SC-06-INFO-03

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

A PREVIEW OF AN ACCOUNT OF DEEPWATER SHARKS OF THE SOUTHWESTERN INDIAN OCEAN

Relates to agenda item: 7.6.1

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Abstract

This note provides a brief summary of information regarding deep water sharks collected by Paul Clerkin while undertaking two trips on the F.T. *Will Watch* in SIOFA waters in 2012 and 2014.

SIODFA Technical Report
21/01

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

A PREVIEW OF AN ACCOUNT OF DEEPWATER SHARKS OF THE SOUTHWESTERN INDIAN OCEAN

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February 2021

1. INTRODUCTION

This note provides a brief summary of information collected by Paul Clerkin while undertaking two trips on the F.T. Will Watch in SIOFA waters in 2014. It. This information has yet to be published[1], though the usefulness of doing this as soon as possible is appreciated.

The study investigated the deep-sea chondricthyan fauna from a remote area of the Southwestern Indian Ocean and presents the analysis of biological parameters relating to the life histories of the shark species that were encountered. Specimens were collected as bycatch by deep-sea fisheries along deepwater seamounts of the Southwest Indian Ocean Ridge and the Madagascar Ridge. Among the species encountered were several sharks that on closer examination were determined to be distinct from other members of their genera. A total of 4009 specimens – a census study - were examined and sex ratios, size range, smallest mature, largest immature, and length at 50% maturity (L_{T50}) calculated. Detailed information was recorded for their reproductive biology, life history, and distribution of 31 species, which represented 14 genera

2. SPECIES FOR WHICH INFORMATION WAS COLLECTED

Information was collected on the following species.

Centrophoridae (Gulper sharks)	
Centrophorus granulosus	Gulper shark
Centrophorus squamosus	Leafscale gulper shark
Deania calcea	Birdbeak dogfish
Deania profundorum	Arrowhead dogfish
Etmopteridae (Lantern sharks)	
Etmopterus alphus	Whitecheek lantern shark

[1] Clerkin, P.J. In preparation. Deepwater Sharks of the Southwestern Indian Ocean. 102pp.

Etmopterus bigelowi	Blurred smooth lanternfish
Etmopterus compagnoi	
Etmopterus granulosus	Southern lanternfish
Etmopterus pusillus	Smooth lanternfish
Etmopterus sculptus	*Sculpted lanternfish*
Etmopterus cf. sculptus	

Somniosidae (Sleeper sharks)

Scymnodon plunketi	Plunket Shark
Centroscymnus coelolepis	Portuguese dogfish
Centroscymnus owstonii	Roughskin dogfish
Centroselachus crepidater	Longnose velvet dogfish
Zameus squamulosus	Velvet dogfish
Somniosus cf. rostratus	Little sleeper shark

Dalatiidae (Kitefin sharks)

Dalatias licha	Kitefin shark

Pentanchidae (Deepwater catsharks)

Apristurus sinensis	South China catshark
Apristurus cf. albisoma	
Apristurus cf. ampliceps	
Apristurus cf. manis	
Apristurus cf. melanoasper	Black roughscale catshark

Scyliorhinidae (Cat sharks)

Bythaelurus bachi	Bach's catshark
Bythaelurus naylori	Dusky snout catshark

Pseudotriakidae (False catsharks)

Pseudotriakis microdon	False catshark

Chimaeridae (Shortnose chimaeras or ratfishes)

Chimaera willwatchi	seafarers ghost shark
Chimaera didierae	The Falkor chimaera
Chimaera buccanigella	*Dark mouth chimaera*
Hydrolagus sp. A	

3. BIOLOIGAL INFORMATION COLLECTED

Sex Ratios	Sexual Dimorphism
Maximum Length	Maturity

Mature Oocyte Number
Fecundity
Egg Cases
Neonates
Diet
Distribution
Life Strategy and Reproductive Mode

This information is tabulated as follow.

Table 1.	A list of species encountered, the relationship between total length (TL) and length at first maturity, length at first maturity in relation to maximum length (L_{Tmax}), and length at 50% maturity (L_{T50}) for (a) Squaliformes: Centrophoridae, Etmopteridae, Somniosidae, Dalatiidae (page 26), (b) Carcharhiniformes: Scyliorhinidae, Pseudotriakidae, and Holocephali: Chimaeridae; and lengths reported in the literature for 31 species of deep-sea chondricthyans encountered in the SWIO (page 55), (c) Centrophoridae, Etmopteridae, (page 71) and (d) Somniosidae, Dalatiidae, scyliorhinids and, Pseudotriakidae
Table 2	Sex ratio significance evaluated by p-value<0.05, and χ^2 value for overall, adult, and subadult sex ratio
Table 3.	List of numbers of ovarian oocytes (average and maximum), uterine eggs (left max, right max, total max, and average), and maximum width of ocytes
Table 4.	List of numbers species bearing pups, number of pups, and number of pups reported in literature
Table 5.	List of species found with stomach contents, prey items given by number and percentage composition of estimated volume and diet reported in the literature
Table 6.	Distribution of species encountered during surveys and their reported ranges
Table 7.	SIMPER pairwise comparison of species composition between regions. The contributing and cumulative Bray Curtis similarity (species contributions) percentages, expressed as %
Table 8.	SIMPER pairwise comparison of species composition between trawl gear types. The contributing and cumulative Bray Curtis similarity (species contributions) percentages

4. Sampling Methods and Sampled Areas

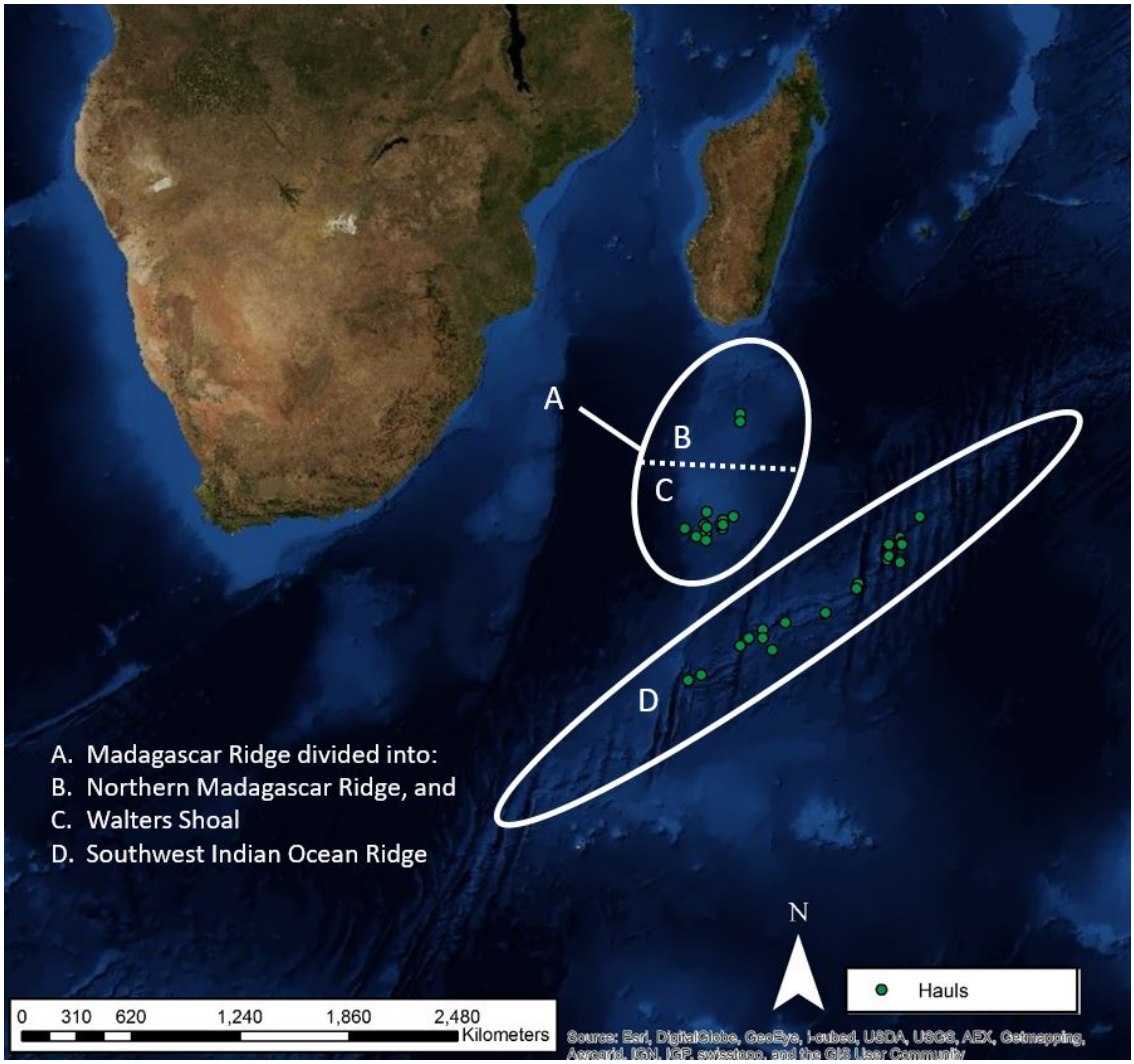
Specimens were collected from 1 March to 23 April 2012 during a 54-day trip, and from 10 April to 7 June 2014 during a 59-day trip aboard the Port Louis-based, Cook Islands-flagged deep-sea factory trawler F.T. *Will Watch*. The survey area extended over the Southwest Indian Ocean Ridge and the Madagascar Ridge in a remote region of the SWIO described by 29°34′–40°40′S; 43°10’—55°15′E (Figure 1).

A 15 m footrope bentho-pelagic trawl net with a 50 m wing span and 5 m headline height was fished at 46 stations. It was towed down seafloor feature slopes starting at no less than 200 m and finishing at no more than 1400 m depth. Bentho-pelagic trawls were rigged with rollers. Mid-water bentho-pelagic trawls were towed approximately 2 m off the bottom and had an 80-100 m wingspan and a 35 m height.

Voucher specimens were sent to the Moss Landing Marine Laboratories for further study. Post-preservation morphometric data were taken to the nearest millimeter following Clerkin *et al.* (2017) modified from Didier and Séret (2002) for chimaeroid specimens, and depending on the shark taxa, modified from Compagno (2001

Figure 1

The Southwestern Indian Ocean showing (a) Madagascar Ridge, with (b) the northern region, (c) southern region (Walters Shoal), and (d) the Southwest Indian Ocean Ridge. Trawl locations are indicated by green circles.



Sharks were captured in 216 tows (138 bottom tows, 78 mid-water tows). The stations were grouped into two major areas based on the distinct ecosystems of the region: Madagascar Ridge (114 tows) — including the northern region (7 tows) and Walters Shoal in the southern region (97 tows) — and the Southwest Indian Ocean Ridge (112 tows). Figures 2 and 3 show examples of some species distributions.

Figure 2
Distribution of Chimera catches by species

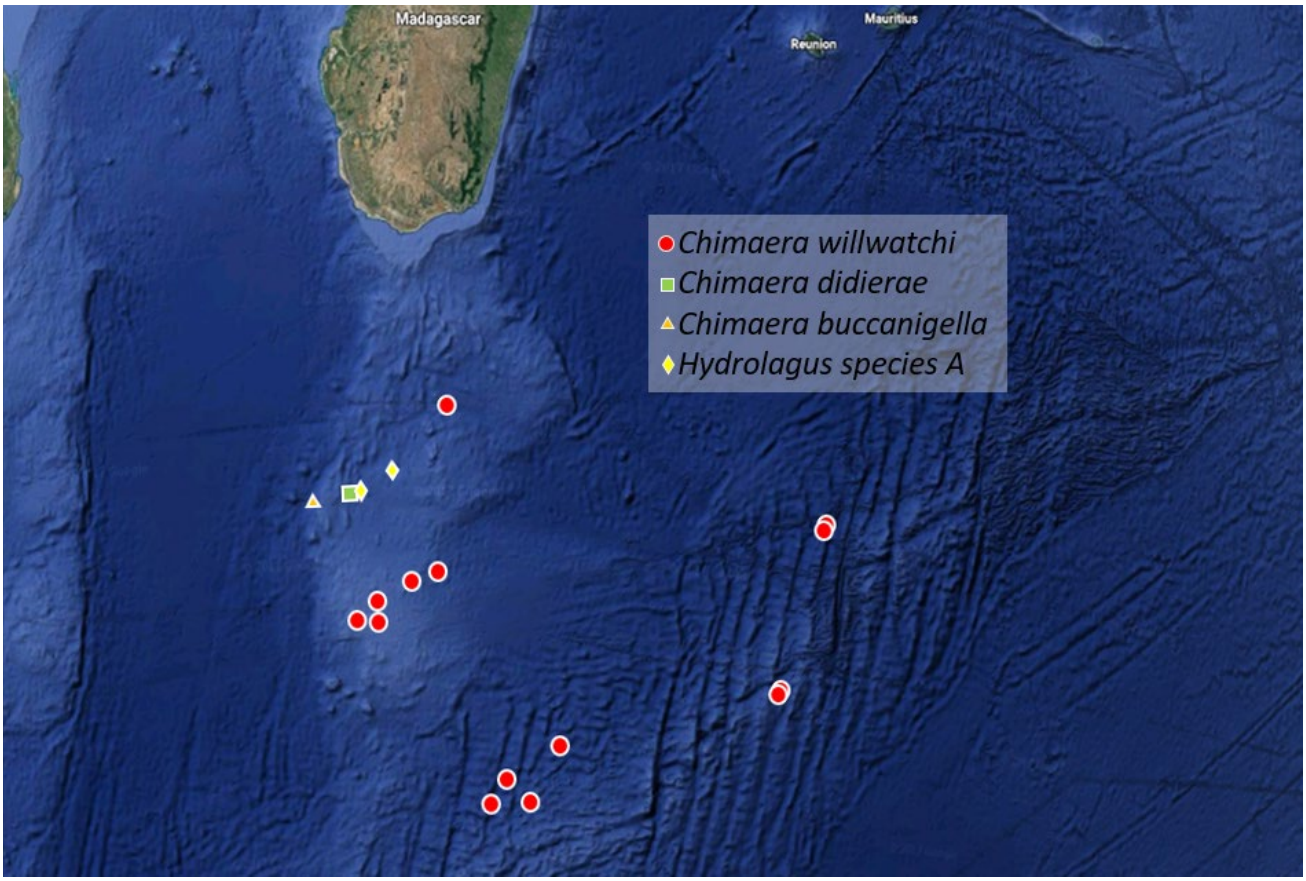
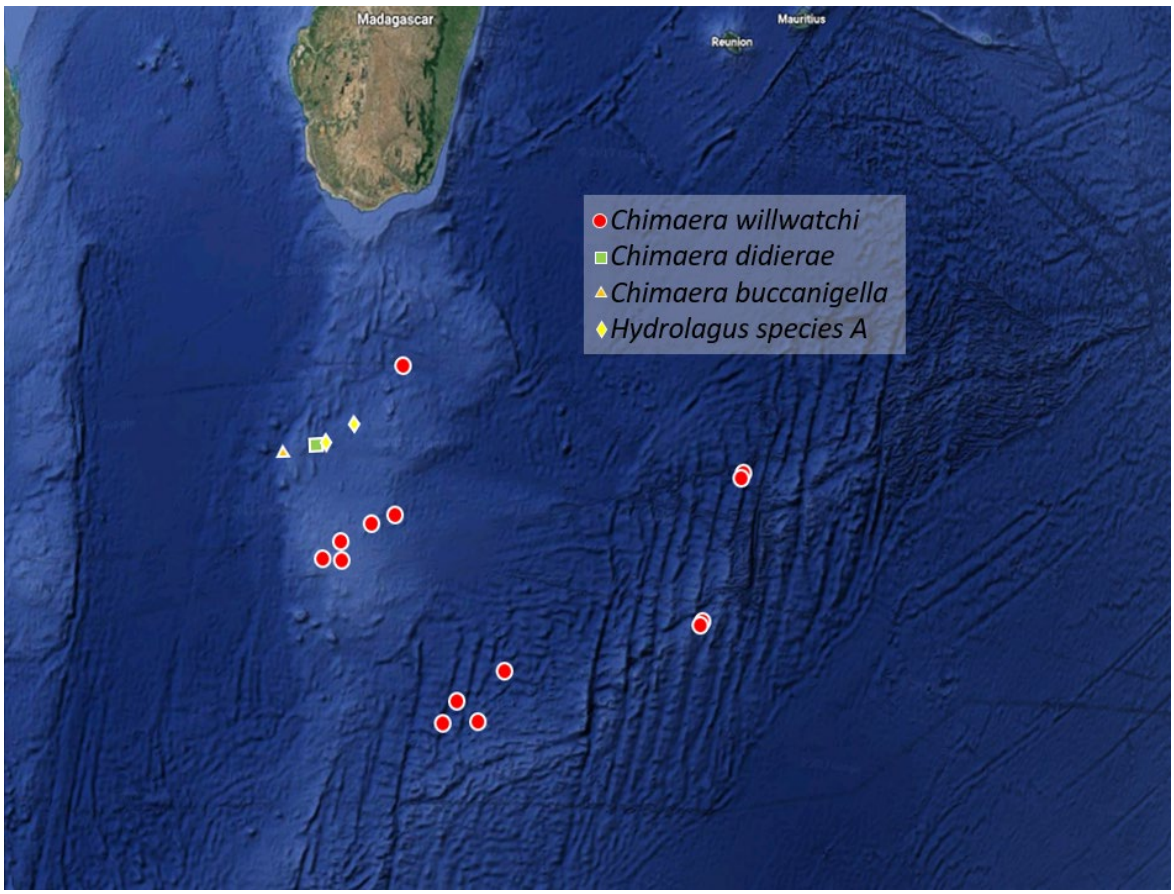


Figure 3

Distribution of *Chimaera* encountered: *Chimaera willwatchi* (red circles), *Chimaera didierae* (green square), *Chimaera buccanigella* (orange triangle), *Hydrolagus* species A (yellow diamond).



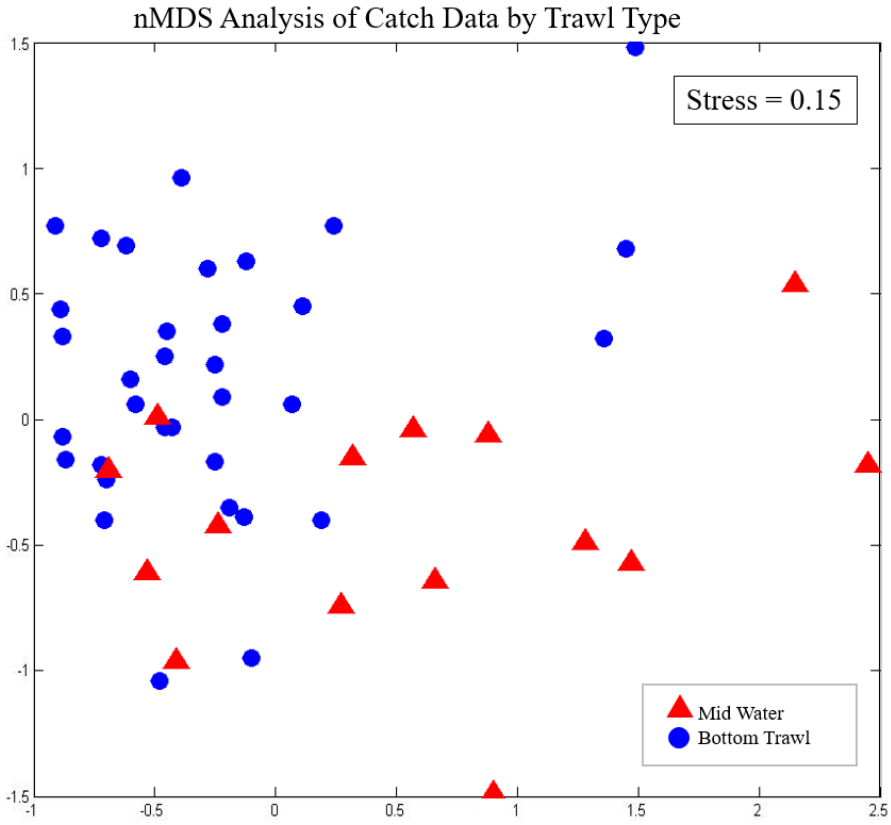
5. SOME DISCUSSION

The Southwestern Indian Ocean Offshore is divided into two ecosystems: the Southwest Indian Ocean Ridge and the Madagascar Ridge, which includes the relatively shallow Walters Shoal. The species surveyed were distributed unevenly between these ecosystems. Although its benthic habitat is less complex (Goslin *et al.* 1980; Sinha *et al.* 1981), the Walters Shoal region of the Madagascar Ridge had a far greater elasmobranch biodiversity - 25 species (80.6% of all encountered) and 11 species (35.5% of all encountered) were found nowhere else during the survey. The Southwest Indian Ocean Ridge had fewer species overall -, 17 species were encountered (54.8% of the total), and seven species (6.5% of the total) restricted solely to this ecosystem.

Demersal trawling, usually targeting orange roughy – *Hoplostethus atlanticus* and mid-water trawling, usually targeting alfonsino - *Beryx splendens*) caught considerably different species with the majority of sharks encountered caught in demersal trawls. The three most abundant

species were found in high numbers in both gear types, with *E. granulosus* and *C. crepidater* more common in bottom trawls and *D. licha* most abundant in mid-water trawls. The other species were more much common in bottom trawls with the exception of *C. squamosus* which was similar in abundance in each habitat. Figure 4 shows an analysis of species distribution by gear type.

Figure 4



The complexity and variation of chondrichthyan life histories found by the study demonstrate that teleost and coastal shark management policies are not necessarily directly translatable to deep-sea chondrichthyans. A detailed understanding of the life histories of deep-sea chondrichthyans is necessary to better conserve this species. The Chimaeridae, despite its global distribution, remains poorly understood, and the deep-sea fauna for chondricthyans of the SIO region is still poorly known. The taxonomic status of SWIO chimaeroids was previously virtually unknown with no prior studies of their sea-mounts fauna in that region. The study identified the first record of *Chimaera spp.* genus in the Southwestern Indian Ocean, which increased the global total to 23 species, including the three new species described during this study (Clerkin *et al.*, 2017). Data gathered during the surveys contributed to the descriptions of two new catsharks, *Bythaelurus bachi* and *B. naylori* (Ebert and Clerkin, 2015; Weigmann *et al.*, 2016), and to the taxonomic resolution of several other taxa. This included the genera *Centrophorus*, *Centroscymnus*, *Etmopterus*, and *Scymnodon* (Straube *et al.*, 2015; White *et al.*, 2013; Weigmann *et al.*, 2016). Tissue samples collected during the surveys were included in the

Tree of Life project web site, which provides an account of extant chondrichthyans and a framework of their relationships through genetic analysis, morphometry, and the fossil record.

6. LITERATURE CITED

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