SC-06-INFO-04

6th Meeting of the SIOFA Scientific Committee (SC6)
22-25 March 2021
(online)

Southern Oceans Deep-sea Elasmobranch Exploration Project (SO-DEEP)

Relates to agenda item: 7.6.1 Info paper ☒

Delegation of SIODFA

Abstract

This note provides an introduction to research work being planned on deepwater sharks in the SIOFA area by Paul Clerkin, Virginia Institute of Marine Science, USA through NSF funding using SIODFA factory trawlers to undertake at-sea research

Southern Indian Ocean Deepsea Fishers Association
南インド洋深海漁業組合

Southern Oceans Deep-sea Elasmobranch Exploration Project (SO-DEEP)

Paul J Clerkin[2,], Ross Shotton[1] & Jan McDowell[2]
[1]Southern Indian Ocean Deepsea Fishers Association
[2]Virginia Institute of Marine Science

Rationale and Significance and Background

Sharks, rays, and chimaeras are top predators in almost every environment they inhabit and as a result they are important to overall ocean health. However, the biology of sharks as a whole is poorly understood. This is especially true when it comes to the deep-sea species of the Indian Ocean, which are difficult to monitor due to improper species identification, gear evasion or gear selectivity, inaccessibility to sites, and time needed to sample. It is increasingly important to work with fishing vessels to gain the baseline information needed management decisions before natural habitat conditions cannot be determined. This project proposes an ongoing collaborative study to research the deep-sea sharks of the Indian Ocean. The results will provide a baseline to monitor seamount health and guide conservation efforts.

A research vessel is expected to participate in this project sometime in 2022. This, as opposed to commercial fishing with data taken opportunistically, will enhance the breadth of this study. Discussions are ongoing with two independent research groups, but have not yet been contractually concluded.

Research Overview

This project will use a combination of methods including (a) taxonomy and DNA barcoding (b), eDNA and (c) underwater cameras to rigorously document and catalogue the shark species of the Indian Ocean deep-sea. This data will then be used to build a database of life history, distribution, survivorship, and other biological information to assess the impact of fishing pressure on each species and to produce identification keys and observer training materials for ongoing monitoring.

- **Creation of a catalog of species, including an associated genetic barcode for each species encountered.**

Researchers will collaborate with volunteer host vessels to take a census of all sharks, rays, and chimaeras that are caught as bycatch during normal fishing operations. An onboard researcher (project co-PI) will collect the primary data from host vessels. After receiving specialized instruction via video and the project website, and being supplied with waterproof identification and sampling guidebooks, it is planned that trained observers deployed on volunteer fishing vessels will collect additional data.

Relevant information including species identity, sex, length, maturity, fecundity, physical condition (if alive), and diet composition will be recorded for every specimen encountered and all sampled specimens will have an associated photograph for verification of observer identifications. Data (photographs, length, maturity, etc.) will be taken with an all-digital and Bluetooth synchronized system (Biomark) to minimize time costs and human error. Data will be uploaded automatically upon Wi-Fi connection and paired with geographic location, depth, and environmental data (temperature, thermocline depth, current speed and direction, etc.) recorded by the ship sensors. However, data will be degraded if required to preserve companies' confidentiality requirements. Genetic material will be sampled for each species at each seamount fished and stored in an appropriate buffer for genetic barcoding. Species identification will be verified from observer photographs (synced wirelessly with data) by trained shark taxonomists and will be randomly spot checked by generating genetic barcodes for a subset of individuals from each species. Successful observer identification rates will be quantified to access efficacy of observer data collections and guide future data collection strategies.

New species will be described, named, and physical vouchers of type specimens (and of rare specimens of interest) will be accessioned to the permanent collections of museums such as the California Academy of Sciences, Museum of Comparative Zoology, National Museum of Natural History, Smithsonian, Natural History Museum, Scripps Institution of Oceanography, Marine Vertebrate Collection, South African Institute for Aquatic Biodiversity, and Iziko-South African Museum.

- **Collection of environmental DNA (eDNA) samples at each seamount fished to estimate species richness and relative abundance and to compare to the same estimates based on catch composition**. Physical specimens from trawls will be compared to species detected in water samples to estimate how many additional species could be in the region.

Sharks can be difficult to monitor because of improper species identification, gear evasion or gear selectivity, inaccessibility to sites, and time needed to sample. In some cases, rare species might be present but in such low numbers that they remain undetected by conventional sampling methods. eDNA is a relatively new technology that takes advantage of the small amounts of genetic material that animals constantly shed into their environment through dead cells, mucus, gametes, waste, tissues, etc. This environmental DNA can be collected, metabarcoded and sequenced and this information can be paired with barcode information generated from whole animal collections to better understand the makeup of shark species associated with each seamount.

For eDNA, water samples will be taken at three depths (surface, 200 meters, and bottom) for each seamount fished. The water will be passed through a nitrocellulose filter and filters containing the bound DNA will be stored in 95% ethanol until DNA can be isolated and sequenced. Results of eDNA sequencing will be compared to results of barcoding studies to better understand species composition. Once sampling protocols have been established, further samples could be taken over time to understand seasonality, migration, and for long term monitoring.

- ***Use gear-mounted deep-water cameras to observe species, bottom conditions, and use video to engage stakeholders***.

Cameras mounted to the water samplers will observe species present, bottom topography, sampling gear functionality, and the results will be disseminated to the scientific community, policy makers, and the general public. Gear- borne cameras can give additional information and a different means of data interpretation. Observation of the seamount surface and its fauna may explain physical data collected relating to species richness and composition (related to bottom topography), behavioural data, e.g., aggregations (due to feeding, mating, and pupping), habit use, human impact (plastic pollutants and habitat degradation), and other phenomenon and anomalies of the data that are difficult to explain without video information. First hand video accounts may also explain potential discrepancies between physical specimens and species detected from water samples (such as gear avoidance or other sampling selectivity).

- ***Build a database of life history, distribution, survivorship, and other biological information to assess the impact of fishing pressure on each species.***

An important requirement for managing the Southern Indian Ocean is to catalogue the shark species of the area and describe new species. Establishing a baseline of species, genetic barcode, distribution, and density will provide the necessary foundation for future management efforts. Species prevalence, sex ratio, sexual segregation, maturation, and fecundity are all important parameters for describing a species susceptibility to fishing estimation of depletion/extinction risk.

Further, distribution, species richness, and estimated relative biomass, can be calculated from trawl specimens and directly compared to eDNA collected at different depths. Life history paired with distribution and biomass can help inform policy makers as to management of sharks of this area.

The information from this study (accurate identification of species, species richness, commercial value, relative abundance, fishing impacts, etc.) can be quantified and used to build a suitability model to quantify the importance of each seamount to the fisheries and which seamounts contribute the most benefits for the Southern Indian Ocean (SIO) biodiversity as a whole.

Expected Outcome and Broader Impacts

This project will be the largest detailed investigation of deep-sea shark fauna in the Southern Indian Ocean and will provide a robust baseline for future work. The data collected by this study will fill in the gaps in the knowledge most needed for informed management decisions. This data is also useful for evaluation of accuracy of observer identification and to build a suitability model for selection of protected areas.

The project will also provide training videos, sampling protocols, a data receptacle, and multiple means of information dissemination. This infrastructure can be expanded or extended into new regions. As such, the study could serve as a conduit to future in-depth studies and collaboration among different Southern Ocean RFMOs. Genetic samples collected as part of this effort will be valuable for future population-level studies to better understand the scale of connectivity for these species and for studies focused on molecular phylogenetics.

深海ザメの写真撮影法（種の査定のため）

R. ショットン[1]・ P. クラーキン[2] ・ 仲谷一宏[3]
[1]Southern Indian Ocean Deepsea Fishers Association
[2]Virginia Institute of Marine Science
[3]北海道大学

深海ザメは、多くの種が似た形と色をしているために、専門家でも正確に査定するのは難しい。まして写真だけから査定をするのは非常に難しい。従って、後の査定のために写真を撮る時には、査定に必要な特徴を写真に写し込むことが重要である。

撮影をする時には、頭を左に、体の右側を下にして置く。そして、サメの左側面を撮影する（反対ページの写真を参照）。種の査定には、以下の点が重要で、これらをしっかり確認できる様に撮影すること。

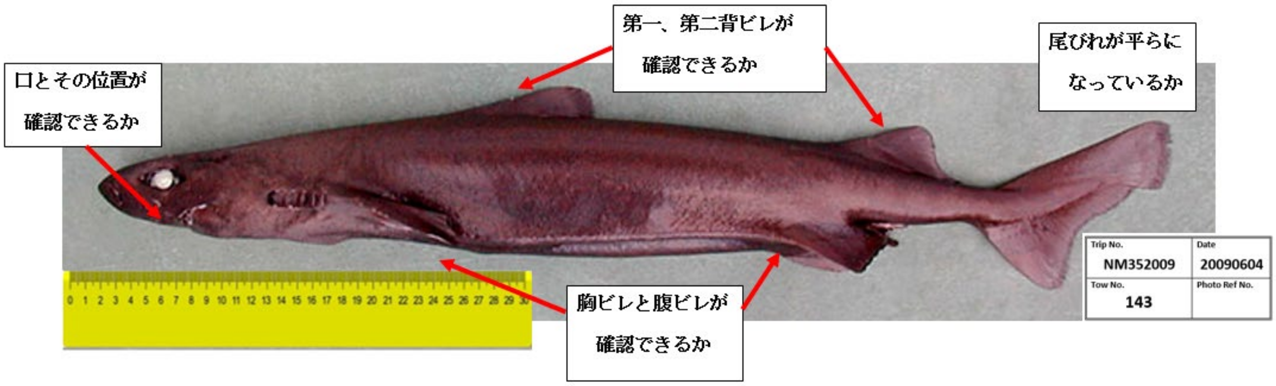
・口の位置　　　　・胸ビレと腹ビレの位置
・第一背ビレと第二背ビレの位置と相対的な大きさ　・腹ビレの様子
・背ビレの前部にある棘（トゲ）の様子（非常に小さいものや、無いサメもいる）
・臀ビレ（あるサメと無いサメがいる）。

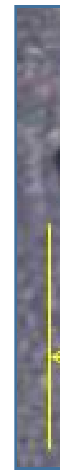
歯の構造（種によって形が違う）、口の形、口の鼻先とエラ穴との位置関係、口角にあるヒダの長さ、なども重要。

定規（例えば、30cmの）を常に写真に写し込むこと。定規は鼻先に合わせること。
サメとコントラストが強い再使用可能な単一色の板の上で撮影すること。
均一で十分な光を当て、必要に応じフラッシュを併用すること。
各写真には以下の情報を一緒に撮影すること
　・航海番号　例　NM352009（ニッコウ丸、航海番号35、西暦2009）
　・8桁の日付　20090604 （西暦・月・日）
　・曳網番号
　・撮影した写真がわかるような写真照合番号

横の写真は：
　コントラストの良い背景板を使っている（良し）
　見やすいラベルを写し込んでいる（良し）
　船の航海番号がない（ダメ）
　定規が入っていない（ダメ）

腹側を下にして撮影しているので、背ビレの起部が
　不明瞭で、口や歯の形も確認できない。背ビレの
　トゲもよく見えない（ダメ）





この写真は：

背景板と魚体のコントラストが明瞭（良し）

見やすいラベルが入っている（良し）

船の航海番号が入っている（良し）

定規が入っている（良し）

サメの頭が左向き（体の左側が手前）に、体が真横になっている（良し）

各ヒレの位置がよく確認できる（良し）

その他の特徴（例えば、歯、鱗など）も写真照合番号を入れて撮影すること。

How to Photograph (Deep-sea) Sharks to Identify Species

R. Shotton[1], P. Clerkin[2] & K.Nakaya[3]
[1]Southern Indian Ocean Deepsea Fishers Association
[2]Virginia Institute of Marine Science
[3]Hokkaido University, Japan

Correctly identifying many deep-sea sharks is difficult even for shark biologists as many species have similar shapes and colours. It is even more difficult if the identification is done from a photo. Hence, when photographing a shark for later identification it is important to capture the features that identify the species.

The fish should be placed with the head to the left, i.e. the shark should be laid on its right side and be photographed to show a clear side image – see the image shown on the reverse side. To best assist identifying the species the image should *clearly* show:

- The position of the mouth
- Placement and relative size of dorsal fin(s)
- Any spines embedded in front of the dorsal fins – these can be difficult to see
- Placement of the pectoral and pelvic fins
- The structure of pelvic fins
- Presence or absence of anal fin

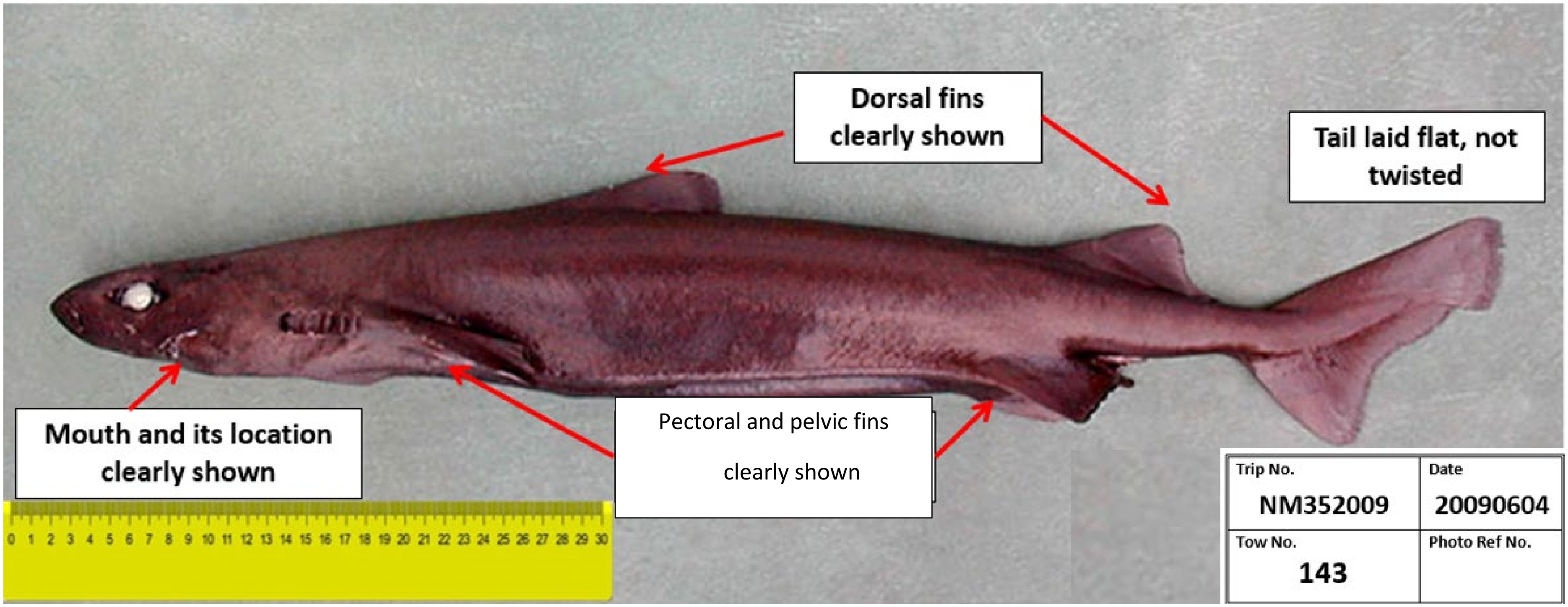
For some species it is necessary to see the teeth structure – they can look different for different species – the shape and the placement the mouth relative to the snout and gills, and the length of the folds of the mouth.

Always place, e.g. a 30 cm rule, in the picture. Align it with the tip of the nose.
Place the shark on a plain background that can be re-used and is contrasting in colour
Try to ensure there is good uniform lighting and/or that the camera uses a flash.
Include in each photograph information that identifies:

- MMR Trip number, i.e. NM352009 (*Nikko Maru*, trip 35, which was in 2009)
- Eight digit full date, i.e. *yyyymmdd*, e.g. *20090604* – 4th June 2009.
- Tow/shot number
- A reference number that links the photo to the image stored on the camera, etc.

This photo shows:

- ✓ Clear contrasting background
- ✓ Clear labeling.
- ✗ No vessel and trip number
- ✗ No ruler in image to indicate shark size
- ✗ Shark placed on its (ventral) underside so that origins of dorsal fins are not clear and no mouth/teeth details are visible. Dorsal fins and spine details are hard to see.



This photo shows:

- ✓ Clear contrast with background
- ✓ Clear labeling.
- ✓ Vessel-trip number
- ✓ Ruler in the image to indicate shark size
- ✓ Shark flat on its right side (head to left) viewed directly from the side
- ✓ Fins viewed straight on to indicate relative position

Other diagnostic features (teeth, denticles, etc.) would be documented in a separate photograph – use that reference number to link the information!