SHORT ARTICLE

# Occurrence and body size of common cartilaginous fishes in the Seaflower Biosphere Reserve

## *Ocurrencias y tamaños corporales de peces cartilaginosos comunes de la Reserva de la Biósfera Seaflower*

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## ABSTRACT

Coral reefs worldwide face numerous threats, endangering both ecosystems and coastal communities. Collecting population data on marine species, particularly apex predators like sharks and rays, is essential for effective conservation. This study presents data on the occurrences and body size of five common species of cartilaginous fishes recorded through diver-operated stereo-video surveys conducted between 2018 and 2022. Significant variation was found in species sightings across locations, highlighting the importance of continued research to assess population status and to inform conservation strategies tailored to specific species and sites.

**KEYWORDS:** Archipelago of San Andrés, Providencia y Santa Catalina; elasmobranchs; stereo-video

## RESUMEN

*Los arrecifes de coral en todo el mundo enfrentan numerosas amenazas, poniendo en peligro tanto los ecosistemas como las comunidades costeras. Recopilar datos poblacionales sobre especies marinas, especialmente depredadores tope como tiburones y rayas, es crucial para una conservación efectiva. En este estudio se presentan datos de ocurrencia y tamaño corporal de cinco especies comunes de peces cartilaginosos observadas durante censos visuales realizados con la técnica de estéreo-video operado por buzo entre 2018 y 2022. Se encontró una variación relevante en la presencia de especies entre localidades; estos hallazgos subrayan la necesidad de continuar la investigación para evaluar el estado poblacional e informar sobre estrategias de conservación adaptadas a cada especie y localidad.*

**PALABRAS CLAVE:** archipiélago de San Andrés; Providencia y Santa Catalina; elasmobranquios; estéreo-video

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## INTRODUCTION

Coral reefs face multiple threats, including climate change, overfishing, and pollution, resulting in substantial worldwide deterioration and loss of ecosystem functionality which jeopardizes the livelihoods of coastal communities (Hughes *et al*., 2017; Souter, Planes, Eicquart, Logan, Obura, & Staub, 2021). Understanding the dynamics and interactions between species within marine communities is essential for the conservation and effective management of marine resources (Auster, Estes, & Coleman, 2013). Top predators and mesopredators play a critical role in shaping and regulating the structure of these communities (Roff *et al*., 2016).

Cartilaginous fishes (sharks and rays) play important roles as mesopredators and apex predators on coral reefs (Heupel, Knip, Simpfendorfer, and Dulvy 2014). They consume a wide variety of prey, including small and medium-sized fishes, crustaceans, and mollusks, regulating their populations and helping to maintain community structure within the ecosystem (Heupel *et al*., 2014; Ruppert, Travers, Smith, Fortin, & Meekan, 2013). Despite their important functions, chondrichthyans face significant threats due to overfishing and habitat degradation. Their conservation is crucial to maintaining coral reef health and biodiversity (Ferretti, Worm, Britten, Heithaus, & Lotze, 2010; Roff *et al*., 2016; Simpfendorfer *et al*., 2023).

To generate efficient conservation strategies, it is necessary to have as much information as possible on the population status of the different species of sharks and rays. However, this represents a challenge because many of the species in the group are under some category of threat and the frequency of sightings is low.

A total of 33 species of sharks and rays are distributed throughout the Seaflower Biosphere Reserve (SBR) (Bolaños-Cubillos, Abril-Howard, Bent Hooker, Caldas and Acero, 2015). The Nurse Shark *(Ginglymostoma cirratum)* and the Caribbean Reef Shark *(Carcharhinus perezii)* are the most common sharks, and the Southern Stingray *(Hypanus americanus)* and the Spotted Eagle Ray *(Aetobatus narinari)* are the most common rays. To contribute to the knowledge of cartilaginous fishes in the Archipelago, this study presents occurrence and body size data of chondrichthyan species observed during visual censuses conducted at various locations within the SBR between 2018 and 2022.

## STUDY AREA

The SBR is a complex of islands, atolls, cays and shoals in the Colombian Caribbean that extends over approximately 180,000 km2. It includes one of the largest coral reef complexes in the Caribbean (Abril-Howard, Bolaños-Cubillos, Machacón, Lasso, Gómez, & Ward, 2012a) and more than 77% of the country's coral reef formations (Abril-Howard, Orozco, Bolaños-Cubillos, & Bent, 2012b). In this study, cartilaginous fishes were recorded in coral reef areas of several SBR islands including San Andres (SA), Courtown Cays or Bolívar Cays (BOL), Southwest Cays or Alburquerque Cays (ALB) and Old Providence and Ketlina (PRO). The main island of the archipelago is SA, located 90 km south of PRO, while BOL and ALB are two cays inhabited by the marines personnel stationed there for protection purposes, situated 25 km and 37 km south of SA, respectively (Fig. 1).

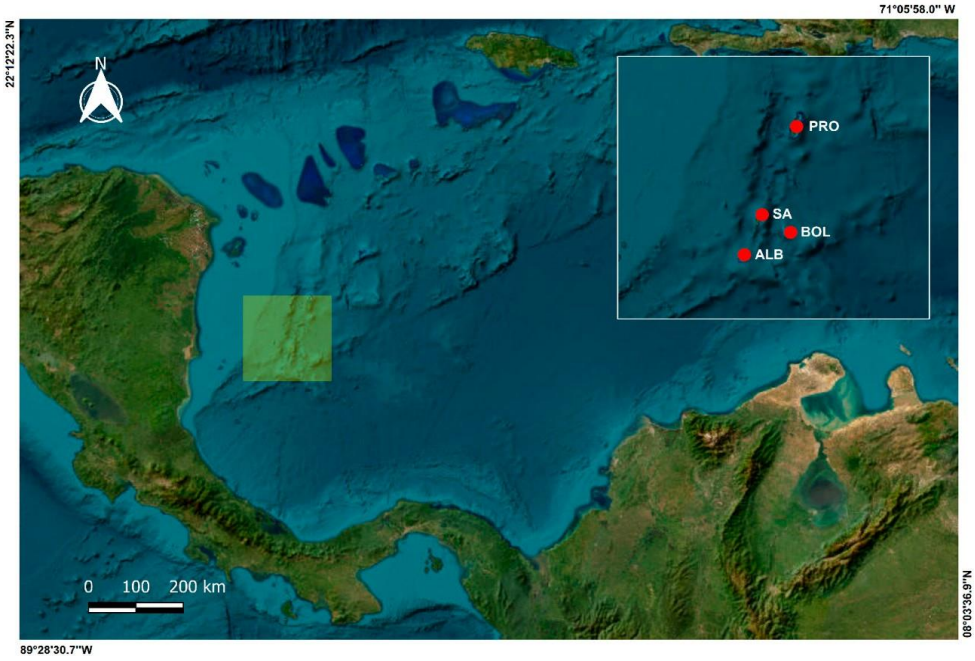


**Figure 1.** Location of the study area in the SBR and the locations sampled from north to south, Old Providence Island (PRO), San Andres Island (SA), Courtown Cays (BOL) and Southwest Cays (ALB).

## METHODOLOGY

### *Censuses and video processing*

The stereo-video technique operated by divers was used, following the methods described in Rivas, Acero, and Tavera (2022, 2023). This approach facilitated the collection of accurate data on individual body size, sex ratio, and overall chondrichthyan composition in the SBR, with minimal estimation error and high resolution. Possible researcher biases were minimized by assigning the same person to perform the processing of all the videos taken, and ensuring a balanced distribution of samples through censuses with specific recording and processing times.

The samplings were carried out between 2018 and 2022, some during the Seaflower scientific expeditions, coordinated by the Colombian Ocean Commission (CCO) (Table 1). The length of all elasmobranch individuals was calculated. In the case of sharks, the total length (TL) taken from the tip of the snout to the tip of the upper caudal lobe was measured; in the case of rays, the disc length (DL) from the tip of the snout to that of the pelvic fins was measured. Additionally and when possible, for the observed rays, their disc width (DW) was calculated, by measuring the distance between the tips of the pectoral fins. Individuals were sexed only when the presence or absence of claspers was evident in the image.

**Table 1.** Locations and stations sampled between 2018 and 2022. The locations that were evaluated during the Seaflower scientific expeditions (*) and the number of stations with records of cartilaginous fishes in the samplings are detailed.

| Year | Location | Stations evaluated | Stations with cartilaginous fish records |
|---|---|---|---|
| 2018 | ALB* | 35 | 1 |
| 2018 | BOL | 16 | 5 |
| 2018 | PRO | 16 | 8 |
| 2018 | SA | 16 | 0 |
| 2019 | PRO* | 23 | 11 |
| 2019 | SA | 16 | 2 |
| 2021 | PRO* | 23 | 6 |
| 2022 | BOL* | 22 | 7 |

## RESULTS AND DISCUSSION

Occurrences and body sizes were collected from 82 individuals, belonging to five species of chondrichthyan, including two species of sharks [*Carcharhinus perezii* (Poey, 1876) and *Ginglymostoma cirratum* (Bonnaterre, 1788)] and three species of rays [*Aetobatus narinari* (Euphrasen, 1790), *Hypanus americanus* (Hildebrand & Schroeder, 1928) and *Urobatis* jamaicensis (Cuvier, 1816)]. PRO was the location with the highest frequency of sighting of this group of fishes (Fig. 2). Comparatively, in 2018, the year in which the four locations were evaluated in a short window of time, elasmobranchs were recorded in eight of the 16 stations evaluated in PRO; BOL, chondrichthyans were recorded in five of the 16 stations; in ALB, a single individual of Nurse Shark was observed in the 35 stations evaluated, and in SA, two individuals of the Southern Stingray ray were recorded in two stations (Table 1).

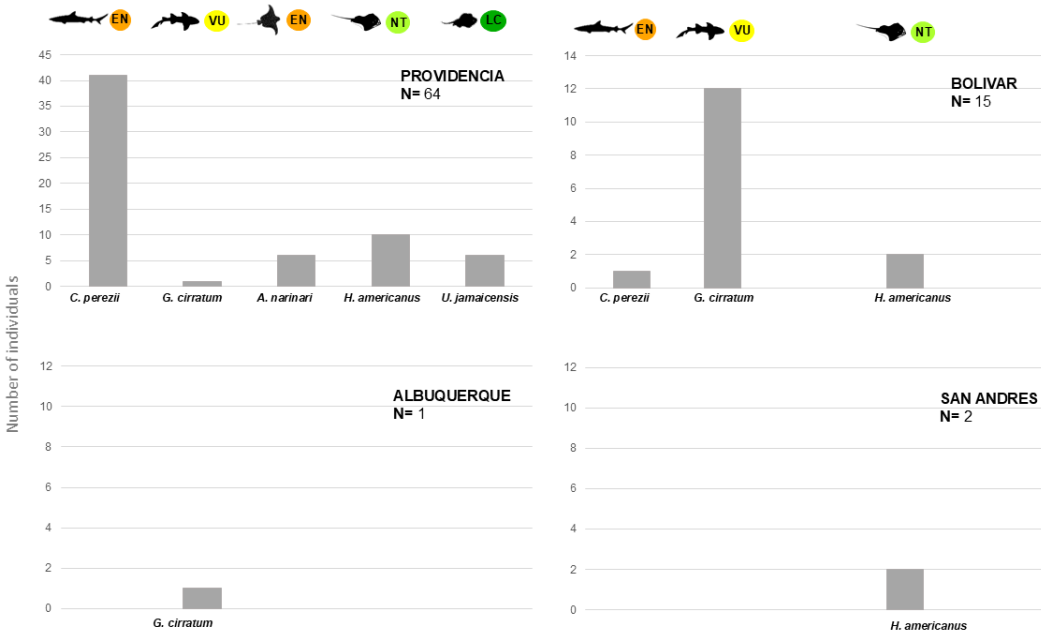


**Figure 2.** Number of individuals of each species recorded at each location. Colored circles indicate the conservation status of the species.

Size data were collected from 42 specimens of the Caribbean Reef Shark *C. perezii*, of which 41 were observed in PRO and one in BOL. This species is listed as endangered (EN), under the Red List of the International Union for Conservation of Nature (IUCN) (Carlson et al., 2021b). These findings match those of Rodríguez-Barragán (2020), who compared the relative abundances of sharks and carnivorous fishes by means of remote baited chambers in ALB, Serranilla Bank, and PRO. The author found that PRO had the highest relative abundance of *C. perezii*, including females, males, juveniles, and adults. Of the 35 sexed individuals in this study, 20 (19 PRO, 1 BOL) corresponded to females whose sizes ranged between 1,163 mm and 2,098 mm, with an average TL of 1,599.75 mm and 15 corresponded to males that measured 1,504 mm and 1,747 mm, with an average size of 1,597.27 mm (Table 2). The data taken in the SBR indicate that both sexes can reach similar sizes, although only four (4) females exceeded lengths of 1.9 m. Likewise, no males smaller than 1,478 m were detected, while eight (8) females fluctuated between 1,163 m and 1,471 m. Following the sexual maturity height of 1,600 mm, reported by Compagno (1984), 24 individuals were immature and 18 mature (Fig.3).

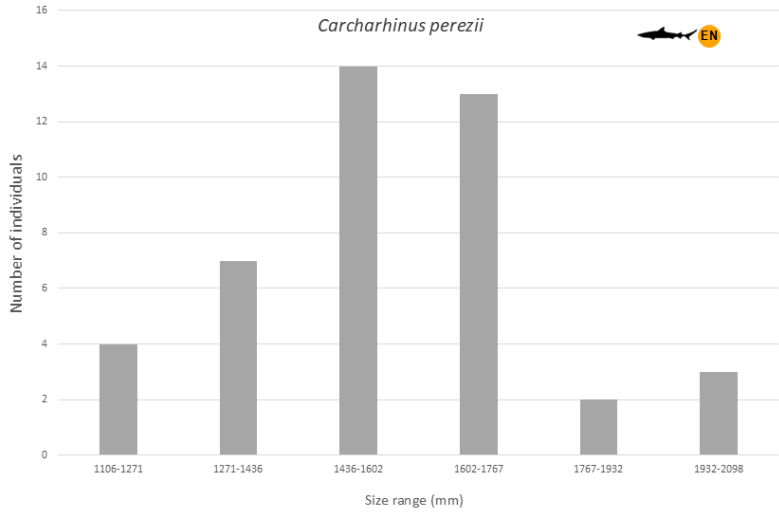


**Figure 3.** Size frequency of the grey reef shark *Carcharhinus perezii*.
The height ranges in mm and the number of individuals in each range are detailed.

Regarding the other recorded shark species, *G. cirratum*, listed as vulnerable (VU) by the IUCN (Carlson *et al*., 2021c), thirteen (13) specimens were measured, twelve (12) in BOL and one (1) in ALB, of which eight could be sexed and all were females (Table 2). This information could be indicative of some sexual segregation, at least in the sampled area. A sexual maturity height of 2,350 mm for females is reported (Compagno, 1984), indicating that all individuals observed during sampling were immature.

For the group of rays, the Spotted Eagle Ray *A. narinari* and the Yellow Stingray *U. jamaicensis*, classified as EN (Dulvy et al., 2020) and least concern (LC) (Carlson et al., 2021a), respectively, were observed in PRO. A total of six (6) individuals from *A. narinari* individuals were measured, the smallest had an DL of 214.041 mm and a DW of 317.301 mm, and the largest had an DL of 1,005.306 mm and a DW of 1,726.762 mm. According to the sexual maturity size reported by Last, Naylor and Manjaji- Matsumoto (2016), all the individuals observed were immature. Likewise, six (6) individuals of *U. jamaicensis* were measured, their DL ranged between 299.557 mm and 358.907 mm, and their DW between 162.069 mm and 192.097 mm. Of the sexed individuals, one (1) was male and two (2) were female, all with sizes smaller than the size of 200 mm DW sexual maturity reported for the species (Last et al., 2016).

As for the Southern Stingray *H. americanus*, classified as near threatened (NT) (Carlson *et al*., 2020), fourteen (14) individuals were recorded, ten (10) in PRO, two (2) in BOL and two (2) in SA. Only two (2) individuals could be sexed, both were females. Following the sexual maturity size data of 700 mm to 800 mm reported by Last et al. (2016), one (1) immature female was observed in BOL and one (1) mature female in PRO. The DL ranged from 419.687 mm (PRO) to 1,191.741 mm (PRO), with an average of 787.801 mm.

Although it should be considered that sampling was not balanced over the years, PRO appears to be a particularly abundant locality for the cartilaginous fish group in the SBR and stands out as a site that should be prioritized for further study of the group, and on which to focus conservation efforts. PRO had the largest and best protected mangrove swamp in the Archipelago until the passage of Hurricanes Iota and Eta in 2020. This ecosystem is widely considered an essential habitat for sharks and rays (López-Angarita, Villate-Moreno, Díaz, Cubillos-M, & Tilley, 2021). Therefore, due to their ecological role and the data from this study, it is essential to identify and delimit important areas for the maintenance of cartilaginous fish populations.

**Table 2.** Occurrences and sizes of cartilaginous fishes in four locations of the Seaflower Biosphere Reserve. The date, location and depth of each station are detailed. Shark sizes correspond to their total length (TL), while for rays, disk length (DL) and disk width (DW) were measured when possible. Each individual was assigned an identifier in the SpID_ind column, which, in the case of rays, allows identification of whether the DL and DW correspond to the same individual.

| Month | Year | Location | Station | Depth | SpID_ind | Species | Sex | Size | RMS | Length |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 2022 | Courtown Cays | 9 | 5 | Cp_1 | *Carcharhinus perezii* | F | 1976,093 | 2,334 | TL |
| 9 | 2022 | Courtown Cays | 10 | 3 | Gc_1 | *Ginglymostoma cirratum* | F | 1294,095 | 3,191 | TL |
| 9 | 2022 | Courtown Cays | 11 | 12 | Gc_2 | *Ginglymostoma cirratum* | F | 2305,639 | 15,307 | TL |
| 9 | 2022 | Courtown Cays | 11 | 12 | Gc_3 | *Ginglymostoma cirratum* | F | 1512,962 | 3,69 | TL |
| 9 | 2022 | Courtown Cays | 12 | 5 | Gc_4 | *Ginglymostoma cirratum* | F | 1503,884 | 1,29 | TL |
| 9 | 2022 | Courtown Cays | 6 | 12 | Gc_5 | *Ginglymostoma cirratum* | F | 2222,279 | 5,253 | TL |
| 9 | 2022 | Courtown Cays | 8 | 6 | Gc_6 | *Ginglymostoma cirratum* | F | 1416,610 | 2,35 | TL |
| 9 | 2022 | Courtown Cays | 10 | 3 | Ha_1 | *Hypanus americanus* | | 827,060 | 2,332 | DL |
| 9 | 2022 | Courtown Cays | 7 | 8 | Ha_2 | *Hypanus americanus* | F | 769,011 | 3,619 | DW |
| 9 | 2022 | Courtown Cays | 7 | 8 | Ha_2 | *Hypanus americanus* | F | 654,157 | 4,041 | DL |
| 7 | 2021 | Old Providence | 10 | 10 | Ha_3 | *Hypanus americanus* | F | 862,987 | 0,445 | DL |
| 7 | 2021 | Old Providence | 10 | 10 | Ha_3 | *Hypanus americanus* | F | 795,697 | 1,277 | DW |
| 7 | 2021 | Old Providence | 10 | 10 | Ha_4 | *Hypanus americanus* | | 835,303 | 1,263 | DW |
| 7 | 2021 | Old Providence | 10 | 10 | Ha_4 | *Hypanus americanus* | | 791,372 | 0,666 | DL |
| 7 | 2021 | Old Providence | 11 | 11 | Uj_1 | *Urobatis jamaicensis* | M | 328,432 | 16,255 | DL |
| 7 | 2021 | Old Providence | 11 | 11 | Uj_1 | *Urobatis jamaicensis* | M | 173,863 | 0,871 | DW |
| 7 | 2021 | Old Providence | 11 | 11 | Uj_2 | *Urobatis jamaicensis* | F | 330,553 | 6,382 | DL |
| 7 | 2021 | Old Providence | 11 | 11 | Uj_2 | *Urobatis jamaicensis* | F | 170,060 | 0,811 | DW |
| 7 | 2021 | Old Providence | 13 | 20 | Cp_2 | *Carcharhinus perezii* | M | 1573,358 | 1,886 | TL |
| 7 | 2021 | Old Providence | 13 | 20 | Cp_3 | *Carcharhinus perezii* | M | 1747,016 | 5,739 | TL |
| 7 | 2021 | Old Providence | 13 | 20 | Cp_4 | *Carcharhinus perezii* | M | 1612,801 | 5,095 | TL |
| 7 | 2021 | Old Providence | 13 | 20 | Cp_5 | *Carcharhinus perezii* | F | 1443,100 | 7,95 | TL |
| 7 | 2021 | Old Providence | 13 | 20 | Cp_6 | *Carcharhinus perezii* | | 1299,331 | 18,797 | TL |
| 7 | 2021 | Old Providence | 13 | 20 | Cp_7 | *Carcharhinus perezii* | F | 1389,584 | 6,437 | TL |

| Month | Year | Location | Station | Depth | SpID_ind | Species | Sex | Size | RMS | Length |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 2021 | Old Providence | 13 | 20 | Cp_8 | *Carcharhinus perezii* | F | 1162,799 | 4,653 | TL |
| 7 | 2021 | Old Providence | 14 | 13 | Ha_5 | *Hypanus americanus* | | 373,182 | 3,365 | DW |
| 7 | 2021 | Old Providence | 14 | 13 | Ha_5 | *Hypanus americanus* | | 939,789 | 1,548 | DL |
| 7 | 2021 | Old Providence | 14 | 13 | Uj_3 | *Urobatis jamaicensis* | F | 358,907 | 0,643 | DL |
| 7 | 2021 | Old Providence | 14 | 13 | Uj_3 | *Urobatis jamaicensis* | F | 192,097 | 1,835 | DW |
| 7 | 2021 | Old Providence | 14 | 13 | Ha_6 | *Hypanus americanus* | | 438,976 | 5,165 | DL |
| 7 | 2021 | Old Providence | 14 | 13 | Ha_6 | *Hypanus americanus* | | 465,813 | 2,429 | DW |
| 7 | 2021 | Old Providence | 5 | 5 | Cp_9 | *Carcharhinus perezii* | | 1268,389 | 8,347 | TL |
| 7 | 2021 | Old Providence | 9 | 9 | Cp_10 | *Carcharhinus perezii* | F | 1959,478 | 1,295 | TL |
| 7 | 2021 | Old Providence | 9 | 9 | Cp_11 | *Carcharhinus perezii* | F | 1637,924 | 0,391 | TL |
| 7 | 2021 | Old Providence | 9 | 9 | Cp_12 | *Carcharhinus perezii* | F | 2097,812 | 4,049 | TL |
| 7 | 2021 | Old Providence | 9 | 9 | Cp_13 | *Carcharhinus perezii* | F | 1792,899 | 0,813 | TL |
| 9 | 2019 | Old Providence | 14 | 10 | Ha_7 | *Hypanus americanus* | | 850,918 | 1,605 | DL |
| 9 | 2019 | Old Providence | 14 | 10 | Ha_8 | *Hypanus americanus* | | 778,535 | 3,721 | DL |
| 9 | 2019 | Old Providence | 16 | 15 | Ha_9 | *Hypanus americanus* | | 759,340 | 0,116 | DL |
| 9 | 2019 | Old Providence | 16 | 15 | Ha_10 | *Hypanus americanus* | | 852,410 | 4,654 | DL |
| 9 | 2019 | Old Providence | 16 | 15 | Uj_4 | *Urobatis jamaicensis* | | 335,395 | 1,023 | DL |
| 9 | 2019 | Old Providence | 17 | 12 | Uj_5 | *Urobatis jamaicensis* | | 299,557 | 0,206 | DL |
| 9 | 2019 | Old Providence | 15 | 10 | An_1 | *Aetobatus narinari* | | 1726,762 | 3,406 | DW |
| 9 | 2019 | Old Providence | 15 | 10 | An_1 | *Aetobatus narinari* | | 1005,306 | 3,340 | DL |
| 9 | 2019 | Old Providence | 19 | 8 | An_2 | *Aetobatus narinari* | | 813,027 | 2,882 | DL |
| 9 | 2019 | Old Providence | 19 | 8 | An_2 | *Aetobatus narinari* | | 1042,358 | 7,527 | DW |
| 9 | 2019 | Old Providence | 19 | 8 | An_3 | *Aetobatus narinari* | | 859,972 | 1,961 | DL |
| 9 | 2019 | Old Providence | 19 | 8 | An_3 | *Aetobatus narinari* | | 1064,975 | 3,270 | DW |
| 9 | 2019 | Old Providence | 20 | 18 | An_4 | *Aetobatus narinari* | | 318,898 | 13,976 | DL |
| 9 | 2019 | Old Providence | 20 | 18 | An_4 | *Aetobatus narinari* | | 506,291 | 5,715 | DW |
| 9 | 2019 | Old Providence | 20 | 18 | An_5 | *Aetobatus narinari* | | 408,602 | 18,577 | DL |
| 9 | 2019 | Old Providence | 20 | 18 | An_5 | *Aetobatus narinari* | | 689,821 | 14,807 | DW |

| Month | Year | Location | Station | Depth | SpID_ind | Species | Sex | Size | RMS | Length |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 2019 | Old Providence | 20 | 18 | An_6 | *Aetobatus narinari* | | 317,301 | 15,297 | DW |
| 9 | 2019 | Old Providence | 20 | 18 | An_6 | *Aetobatus narinari* | | 214,041 | 0,922 | DL |
| 9 | 2019 | Old Providence | 21 | 20 | Cp_13 | *Carcharhinus perezii* | | 1676,800 | 1,720 | TL |
| 9 | 2019 | Old Providence | 21 | 20 | Cp_14 | *Carcharhinus perezii* | | 1332,362 | 3,251 | TL |
| 9 | 2019 | Old Providence | 21 | 20 | Cp_15 | *Carcharhinus perezii* | | 1736,994 | 1,495 | TL |
| 9 | 2019 | Old Providence | 22 | 20 | Ha_11 | *Hypanus americanus* | | 1192,741 | 17,246 | DL |
| 9 | 2019 | Old Providence | 5 | 10 | Gc_7 | *Ginglymostoma cirratum* | | 791,039 | 2,027 | TL |
| 9 | 2019 | Old Providence | 6 | 10 | Cp_16 | *Carcharhinus perezii* | | 1105,719 | 5,175 | TL |
| 9 | 2019 | Old Providence | 9 | 15 | Uj_6 | *Urobatis jamaicensis* | | 162,069 | 0,201 | DW |
| 9 | 2019 | Old Providence | 9 | 15 | Uj_6 | *Urobatis jamaicensis* | | 316,901 | 0,565 | DL |
| 9 | 2019 | Old Providence | 9 | 15 | Ha_12 | *Hypanus americanus* | | 479,144 | 6,340 | DW |
| 9 | 2019 | Old Providence | 9 | 15 | Ha_12 | *Hypanus americanus* | | 419,687 | 4,169 | DL |
| 9 | 2019 | San Andres | 12 | 18 | Ha_13 | *Hypanus americanus* | | 957,039 | 5,520 | DL |
| 9 | 2019 | San Andres | 16 | 15 | Ha_14 | *Hypanus americanus* | | 704,208 | 1,885 | DL |
| 9 | 2018 | Southwest Cays | 13 | 15 | Gc_8 | *Gynglimostoma cirratum* | | 1182,939 | 9 | TL |
| 10 | 2018 | Courtown Cays | 1 | 12 | Gc_9 | *Gynglimostoma cirratum* | | 1302,759 | 0,785 | TL |
| 10 | 2018 | Courtown Cays | 2 | 18 | Gc_10 | *Gynglimostoma cirratum* | | 1079,753 | 4 | TL |
| 10 | 2018 | Courtown Cays | 3 | 18 | Gc_11 | *Gynglimostoma cirratum* | | 2189,132 | 7 | TL |
| 10 | 2018 | Courtown Cays | 5 | 15 | Gc_12 | *Gynglimostoma cirratum* | | 2136,207 | 15 | TL |
| 10 | 2018 | Courtown Cays | 6 | 14 | Gc_13 | *Gynglimostoma cirratum* | F | 973,852 | 0,438 | TL |
| 10 | 2018 | Courtown Cays | 6 | 14 | Gc_14 | *Gynglimostoma cirratum* | F | 1530,865 | 5,116 | TL |
| 10 | 2018 | Old Providence | 1 | 24 | Cp_16 | *Carcharhinus perezi* | M | 1531,967 | 2,052 | TL |
| 10 | 2018 | Old Providence | 1 | 24 | Cp_17 | *Carcharhinus perezi* | M | 1626,207 | 18,228 | TL |
| 10 | 2018 | Old Providence | 1 | 24 | Cp_18 | *Carcharhinus perezi* | F | 1713,048 | 3,378 | TL |
| 10 | 2018 | Old Providence | 1 | 24 | Cp_19 | *Carcharhinus perezi* | F | 1910,761 | 15,713 | TL |
| 10 | 2018 | Old Providence | 2 | 20 | Cp_20 | *Carcharhinus perezi* | F | 1330,706 | 11,060 | TL |
| 10 | 2018 | Old Providence | 2 | 20 | Cp_21 | *Carcharhinus perezi* | F | 1470,822 | 3,865 | TL |

| Month | Year | Location | Station | Depth | SpID_ind | Species | Sex | Size | RMS | Length |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 2018 | Old Providence | 5 | 19 | Cp_22 | *Carcharhinus perezi* | | 1398,265 | 2,990 | TL |
| 10 | 2018 | Old Providence | 5 | 19 | Cp_23 | *Carcharhinus perezi* | M | 1559,285 | 0,340 | TL |
| 10 | 2018 | Old Providence | 5 | 19 | Cp_24 | *Carcharhinus perezi* | M | 1477,766 | 5,019 | TL |
| 10 | 2018 | Old Providence | 5 | 19 | Cp_25 | *Carcharhinus perezi* | M | 1658,137 | 3,071 | TL |
| 10 | 2018 | Old Providence | 5 | 19 | Cp_26 | *Carcharhinus perezi* | F | 1515,272 | 7,858 | TL |
| 10 | 2018 | Old Providence | 6 | 24 | Cp_27 | *Carcharhinus perezi* | F | 1685,787 | 7,658 | TL |
| 10 | 2018 | Old Providence | 6 | 24 | Cp_28 | *Carcharhinus perezi* | F | 1388,097 | 13,258 | TL |
| 10 | 2018 | Old Providence | 6 | 24 | Cp_29 | *Carcharhinus perezi* | M | 1515,918 | 0,078 | TL |
| 10 | 2018 | Old Providence | 6 | 24 | Cp_30 | *Carcharhinus perezi* | M | 1642,870 | 0,971 | TL |
| 10 | 2018 | Old Providence | 7 | 24 | Cp_31 | *Carcharhinus perezi* | M | 1612,737 | 3,081 | TL |
| 10 | 2018 | Old Providence | 7 | 24 | Cp_32 | *Carcharhinus perezi* | M | 1557,779 | 1,688 | TL |
| 10 | 2018 | Old Providence | 7 | 24 | Cp_33 | *Carcharhinus perezi* | M | 1743,006 | 10,162 | TL |
| 10 | 2018 | Old Providence | 9 | 30 | Cp_34 | *Carcharhinus perezi* | M | 1504,473 | 6,854 | TL |
| 10 | 2018 | Old Providence | 9 | 30 | Cp_35 | *Carcharhinus perezi* | F | 1458,141 | 3,552 | TL |
| 10 | 2018 | Old Providence | 11 | 28,1 | Cp_36 | *Carcharhinus perezi* | F | 1279,979 | 2,150 | TL |
| 10 | 2018 | Old Providence | 11 | 28,1 | Cp_37 | *Carcharhinus perezi* | F | 1562,843 | 0,958 | TL |
| 10 | 2018 | Old Providence | 11 | 28,1 | Cp_38 | *Carcharhinus perezi* | F | 1683,936 | 4,712 | TL |
| 10 | 2018 | Old Providence | 11 | 28,1 | Cp_39 | *Carcharhinus perezi* | M | 1597,417 | 1,551 | TL |
| 10 | 2018 | Old Providence | 13 | 10 | Cp_40 | *Carcharhinus perezi* | F | 1535,074 | 4,827 | TL |

## Conclusions and recommendations

In this work, the data collected on the occurrence and sizes of the most common cartilaginous fishes in four locations of the SBR are presented in a descriptive manner. There is a high variation in the frequency of sightings of the evaluated species between locations relatively close to each other. The information collected indicates that the two sexes reach similar average sizes in *Carcharhinus perezii*, but that the specimens with larger sizes are females. On the other hand, small males of this species do not seem to occupy the sampled area suggesting a possible segregation by size. Meanwhile, in the case of *Ginglymostoma cirratum* some sexual segregation seems to occur, indicated by the absence of males. These results highlight the importance of continuing efforts to collect information on this highly threatened group and thus recognize and better understand the differences in sizes and occurrences according to locations and species, which will allow establishing efficient and particular conservation strategies for each species.

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## Authors' Contribution

Conceptualization, N. R., A. P. S., J. T. and A. A. P.; methodology, N.R.; software, N. R.; validation N. R.; analysis, N. R.; research, N. R., A. P. S., J. T. y A. A. P.; resources, N. R., A. P. S., J. T. y A. A. P.; data curation, N. R.; drafting-preparation of the original draft, N. R.; drafting-revision and editing N.R., A.P.S., J.T. and A.A.; visualization N. R., A. P. S., J. T. y A. A.; supervision, N.R., A.P. S., J. T. and A. To; project management, N.R., A.P.S., J.T., and A.A.; fundraising, N.R., A.P.S., J.T. and A.A. All authors have read and accepted the published version of the manuscript.

## Referencias bibliográficas

Abril-Howard, A.; Bolaños-Cubillos, N.; Machacón, I.; Lasso, J.; Gómez, D. I.; Ward, V. (2012a). Actualización del conocimiento de los ecosistemas marinos en la Reserva de Biósfera Seaflower, con énfasis en las islas de San Andrés y Providencia. En: D. I. Gómez-López (Ed.), *Atlas de la Reserva de Biósfera Seaflower*. Archipiélago de San Andrés, Providencia y Santa Catalina (pp. 129-157). Invemar - Coralina.

Abril-Howard, A.; Orozco, C. T.; Bolaños-Cubillos, N.; Bent, H. H. (2012b). Primera aproximación al conocimiento de las comunidades coralinas de los complejos arrecifales de Serranilla, Bajo Alicia y Bajo Nuevo-Colombia, sección norte de la Reserva de Biósfera Seaflower, Caribe occidental. *Revista Ciencias Marinas Costeras,* 4, 51-65. https://doi.org/10.15359/revmar.4.3

Auster, P. J.; Estes, J. A.; Coleman, F. C. (2013). Species interactions in marine communities: the invisible fabric of nature. *Bulletin of Marine Science*, 89(1), 3-9. https://doi.org/10.5343/bms.2012.1051

Bolaños-Cubillos, N.; Abril-Howard, A.; Bent Hooker, H.; Caldas, J. P.; Acero, P., A. (2015). Lista de peces conocidos del archipiélago de San Andrés, Providencia y Santa Catalina, Reserva de Biósfera Seaflower, Caribe occidental colombiano. *Boletín de Investigaciones Marinas y Costeras,* 44(1), 127-162. https://doi.org/10.25268/bimc.invemar.2015.44.1.24

Carlson, J. *et al.* (2020). Southern stingray *Hypanus americanus*. The IUCN Red List of Threatened Species: e.T181244884A104123787 . https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T181244884A104123787.en.

Carlson, J. *et al.* (2021a). Yellow stingray *Urobatis jamaicensis* (amended version of 2020 assessment). The IUCN Red List of Threatened Species: e.T60109A206646540. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T60109A206646540.en.

Carlson, J. *et al.* (2021b). Caribbean reef shark *Carcharhinus perezii*. The IUCN Red List of Threatened Species: e.T60217A3093780. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T60217A3093780.en.

Carlson, J. et al. (2021c). Atlantic nurse shark *Ginglymostoma cirratum*. The IUCN Red List of Threatened Species: e.T144141186A3095153. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T144141186A3095153.en.

Compagno, L. J. V. (1984). *FAO Species Catalogue*. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1 - Hexanchiformes to Lamniformes. FAO Fish. Synop. 125(4/1), 1-249. Rome, FAO.

Dulvy, N. K. *et al.* (2021). *Whitespotted eagle ray Aetobatus narinari*. (amended version of 2021 assessment). The IUCN Red List of Threatened Species 2021: e.T42564343A201613657. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T42564343A201613657.en.

Ferretti, F.; Worm, B.; Britten, G. L.; Heithaus, M. R.; Lotze, H. K. (2010). Patterns and ecosystem consequences of shark declines in the ocean. Ecology Letters, 13, 1055-1071, https://doi.org/10.1111/j.1461-0248.2010.01489.x

Harvey, E. S.; Shortis, M. (1998). Calibration stability of an underwater stereo-video system: implications for measurement accuracy and precision. Marine Technology Society Journal 32, 3-17

Heupel, M. R.; Knip, D. M.; Simpfendorfer, C. A.; Dulvy, N. K. (2014). Sizing up the ecological role of sharks as predators. *Mar Ecol Prog Ser* 495, 291-298, https://doi.org/10.3354/meps10597

Hughes, T. P.; Barnes, M. L.; Bellwood, D. R.; Cinner, J. E.; Cumming, G. S.; Jackson, J. B.; Kleypas, J.; Van De Leemput, I. A.; Lough, J. M.; Morrison, T. H. (2017). Coral reefs in the Anthropocene. *Nature,* 546(7656), 82-90. https://doi.org/10.1038/nature22901

Last, P.; Naylor, G.; Manjaji-Matsumoto, B. (2016). A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights. *Zootaxa,* 4139 (3), 345. https://doi.org/10.11646/zootaxa.4139.3.2

López-Angarita, J.; Villate-Moreno, M.; Díaz, J. M.; Cubillos-M, J. C.; Tilley, A. (2021). Identifying nearshore nursery habitats for sharks and rays in the Eastern Tropical Pacific from fishers' knowledge and landings. Ocean & Coastal Management, 213: 105825. https://doi.org/10.1016/j.ocecoaman.2021.105825.

Rivas, N.; Acero P., A.; Tavera, J. (2022). *Spatial variation of parrotfish assemblages at oceanic islands in the western Caribbean: evidence of indirect effects of fishing?* PeerJ, 10, e14178, https://doi.org/10.7717/peerj.14178

Rivas, N.; Acero, P., A.; Tavera, J. (2023). Estéreo-video operado por buzos: una potente herramienta para realizar estudios comparativos de tallas de peces marinos. *Colección Jorge Álvarez Lleras Academia Colombiana de Ciencias Exactas, Físicas y Naturales,* 45, 231-238.

Rodríguez-Barragán, M. E. (2020). *Shark and predatory fish relative abundance in three locations of the SeaFlower Biosphere reserve using BRUVS*. Tesis: biología, Universidad de los Andes. https://repositorio.uniandes.edu.co/server/api/core/bitstreams/6881366e-3541-4154-857b-8759f423dc1b/content

Roff, G.; Doropoulos, C.; Rogers, A.; Bozec, Y-M.; Krueck, N. C.; Aurellado, E.; ... Mumby, P.J. (2016). The ecological role of sharks on coral reefs. *Trends in Ecology & Evolution,* 31(5), 395-407. https://doi.org/10.1016/j.tree.2016.02.014

Ruppert, J. L. W.; Travers, M. J.; Smith, L. L.; Fortin, M-J.; Meekan, M. G. (2013). Caught in the middle: Combined impacts of shark removal and coral loss on the fish communities of coral reefs. *PLoS ONE* 8(9), e74648. 10.1371/journal.pone.0074648 https://doi.org/10.1371/journal.pone.0074648

Simpfendorfer, C.; Heithaus, M.; Heupel, M.; Macneil, A.; Meekan, M.; Harvey, E.; … Chapman, D. (2023). Widespread diversity deficits of coral reef sharks and ray. *Science* 380, 1155-1160, 10.1126/science.ade4884 https://doi.org/10.1126/science.ade4884

Souter, D.; Planes, S.; Eicquart, J.; Logan, M.; Obura, D. ; Staub, F. (2021). *Status of coral reefs of the world: 2020.* Global Coral Reef Monitoring Network (GCRMN) / International Coral Reef Initiative (ICRI). https://doi.org/10.59387/WOTJ9184