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**MANUELA ALVES NOBRE SALES**

**LIMITE AO SUL DA DISTRIBUIÇÃO DA RAIA REDONDA, *Styracura schmardae***  
**(POTAMOTRYGONIDAE)**

**FORTALEZA**

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(POTAMOTRYGONIDAE)**

**Trabalho de Conclusão de Curso apresentado ao curso  
de Bacharelado em Oceanografia do Instituto de  
Ciências do Mar da Universidade Federal do Ceará.**

**Orientador: Prof. Dr. Vicente Vieira Faria**

**Coorientador: Dr. João Eduardo Pereira de Freitas**

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BANCA EXAMINADORA

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Prof. Dr. Vicente Vieira Faria (Orientador)

Departamento de Biologia, Universidade Federal do Ceará - UFC

---

Prof. Dr. Manuel Antonio de Andrade Furtado Neto

Departamento de Engenharia de Pesca, Universidade Federal do Ceará - UFC

---

Profa. Dra. Caroline Vieira Feitosa

Instituto de Ciências do Mar – LABOMAR, Universidade Federal do Ceará- UFC

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## RESUMO

O conhecimento da faixa de distribuição geográfica de uma espécie é importante para a compreensão de sua tolerância e necessidades ambientais. Este conhecimento também é importante para o desenvolvimento de estratégias de conservação espécie-específica. Uma das espécies de elasmobrânquios que ainda não tem a sua faixa de distribuição completamente conhecida é a raia redonda, *Styracura schmardae* (até recentemente conhecida como *Himantura schmardae*). Além disso, esta espécie é considerada ‘Deficiente em Dados’ pela União Internacional para a Conservação da Natureza (IUCN). Dentro desse contexto, o presente estudo teve como objetivo estabelecer o limite sul da faixa de distribuição geográfica de *S. schmardae*. Isto foi feito a partir de um espécime amostrado na costa de Icapuí, Ceará, Brasil, capturado por uma rede de arrasto (picaré). Várias características morfológicas do exemplar são diagnósticas da espécie *Styracura schmardae*. Além disto, a sequência de DNA do gene mitocondrial NADH do exemplar teve 99% de similaridade com sequências homólogas de *S. schmardade* disponíveis no Genbank após análise do tipo BLAST. O espécime foi depositado na Coleção Ictiológica do Departamento de Biologia da Universidade Federal do Ceará (DBUFC 82). Este é o primeiro registro confirmado de *S. schmardae* no sudoeste do Oceano Atlântico.

**Palavras-chave:** Elasmobranchii, Sudoeste Atlântico, NADH-2, Distribuição geográfica.



## ABSTRACT

Knowledge about a species distribution range is important for understanding its environmental tolerance and needs. This knowledge is also relevant for the development of species-specific conservation strategies. One elasmobranch species that still does not have its distribution range well known is the Caribbean whiptail stingray *Styracura schmardae* (until recently known as *Himantura schmardae*). Moreover, this species is considered 'Data Deficient' by the International Union for the Conservation of Nature (IUCN). It is within this context that the present study had the goal of establishing the southernmost distribution range limit for *S. schmardae*. This was done based on one specimen caught on the coast of Icapuí, Ceará, Brazil, using beach seine net. Several morphological features of the specimen are diagnostic for *S. schmardae*. In addition, a sequence of the mitochondrial DNA gene NADH-2 obtained for this specimen was 99% similar to *S. schmardae* homologous sequences available on GenBank after BLAST analyses. The specimen was deposited at the Ichthyological Collection at Department of Biology at the Federal University of Ceará (DBUFC 82). This is the first confirmed record of *S. schmardade* in the southwest Atlantic.

**Key words:** Elasmobranch, Southwest Atlantic Ocean, NADH-2, Distribution range

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## 1. INTRODUCTION

Knowledge about distribution range is important for understanding a species tolerance and needs, as well as for the development of conservation strategies (BROWN and LOMOLINO, 1998). One species of Elasmobranchii that does not have its distribution range well studied is the Caribbean whiptail stingray *Styracura schmardae* (Werner, 1904). This species is more commonly known as *Himantura schmardae* (Werner, 1904), belonging to the family Dasyatidae. Nevertheless, morphological and molecular evidence has shown that this species is, in fact, too much divergent from other *Himantura* species (LOVEJOY et al. 1998; COMPAGNO 1999; NAYLOR et al. 2012; LAST et al. 2016). As a result, this species was recently placed in a new genus (*Styracura*) and in a new subfamily (Styracurinae) (DE CARVALHO et al., 2016). Some of the morphological distinctive features of this species are: a rounded to weakly rhomboidal disk with a snout barely projected; a dorsal and anterior part of the tail covered with small tubercles; and the presence of a pair of dorsal scapular tubercles situated in the middle part of the disc laterally to the spine (STEHMANN et al., 1978; DE CARVALHO, 2016; DE CARVALHO et al., 2016).

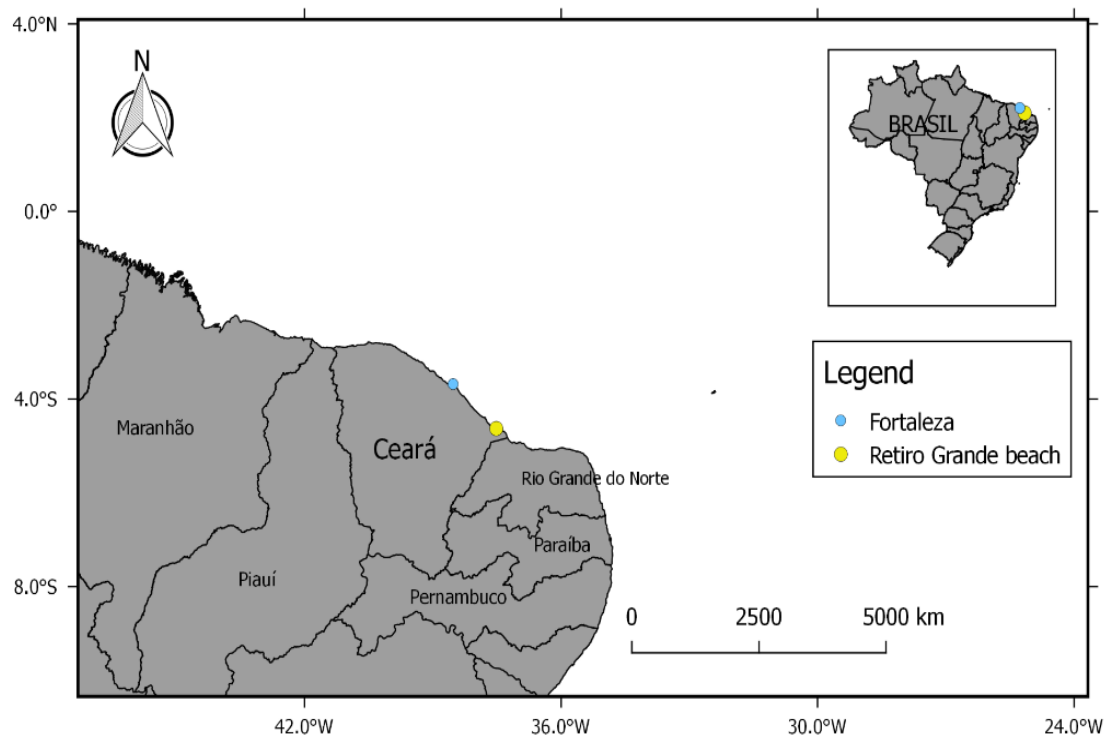
The Caribbean whiptail stingray, *S. schmardae*, is considered 'Data Deficient' by the International Union for the Conservation of Nature (IUCN). This is, at least in part, due to the incomplete knowledge about of its distribution range (CHARVET-ALMEIDA & ALMEIDA, 2006). This species inhabits marine and estuarine environments with sandy or muddy bottoms in the western Atlantic (STEHMANN *et al.*, 1978). Until recently, its distribution range was considered to extend from southern Mexico to northern Brazil (CHARVET-ALMEIDA & ALMEIDA, 2006; ALMEIDA et al., 2008). Nevertheless, this species northernmost range is now known to include The Bahamas (O'SHEA et al. 2017). As for its southernmost limit, there is an unconfirmed record for this species in Ceará, northeastern Brazil. This unconfirmed record was based on a incomplete fishery-landed *H. cf. schmardae*, which was missing its head, pelvic fins, and tail (JUCÁ-QUEIROZ *et al.*, 2008), making it difficult to confirm the species identification and capture location as well. It is within this context that the present study had the goal to establish the southernmost distribution range limit for *S. schmardae*, based on a complete specimen sampled on the easternmost portion of Ceará state, northeastern Brazil.

## 2. MATERIAL AND METHODS

### 2.1. Study area and sampling

Retiro Grande beach is located in Icapuí municipality, on the easternmost portion of Ceará State, Brazil, close to the border with Rio Grande do Norte State (Fig. 1). This beach is characterized by a sandy substrate and a low transparency of the water, probably because becomes clayey towards the west (Fig. 2). The specimen was captured at low tide on June 24, 2013, using a 1,0 m x 2,2 m beach seine (12 mm mesh size) deployed to a maximum depth of 1 m, in parallel and 50 m distant from the coast (Fig 3), at the 4° 38' 30.63'' S 37° 31' 55.30'' W mark.

**Fig. 1** – Capture location for the Caribbean whiptail stingray, Map showing the capture area of the *Styracura schmardae*, Retiro Grande Beach (Yellow dot), Icapuí, Ceará, Brazil. Source: author.



**Fig. 2.** The samplig site: Retiro Grande beach, Icapuí, easternmost Ceará, Brazil. Source: Carlos Cavalcante.



**Fig. 3.** The specimen of the Caribbean whiptail stingray, *Styracura schmardae*, during its capture at Icapuí, easternmost Ceará State, Brazil. Source: Carlos Cavalcante.



## 2.2. Morphological identification

In laboratory, the specimen was identified based on diagnostic morphological characters proposed by Stehmann, McEachran & Vergara (1978). Then, morphometric measurements were taken following Carvalho *et al.* (2016). In addition, the following data were recorded: (1) total body mass (using a digital scale), (2) gender, and (3) clasper rigidity. The specimen was then deposited at the Ichthyological Collection from the Department of Biology of the Federal University of Ceará (UFC) (DBUFC 82).

## 2.3. Molecular identification

A sample of muscle tissue was obtained from the specimen. The sample was deposited at the tissue sample collection of the Laboratory of Evolution and Conservation of Marine Vertebrates (EvolVe) at the Department of Biology (UFC) (FAR 324). Part of the sample was then used for DNA extraction. The total cell DNA was extracted with the DNeasy Blood & Tissue Kits, following manufacturer's instructions (QIAGEN Inc., Valencia, CA, USA). Quality of the extracted DNA was assessed using the spectrophotometer NanoDrop 2000.

The extracted DNA was used for polymerase chain reaction (PCR) amplifications of the mitochondrial DNA gene NADH-2. The reactions were performed using the primers Ilem-Mustelus 5' AAGGACCACTTTGATAGAGT 3' and Asn-Mustelus 5' AACGCTTAGCTGTTAATTAA 3' (Naylor *et al.* 2012). The PCR reactions were made in a total volume of 25 µl, containing 50 ng of DNA, 1XAmpliTaq Gold 360 Master Mix (Life Technologies, Paisley, UK) and 0,5 µM of primer's final concentration. The cycle reaction was as follows: initial denaturation of 94° C for 2 minutes; 39 cycles of denaturation at 95° C for 30 seconds, primer annealing at 48° C for 30 seconds, and extension at 72° C for 90 seconds; with final extension at 72° C per 7 minutes. The PCR reactions were performed using a Veriti 96-Well thermal cycler (Applied Biotech, Inc.).

The PCR products were verified in 1.3% agarose gel made with Tris-borate buffer (TBE) and stained with Ethidium Bromide. A molecular weight marker (100 bp DNA Ladder; New England BioLabs) was used for calibration. Each gel was photographed in a gel imaging system (Loccus, Cotia, São Paulo). Then, based on the band intensity, the amplified DNA concentration was estimated using LabImage 1D software (Loccus). Sucessfully amplified PCR

products were then purified using ExoSAP-IT (Affymetrix, Inc.) following the manufacturer's guidelines. The purified PCR product was then sent to MacroGen Inc. (Seoul, South Korea) where were sequenced using capillary sequencer (EZ-Seq service; [www.macrogen.com](http://www.macrogen.com)). In addition to the forward and reverse primers, one internal primer was also used for sequencing: ND2-batoids-IFA 5' CACTTYTGACTWCCAGAAGT -3' (Naylor *et al.* 2012)

The DNA sequences obtained were edited and aligned using the program Geneious 7.1.5. The full NADH-2 sequence was delimited using the mitochondrial genome of *Styracura schmardae* (GenBank – JN184062.1) as a model. The obtained 1,046bp NADH-2 gene sequence was then compared with two sequences of *S. schmardae* (GenBank - JN184062.1; JQ519155) through BLAST ([https://blast.ncbi.nlm.nih.gov/Blast.cgi?PAGE\\_TYPE=BlastSearch](https://blast.ncbi.nlm.nih.gov/Blast.cgi?PAGE_TYPE=BlastSearch); Altschul et al. 1990).



## RESULTS

The specimen of ray was identified as belonging to the species *Styracura schmardae* based on the following diagnostic characters: (1) rounded rhomboid disk with rounded edges; (2) snout barely projected as a broad-based papilla; (2) anterior margin of the disc large and transverse to the body axis; (3) dorsal and anterior part of the tail covered with small tubercles; (4) dorsum dark brown to greenish; (5) presence of a pair of dorsal scapular tubercles situated in the middle part of the disc, laterally to the spine (typical of juveniles; adults have two or more pairs); (6) ventral coloration whitish to yellowish; (7) absence of caudal fins and dorsal fins; and (8) each side of the tail with a low longitudinal ridge running along anterior  $\frac{1}{4}$  of the tail. The disc length was 258 mm and total body mass was 790g (Table 1). The specimen was an immature male with non-calcified claspers (Fig. 4).

**Fig. 4.** The specimen of the Caribbean whiptail stingray, *Styracura schmardae*, captured at the limit of its distribution range in the southwest Atlantic. This specimen is now deposited at the ichthyological collection at



Department of Biology at the Federal University of Ceará (DBUFC 82). Source: Eduardo Freitas.

**Table 1.** Morphometric measurements of the Caribbean whiptail stingray, *Styracura schmardae*, specimen (DBUFC 82) captured at Icapuí, Ceará state, northeastern Brazil, Southwest Atlantic. Morphometrics of the specimens; BMNH 1904.04.30.12, described by Carvalho *et al.* (2016) and stored at the British Museum of Natural History, and MPEG 3547, described by Almeida *et al.* (2008) stored at the Museum Paraense Emílio Goeldi, is provided for comparison purposes.

Morphometric Measurements	DBUFC 82		BMNH 1904.4.30.12		MPEG 3547	
	mm	%DW	mm	%DW	Mm	%DW
Total length (TL)	628	242.5	601	245.3	1280	237.0
Disc length (DL)	246	95.0	224	91.4	508	94.1
Disc width (DW)	259	-	245	-	540	-
Interorbital distance	37	14.3	34	13.9	78	14.4
Interspiracular distance	40	15.4	50	20.4	82	15.2
Eye diameter	6	2.3	7	2.9	17	3.1
Spiracular length	20	7.7	19	7.8	35	6.5
Preorbital length	57	22.0	45	18.4	105	19.4
Prenasal length	35	13.5	31	12.7	78	14.4
Preoral length	44.5	17.2	43	17.6	96	17.8
Internarial distance	21	8.1	20	8.2	41	7.6
Mouth width	23	8.9	20	8.2	45	8.3
Distance between 1st gill slits	53	20.5	55	22.4	-	-
Distance between 5th gill slits	44	17.0	44	18.0	-	-
Branchial basket length	40	15.4	40	16.3	-	-
Pelvic fin anterior margin length	54	20.8	45	18.4	-	-
Pelvic fin width	121	46.7	114	46.5	-	-
Clasper external length	3	1.2	4	1.6	-	-
Clasper internal length	13	5.0	22	9.0	-	-
Distance between cloaca and tail tip	400	154.4	387	158.0	-	-
Tail width	25	9.7	28	11.4	-	-
Snout to cloaca distance	207	79.9	208	84.9	-	-
Pectoral to posterior pelvic length	28	10.8	34	13.9	-	-
Distance from cloaca to sting origin	22	8.5	163	66.5	-	-

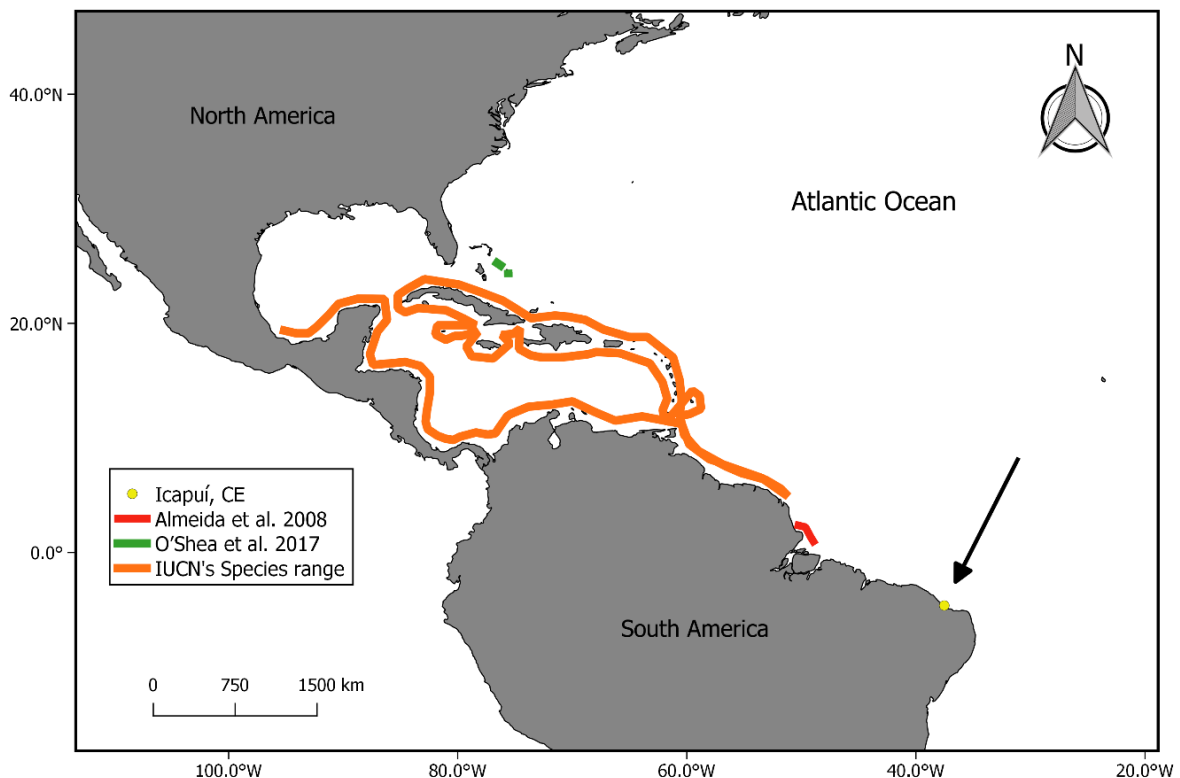
The full NADH-2 sequence obtained from the *S. schmardae* specimen (DBUFC 82) showed high percent identity with the two DNA sequences available in GenBank for its respective species (JN184062.1 and JQ519155). The BLAST outputs for both comparisons reached a value of 99% percent identity.



### 3. DISCUSSION

The Caribbean whiptail stingray, *Styracura schmardae*, has its distribution range in the Southwest Atlantic. This was provisionally postulated by Jucá-Queiroz *et al.* (2008) and is now confirmed. Before the present study, the southernmost confirmed record for this species was the northern coast of Brazil, between Amapá and Pará; (ALMEIDA *et al.* 2008). The record of *S. schmardae* on the easternmost portion of Ceará, northeastern Brazil, extends the species' known southernmost limit for 1,500 km. In addition, According to Garcia Jr. *et al* (2015), the species is not considered part of the marine fish fauna of the east-neighbouring state of Rio Grande do Norte.

**Fig.5.:** Distribution range for the Caribbean whiptail stingray, *Styracura schmardae*. Colors indicate the range agreeing with the cited article: In yellow, the area of capture of the specimen of this study; In red, an addition of the distribution of *S. schmardae* proposed by Almeida *et al* (2008); In Green, the addition of the distribution of *S. schmardae* proposed by O'Shea *et al.* (2017); In orange, it is the distribution range of the specie known by the International Union for the Conservation of Nature (IUCN).



The identification of the specimen as *S. schmardae* is secure. This is because it is supported by all sets of data obtained. All morphological characters support this identification. Also the morphometric data is unequivocal, due to the percent of TL values for

nearly all morphometric characters are practically the same as of those from Almeida *et al.* (2008), a *S. schmardae* specimen from the northern coast of Brazil. Finally, the DNA sequence high match to the reference sequence available from GenBank is also reassuring about the species identity.

Given this confirmed species identification status, it is important that this new information about *S. schmardae*'s distribution range be available to any management plan for this species. Species that are regarded as 'Data Deficient' by IUCN often lack information on abundance and distribution (CHARVET-ALMEIDA & ALMEIDA, 2006). The present study helps fill in this lack of knowledge. This can be considered relevant because sharks and rays are k-strategists, with a slow growth, late maturity and low fecundity, which makes them difficult to recover in the case of overfishing (STEVENS *et al.*, 2000; KYNE, 2016). This species are caught as by-catch in Cuba and at the Bahamas, with purse-seine and shrimp-trawl (NPOA 2015; O`SHEA *et al.*, 2017). Therefore, knowledge about these animals should be gathered as early as possible just so it can be used toward species conservation before depletion or overexploitation takes place.

#### 4. CONCLUSION

- The southernmost limit of the known distribution range of *S. schmardae* is Retiro Grande beach, Icapuí, Ceará.

## REFERENCES

- ALMEIDA, M. P.; CHARVET-ALMEIDA, P.; RINCON, G.; BARTHEM, R. **Registro de ocorrência de *Himantura schmardae* (Chondrichthyes: Dasyatidae) na costa Norte do Brasil**. Arquivos de Ciências do Mar, v. 41, n.2, p. 90-94, 2008.
- ALTSCHUL, S. F.; GISH, W.; MILLER, W.; MYERS, E. W.; LIPMAN, D. J. **Basic local alignment search tool**. *J. Mol. Biol.*, v. 215, p. 403-410, 1990.
- BIGELOW, H. B.; SCHOEDER, W. C. **Fishes of the Western North Atlantic. Part two: sawfishes, skates and rays**. Mem. Sears Found. Mar. Res, v.2, p.1-588, 1953.
- BROWN, James H.; LOMOLINO, Mark V. **Biogeography**. 2nd Edition. Sunderland: Sinauer Associates, 1998. 560p.
- CHARVET-ALMEIDA, P.; DE ALMEIDA, M. P. 2006. ***Himantura schmardae*. The IUCN Red List of Threatened Species**. Version 2014.2. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on 25 August 2014.
- COMPAGNO, L.J.V. Checklist of living elasmobranchs. In: HAMLETT, W.C. (Ed.) **Sharks, skates, and rays: the biology of elasmobranch fishes**. John Hopkins University Press, Maryland, 1999. p. 471-498.
- DE CARVALHO, M. R. Neotropical Stingrays: Family Potamotrygonidae. In: LAST, P.R., WHITE, W.T.; DE CARVALHO, M. R.; SÉRET, B.; STEHMANN, M.F.W.; NAYLOR, G. J. P. **Rays of the World**. Austrália: CSIRO, 2016. p. 619-655.
- DE CARVALHO, M. R.; LOBODA, T. S.; DA SILVA, J. P. C. B. **A new subfamily, Styracurinae, and new genus, Styracura, for *Himantura schmardae* (Werner, 1904) and *Himantura pacifica* (Beebe & Tee-Van, 1941) (Chondrichthyes: Myliobatiformes)**. *Zootaxa*, v. 4175, n. 3, p.201-221, 2016.

- GARCIA-JÚNIOR, J.; NÓBREGA, M. F.; OLIVEIRA, J. E. L. **Coastal fishes of Rio Grande do Norte, northeastern Brazil, with new records.** Checklist, v. 11(3): 1659, 2015.
- JUCÁ-QUEIROZ, B.; SANTANDER-NETO, J.; MEDEIROS, R. S.; NASCIMENTO, F. C. P.; FURTADO-NETO, A. A.; FARIA, V. V.; RINCON, G. **Cartilaginous fishes (class Chondrichthyes) off Ceará State, Brazil, Western equatorial Atlantic – An update.** Arquivos de Ciências do Mar, v. 41(2), p.73-81, 2008.
- KYNE, P. M. Ray Conservation. In: LAST, P.R., WHITE, W.T.; DE CARVALHO, M. R.; SÉRET, B.; STEHMANN, M.F.W.; NAYLOR, G. J. P. Rays of the World. Austrália: CSIRO, 2016. p. 21-24.
- LAST, P. R.; NAYLOR, G. J. P.; MANJAJI-MATSUMOTO, B. M. **A revised classification of the family Dasyatidae (Chondrichthyes: Myliobatiformes) based on new morphological and molecular insights.** Zootaxa, v. 4139, n. 3, p. 345-368, 2016.
- LOVEJOY, N. R.; BERMINGHAM, E.; MARTIN, A. P. **Marine incursion into South America.** Nature, v. 396, n.6710, p.421-422, 1998.
- NAYLOR, G. J. P.; CAIRA, J.; JENSEN, K.; ROSANA, K. A.;WHITE, W.;LAST, P. **A DNA sequence–based approach to the identification of shark and ray species and its implications for global elasmobranch diversity and parasitology.** Bulletin Of The American Museum Of Natural History, v. 367, p. 262, 2012.
- MINISTRY OF THE FOOD INDUSTRY. **National plan of action for the conservation and management of Chondrichthyes in the Republic of Cuba.** Havana, Cuba. 2015. 48 p.



O'SHEA, O. R. O.; WARD, C. R. E.; BROOKS, E. J. **Range Extension in *Styracura* (=Himantura) schmardae (Caribbean Whiptail Stingray) from The Bahamas.** Caribbean Naturalist, v. 38, p. 1–8, 2017.

STEHMANN, M., McEACHRAN, J. D., & VERGARA, R.R. Dasyatidae. In W. Fischer (ed.) **FAO species identification sheets for fishery purposes.** Western Central Atlantic (Fishing Area 31). Vol. 1., FAO, Rome, pp. DasyHimant 1, 1978.

STEVENS, J. D., BONFIL, R., DULVY, N. K., & WALKER, P. A. **The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the implications for marine ecosystems.** ICES Journal of Marine Science, v.57, p. 476–494, 2000.