that the BNC is likely a nursery for the species, and thus a critical area for its conservation.

Keywords: Carcharhinidae; Brazil's Northern Coast; movement ecology; vertebrae trace elements.



IS THE SHARPSNOUT STINGRAY MOODY? HOW ENVIRONMENTAL FACTORS INFLUENCE THE CAPTURES OF *Fontitrygon geijskesi*

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The Amazon coast has two well-demarcated seasons that rule the fishing harvest throughout the year, dry and rainy. During the rainy season, the salinity levels decrease and the euryhaline fishes approach to the coast, while in the dry season, the opposite occurs, and marine fishes are more abundant. The euryhaline species *Fontitrygon geijskesi* is endemic to the Brazilian Northern coast and can tolerate these usual abiotic variations in the Amazonian environment. The present study aims to investigate the influence of abiotic factors on the behavior of this stingray species by monitoring the artisanal fishing in the state of Pará in 2011 and 2012. During this period, 14 specimens of *F. geijskesi* were recorded (Mean \pm SD = 490.7mm DW \pm 251.7), including 8 males with discs width range between 215 and 670mm DW and 6 females between 215 to 930mm DW. The catches occurred from 1:00 am to 15:00 pm, at low tides ranging between 0.1 and 0.6m, environmental temperature from 26.5 to 31.6oC, water temperature from 26.6 to 31.4oC, dissolved oxygen varying between 7 and 8 mg/l, pH between 7.5 and 8, and rainfall between 0 and 1.1mm. Salinity is the most influential parameter for the different stages of development: 1) neonates were caught only at low salinity conditions (12-13); 2) the young specimens tolerate large amplitude (13-48); 3) the subadults and adults prefer high levels of salinity (38-46), except one male that was caught at salinity 13. The moon phases seem to influence the capture of all stages since 78.6% of sample was caught in the full moon phase. A pregnant female was caught in dry season at full moon phase and salinity 38, with an egg in its left uterus.

Keywords: salinity, temperature, rainfall, moon phases, artisanal fisheries.



POTENTIAL DISTRIBUTION OF THE SMALLTAIL SHARK *Carcharhinus porosus* INFERRED FROM SPECIES DISTRIBUTION MODELS

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Updated distribution ranges are crucial for conservation status assessments. Comprehensive analyses combining published literature and available data on historical catch trends and species distribution models (SDMs) are effective tools that could improve the prediction of more realistic scenarios for some species, especially those with limited information available and facing multiple threats. The present study aimed at generating an updated distribution for *Carcharhinus porosus*, providing estimates for the key areas for its conservation based on the SDMs, and estimate population trends from published historical catch data from Mexico, Guyana, and northern Brazil. Four algorithms (BIOCLIM, Domain, Mahalanobis, and Maximum Entropy) were used to model the distribution of *C. porosus* and calculate its habitat suitability based on marine environmental variables. The SDM results suggest that the Northern Coast of South America (NCSA) harbours the most suitable habitats for *C. porosus* in the world, which was expected given its historically high catch rate in this region. Therefore, the NCSA should be considered the currently most important area in the world for this species conservation. Furthermore, the lack of data throughout Central and South American marine regions hampers the evaluation of extinction risk throughout its updated distribution and research in these areas is urgently needed for a more comprehensive assessment.

Keywords: coastal shark; conservation evaluation; distribution; modelling.



ANÁLISE DOS CONTEÚDOS ESTOMACAIS E IDENTIFICAÇÃO DO NÍVEL TRÓFICO EM RAIAS DE ÁGUA DOCE *Potamotrygon motoro* NOS LAGOS DE VIANA, MARANHÃO

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As raias brasileiras do gênero *Potamotrygon* são exclusivamente dulcícolas e o Brasil apresenta a maior diversidade de espécies no mundo. O gênero *Potamotrygon* apresenta ampla distribuição na América do Sul, distribuído nas bacias Amazônica, Paraná-Paraguai e Orinoco, com alguns casos de espécies isoladas em pequenas bacias e rios, como as raias das bacias do Parnaíba, Pindaré-Mirim e do sistema lagunar de Viana. O presente estudo foi desenvolvido no lago de Viana, localizado no município de Viana na microrregião da Baixada Maranhense, com base em coletas realizadas entre 2018-2019, com pesca de espinhel. Foram analisados 27 exemplares de *Potamotrygon motoro*, 20 fêmeas (74,93%) e 7 machos (25,93%). Com o objetivo da identificação do perfil trófico das raias de água doce ocorrentes nos lagos de Viana a fim de se responder quais organismos são frequentes na alimentação natural desses animais. Este trabalho emprega a abordagem de praxe (IIR) em estudos de alimentação de peixes cartilagosos visando elucidar quais componentes tróficos são mais relevantes na dieta das raias e o cálculo do posicionamento trófico. A análise do conteúdo estomacal foi feita com base na identificação, ao menor táxon possível, de cada item, sua porcentagem numérica (%N), porcentagem em peso (%P) e porcentagem da frequência relativa de ocorrência (%FO), e o nível trófico segundo Cortés, 1999. Todos os estômagos foram pesados e identificados com lacre, abertos mediante um corte latitudinal, e após a realização das análises qualitativas e quantitativas necessárias, as amostras foram fixadas em formal a 10%. Neste estudo identificamos que a alimentação das raias *P. motoro* encontradas nos lagos de Viana, se baseia principalmente em peixes (presentes em 88,88% dos estômagos), caracterizando como ictiófaga, a presença de uma ampla diversidade de itens considera a espécie oportunista e generalista. Apresentou alto nível trófico e forte interação com a pesca na região, além de não apresentar variação de itens alimentares por sexo, nível de gestação e época do ano. Em relação a interação com a pesca faz-se urgente a elaboração de políticas públicas que procurem diminuir o impacto da interação com a pesca, e ações de conservação da raia na região.

Palavras-chave: Potamotrygonidae, Pindaré-Mirim, Alimentação.



DIETA AMAZÔNICA: HÁBITO ALIMENTAR DE *Rhizoprionodon porosus*

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O presente estudo teve o objetivo de descrever o hábito alimentar de *Rhizoprionodon porosus* no litoral maranhense, para compreender as relações ecológicas com diversidade biológica local e o uso do habitat por se tratar de uma espécie de tubarão costeiro de pequeno porte distribuída ao longo de toda a costa brasileira. Foram analisados estômagos de *R. porosus* capturados pela pesca artesanal em três períodos, sendo o primeiro de janeiro a dezembro de 1998, o segundo período de maio a novembro de 2002 e o terceiro período de setembro de 2010 a maio de 2012. No primeiro e segundo períodos, um total 381 indivíduos foram analisados, dos quais 134 (35,17%) estômagos estavam vazios e 247 (64,83%) estômagos continham itens alimentares. No terceiro período analisado, cerca de 14 (13,21%) estômagos estavam sem alimentos e 92 (86,79%) estômagos com itens alimentares. Todos os itens alimentares foram analisados e identificados até o menor táxon possível e a maior frequência de ocorrência foi representada pelo item “peixe ósseo”, correspondendo a 52,98% entre o primeiro e segundo períodos e 72,83% no terceiro período. Ascídias (0,75%) e moluscos (17,91%) estiveram presentes no primeiro e segundo períodos. Crustáceos estiveram presentes ao longo de todo o estudo, perfazendo no 17,91% dos itens no primeiro e segundo períodos e no terceiro período 3,26%. Extraordinariamente, sementes foram encontradas no terceiro período, correspondendo 8,70%. Foi possível identificar as espécies de peixes *Anchoa spinifer*, *Cetengraulis edentulus*, *Eucinostomus* sp., *Macrodon ancylodon*, *Nebris microps*, *Ogcocephalus verpetilio*, *Peprilus paru*, *Sphoeroides testudineus*, *Stellifer naso*, *Stellifer* sp., *Trichiurus lepturus* e as espécies pertencentes a ordem Elopiformes, e das famílias Muraenidae, Clupeidae e Ariidae. Portanto, considerando-se a identificação de 15 espécies de presas, conclui-se que a espécie possui alta amplitude de nicho e comportamento alimentar generalista, contudo a presença de sementes mostra que a espécie possui hábito de forragear em locais costeiros como em ambientes estuarinos com cobertura de vegetal que parece ser o próprio manguezal.

Keywords: espectro trófico, ecologia alimentar, tubarões.



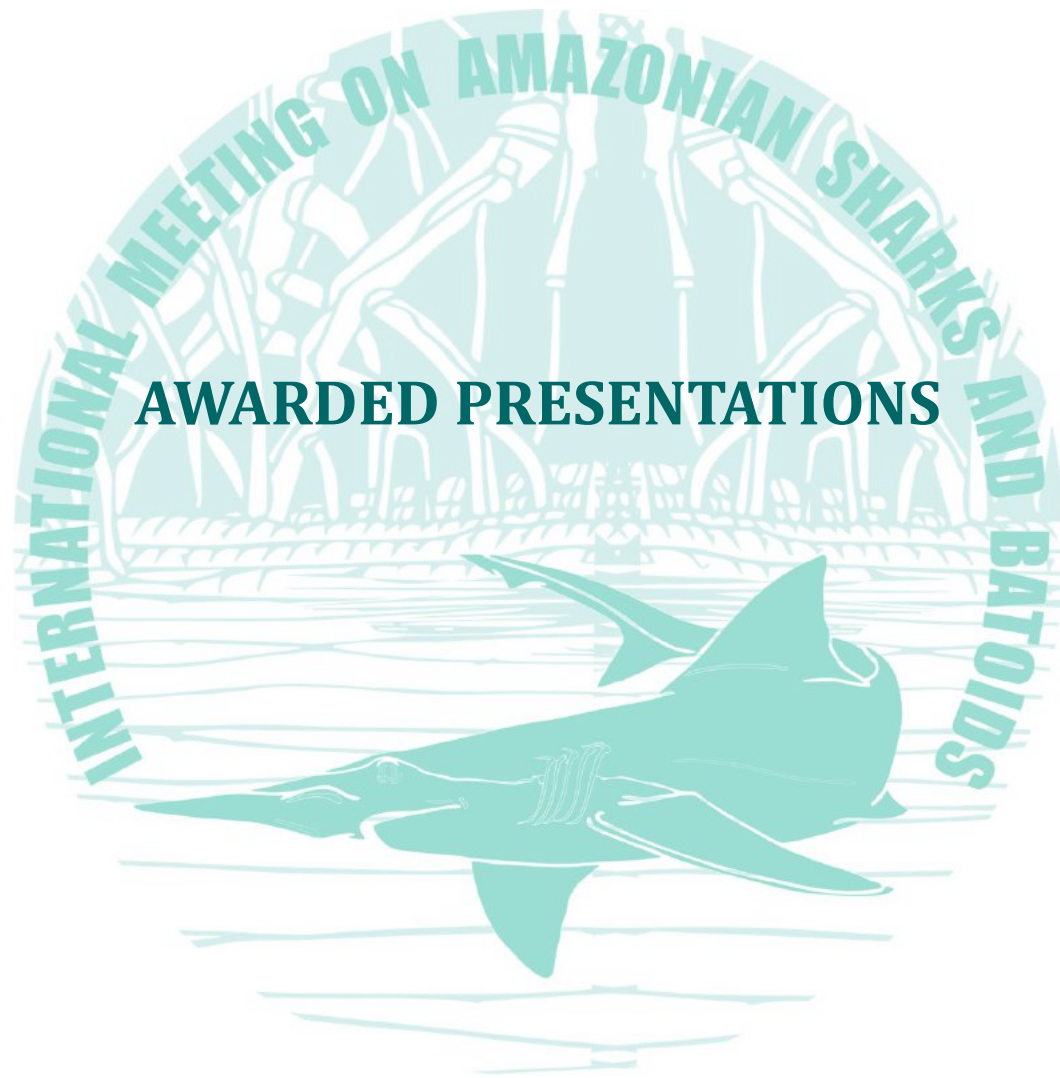
MICROPLASTIC ACCUMULATION ON THE LONGNOSE GUITARFISH, *Hypanus guttatus* FROM MARANHÃO GULF

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The oceans have been exposed to intense anthropogenic activities, resulting in environmental degradation and billions of tons of solid waste, with plastic debris being a matter of growing concern. Microplastics are found not only in the water column, but also deposited in large quantities on the substrate. Thus, benthic organisms become particularly vulnerable to accumulation, given their intense dependence on the substrate. This study aimed to evaluate the accumulation of microplastics in *Hypanus guttatus*, a benthic ray distributed throughout the Maranhão Gulf. The contents of the stomach, gills and tegument of 23 stingrays were analyzed. The studied specimens were obtained through fishermen acquisition in Porto da Raposa from August 2018 to March 2019. A total of 19 particles were identified in the stomach content of 9 individuals, no items were found in the gills and integument. All plastics found were categorized into microplastics (<5 mm) and were divided into five categories according to color and frequency: blue (42%), transparent (32%), black (16%), orange (5%) and red (5%). Our results demonstrate that, although still observed only in stomach content, microplastic contamination is already a reality for species in the state of Maranhão, being necessary to evaluate the potential accumulation in other benthic elasmobranchs, as well as to compare the presence and frequency between benthic species and pelagic.

Keywords: Marine litter, Longnose stingray, Brazilian Amazon Coast.



AWARDED PRESENTATIONS

AWARDED ORAL PRESENTATION

STUDENT

ONDE ESTAMOS E PARA ONDE VAMOS? A GENÉTICA DAS RAIAS DE ÁGUA DOCE (POTAMOTRYGONINAE, MYLIOBATIFORMES)

Yan Torres¹, Thiago L. Matos¹, João Eduardo P. de Freitas¹,
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PROFESSIONAL

GUARDIÕES DO MAR: ESCOTEIRISMO E EDUCAÇÃO AMBIENTAL A SERVIÇO DA CONSERVAÇÃO DE TUBARÕES E RAIAS

Jorge Luiz Silva Nunes¹;
Ana Rita Onodera Palmeira Nunes¹

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AWARDED POSTER PRESENTATION

STUDENT



***Pseudobatos percellens* SEXUAL DIMORPHISM: A CONSERVATION ALERT**

Renata Daldin Leite¹, Natascha Wosnick¹,
Carolina Arruda Freire¹

¹Universidade Federal do Paraná, Curitiba, Brazil – daldin.r@gmail.com.



PROFESSIONAL

THERMAL SIGNATURE OF NURSE SHARKS EXPOSED TO FISHING STRESS: EVIDENCE OF LINK BETWEEN HEAT DISPERSION AND PLASMA LACTATE CONCENTRATIONS

Natascha Wosnick¹, Jacob Jerome², Yuri Niella³, Carlos Navas⁴,
Carolina Arruda Freire¹, Emygdio Monteiro-Filho¹, Neil Hammerschlag⁵

¹Programa de Pós-Graduação em Zoologia. Universidade Federal do Paraná n.wosnick@gmail.com; ²Field School; ³Department of Biological Sciences. Macquarie University; ⁴Instituto de Biociências. Universidade de São Paulo; ⁵Rosenstiel School of Marine and Atmospheric Science. University of Miami.

DNA BARCODING REVELA ESPECIAÇÃO CRÍPTICA DENTRO DO GÊNERO RHINOPTERA VAN HASSELT, 1824 ATLÂNTICO SUL OCIDENTAL

João Braullio de L. Sales¹; Thaissa Alves de Lima²; Tarcisio Augusto Costa³; Suellen Gales Serrão¹;
Vanessa P. Cruz⁴; Matheus M. Rotundo⁵; Jonathan Ready¹; Luis Fernando S. Rodrigues-Filho⁶

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PHOTO CONTEST

“BEAUTY BEHIND THE BEAST”

CONTEST RULES

INTERNATIONAL MEETING ON
AMAZONIAN SHARKS AND BATOIDS

CONCURSO DE FOTOGRAFIA



Foto: Veturlio Rincón

**Centro de Criatividade Odylo Costa Filho
(Centro Histórico)**

“A BELEZA POR TRÁS DA FERA”

**20 fotos selecionadas para a exposição
com certificado**

(Fotos artísticas de autoria do participante)
***regras no Ig @geem.2019**




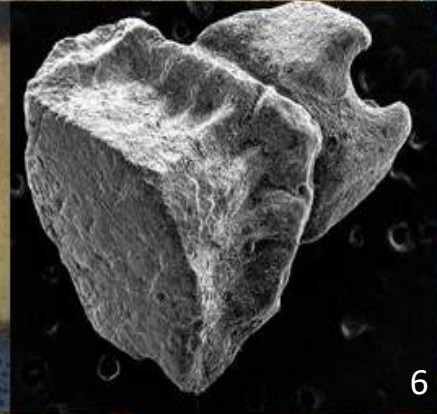
INTERNATIONAL MEETING ON
AMAZONIAN SHARKS AND BATOIDS

Concurso de Fotografia “A BELEZA POR TRÁS DA FERA”

REGRAS

1. Serão selecionadas 20 fotos de tubarões, raias e quimeras para a exposição no Centro de Criatividade Odylo Costa Filho, com certificado de exposição para os autores;
2. Das 20 selecionadas, uma delas será escolhida por artistas visuais para ser a capa da edição especial de Chondrichthyes do Boletim do Laboratório de Hidrobiologia;
3. Apenas participantes inscritos no congresso poderão enviar fotos e participar do concurso;
4. Dois temas serão aceitos - ANIMAIS NA NATUREZA e FOTOS ANATÔMICAS E DE ESTRUTURAS;
5. A foto deve possuir até 2MB de tamanho e obrigatoriamente 300dpi;
6. A captação das fotografias independe do equipamento utilizado, podendo ser câmeras fotográficas, celulares ou outros;
7. As fotografias não poderão ser editadas, salvo correções básicas de saturação, exposição, cor, etc;
8. Cada participante pode submeter até duas fotos (duas na mesma categoria ou uma em cada categoria);
9. As fotos devem ser salvas em jpeg ou png e o nome do arquivo deve ser: NOME DO AUTOR_CATEGORIA (natureza ou anatômica);
10. Cada foto deve possuir um título e legenda (em Português) que devem ser encaminhados no corpo do e-mail juntamente com as fotos no seguinte endereço (amazonianelasmobranchs@gmail.com)
11. O concurso será encerrado no dia 05 de Setembro às 00:00h no horário de Brasília, não sendo aceitas fotos após este período
12. O candidato se compromete a participar apenas com fotografias de sua autoria, sendo o único responsável por quaisquer violações a direitos autorais e de imagem que tenham repercussão na esfera cível e criminal;
13. O candidato garante que, havendo imagens de outras pessoas ou marcas de estabelecimentos comerciais em suas fotografias, todas foram devidamente autorizadas, mediante assinatura de Termo de Autorização de Uso de Imagem;
14. O Termo de Autorização de Uso de Imagem exigido no item anterior será dispensado nos casos em que a fotografia contenha imagens de grupos indiscriminados de pessoas, não sendo possível identificar cada indivíduo;
15. As 20 fotos selecionadas poderão ser utilizadas para futuros produtos e mídia do GEEM por meio de um termo de autorização de uso de imagem.







“BEAUTY BEHIND THE BEAST”

AUTHORS AND TITLES

1 Title: “Cidade das Raias”

: A Cidade das raias é um banco de areia localizado nas Ilhas Cayman – Caribe. É um importante ponto turístico de região, onde pessoas podem mergulhar com raias em seu habitat natural. Após a morte de Steve Irwin por uma ferroada de *Dasyatis* spp. (espécie da foto), o medo se alastrou, fazendo com que muitas pessoas vissem raias como vilãs, assim como os tubarões. Dito isso, pontos de mergulho que permitam a interação ética e fiscalizada são de extrema importância, pois reforçam a importância do ecoturismo para a conscientização e consequente conservação destes animais.

Author: Natascha Wosnick

2 Title: “Banho de Sol”

Subtitle: Fêmea de *Zapteryx brevirostris* aguardando o momento da soltura compensatória na praia de Matinhos - PR.

Author: Renata Daldin Leite

3 Title: “Com o rosto para o sol”

Subtitle: *Pseudobatos percellens* (Walbaum 1792). Exemplar capturado por Indígenas de la Etnia Warao, en la desembocadura del Caño Macareo, Delta del Río Orinoco, Venezuela.

Author: Oscar Lasso Alcalá

4 Title: "Por que cação-de-esporão?"

Subtitle: Na minha pesquisa de mestrado, uma das perguntas feitas aos pescadores do sul da Bahia era porquê eles denominavam os tubarões do gênero *Squalus* de cação-de-esporão. Táí o porquê.

Author: Márcio Vargas

5 Title: “Resiliência”

Subtitle: *Zapteryx brevirostris* é uma espécie extremamente robusta, e essa força e resiliência também são observadas em sua prole. Seus filhotes já demonstram adaptações impressionantes mesmo em estágios iniciais de desenvolvimento. Desde muito pequena essa raia já possui uma gana em sobreviver.

Author: Aline Prado

6 Title: “Dente de raia de água doce”

Subtitle: foto dente de *Potamotrygon henley* em microscopia eletrônica de varredura, mostrando as comissuras, o formato de raiz, a coroa do dente e as irregularidades e a sobreposição com encaixes feitos pelos dentes na formação da placa dentária.

Author: Rafael Oliveira Duarte da Mota

7 Title: “Cidade das Raias”

Subtitle: A Cidade das raias é um banco de areia localizado nas Ilhas Cayman – Caribe. É um importante ponto turístico de região, onde pessoas podem mergulhar com raias em seu habitat natural. Após a morte de Steve Irwin por uma ferroada de *Dasyatis* spp. (espécie da foto), o medo se alastrou, fazendo com que muitas pessoas vissem raias como vilãs, assim como os tubarões. Dito isso, pontos de mergulho que permitam a interação ética e fiscalizada são de extrema importância, pois reforçam a importância do ecoturismo para a conscientização e consequente conservação destes animais.

Author: Natascha Wosnick

8 Title: “Anatomia da respiração”

Subtitle: Fotografia macroscópica de um arco branquial de *Rhinoptera bonasus* capturada no litoral paranaense.

Author: Renata Daldin Leite

9 Title: “Reflexo”

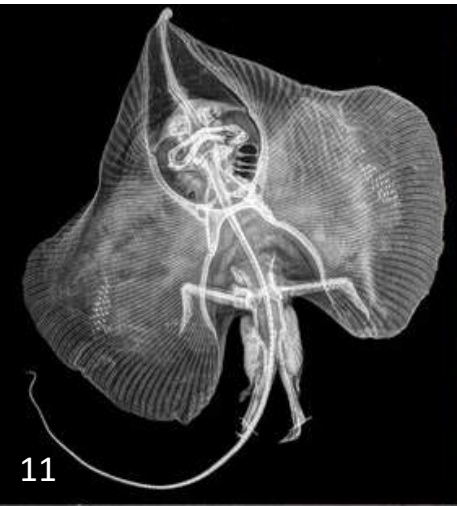
Subtitle: Reflexo da árvore na água ressaltando a beleza dos ocelos da *Potamotrygon motoro*.

Author: Kerly Melo Pereira

10 Title: “A Rainha do Xingu tem futuro?”

Subtitle: A majestosa endêmica Arraia Xingu (*Potamotrygon leopoldi*) caçando nas águas rasas das corredeiras do médio rio Xingu no fim do dia.

Author: Kurt Schmid



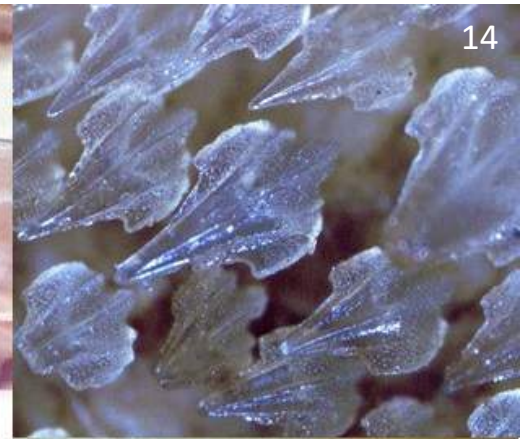
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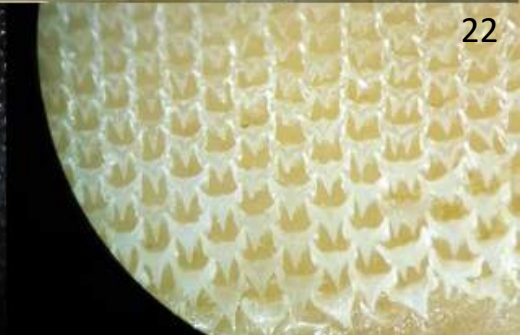
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“BEAUTY BEHIND THE BEAST”

AUTHORS AND TITLES

11 Title: “Das Profundezas Negras”

Subtitle: Especie *Schroederobatis americana* (Bigelow & Schroeder 1962). Ejeplar capturado por personal del Buque de Investigaciones Noruego Fridtjof Nansen, en el talud continental de Venezuela (640-670 m) en 1988. Radiografía de alta definición (Mamografía) realizada por M. Perrdomo y O. Lasso-Alcalá en el Instituto Clínico La Florida, Caracas, 2018.

Author: Oscar Lasso Alcalá

12 Title: “Ampolas de Lorenzini”

Subtitle: Gel das ampolas de Lorenzini de *Rhizoprionodon lalandii* sendo retirado para avaliação fisiológica.

Author: Aline Prado

13 Title: “Aula de Anatomia”

Subtitle: Fotografia do corte longitudinal da cabeça de *Rhizoprionodon* spp.

Author: Eloísa Pinheiro Giareta

14 Title: “Microscopia eletrônica de dentículos dérmicos de tubarão”

Subtitle: Dentículos dérmicos de *Scyliorhinus*, feito em microscópio estereoscópico, mostrando a formação 3 cúspides em forma de uma flecha, proporcionando à espécie uma melhor hidrodinâmica.

Author: Rafael Oliveira Duarte da Mota

15 Title: “Lágrimas de Lorenzini”

Subtitle: Olho e Ampolas de Lorenzini de *Isogomphodon oxyrhynchus*, espécie com o focinho muito comprido que só ocorre no Litoral Amazônico e encontra-se criticamente ameaçada de extinção.

Author: Ana Rita Onodera Palmeira Nunes

16 Title: “Dentes de *Fontitrygon geijskesi*”

Subtitle: Dentes da mandíbula superior de *Fontitrygon geijskesi*.

Author: Gabrielle Silva Neves

17 Title: “Sorriso afiado”

Subtitle: Fotografia da arcada dentária de *Carcharias taurus*.

Author: Eloísa Pinheiro Giareta

18 Title: “Teu Sorriso é Calmaria”

Subtitle: Estrutura dentária de *Pseudobatos percellens*.

Author: Hellida Negrão Dias

19 Title: “Pequena grande fera”

Subtitle: Cabeça de um *Etmopterus gracilispinis* do sul do Brasil. A foto foi tirada originalmente com filme fotográfico, mas o negativo foi escaneado para digitalização.

Author: Getulio Rincon

20 Title: “Sob o azul do mar”

Subtitle: *Squalus albicaudus* do nordeste do Brasil capturado durante o programa REVIZEE na década de 90. O animal foi fotografado em filme fotográfico e o negativo escaneado e digitalizado.

Author: Getulio Rincon

21 Title: “*Styracura's* sky: a bloom of dermal stars”

Subtitle: Dentículos dérmicos da raia *Styracura schmardae*, com seus dois tubérculos no dorso característicos dessa espécie amazônica.

Author: Ana Rita Onodera Palmeira Nunes

22 Title: “O Sorriso da Mariposa”

Subtitle: Estrutura dentária de *Gymnura micrura*.

Author: Hellida Negrão Dias



AWARDED PHOTO

“REFLEXO” - Kerly Cristina Melo Pereira

Undergraduate student in Fisheries Engineering from the Federal University of Maranhão (UFMA), she works on the project “Morphology and Ecology of the Freshwater Stingrays of Viana Lake System, Maranhão, under the guidance of Dr. Getulio Rincon (UFMA – campus Pinheiro).









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INTERNATIONAL MEETING ON AMAZONIAN SHARKS AND BATOIDS



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**September
8th-12th
Come to
São Luis!**



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AMAZONIAN SHARKS AND BATOIDS**



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PROCEEDINGS OF INTERNATIONAL MEETING ON AMAZONIAN SHARKS AND BATOIDS

ANAIS DO CONGRESSO INTERNACIONAL SOBRE
TUBARÕES E RAIAS DO LITORAL AMAZÔNICO

Brazil northern coast is considered a global conservation hotspot for Chondrichthyes comprising nursery areas and the use of several habitats for endangered and/or endemic species. Many species migrate along the rivers and coastal areas, and their populations extend beyond the geopolitical boundaries. This scenario makes the joint efforts by the countries in the Amazon coast extremely necessary to ensure mutual cooperation for effective management and legislation have a continuous flow in both hydrographic basins and the littoral.

In this scenario, exchanging information and the coordinated development of scientific research between the countries in the Amazon region are fundamental to widen the knowledge about this biome chondrofauna, thus enabling the elaboration of strategic plans for its conservation. In this way, this event with researchers from the whole Amazon region was a turning point for conservation research of this biome fishing resources.

