Arquivos de Ciências do Mar

# CARTILAGINOUS FISHES (CLASS CHONDRICHTHYES) OFF CEARÁ STATE, BRAZIL, WESTERN EQUATORIAL ATLANTIC - AN UPDATE

## Peixes cartilaginosos (Classe Chondrichthyes) do Estado do Ceará, Brasil, Atlântico Equatorial Ocidental - uma atualização

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### *RESUMO*

*Aproximadamente 1.100 espécies de Chondrichthyes (tubarões, raias e quimeras) são hoje conhecidas mundialmente. O inventário faunístico mais recente para águas brasileiras compilou a ocorrência de 160 espécies de elasmobrânquios (tubarões e raias). Entretanto, o conhecimento pleno da riqueza de espécies de Chondrichthyes no Brasil ainda está longe de ser alcançada porque faltam pesquisas no campo de inventários faunísticos. Isto se deve à falta de recursos para pesquisa e conservação. Os peixes cartilaginosos não recebem prioridade de financiamento de pesquisa porque geralmente não são alvo direto de pescarias. Até o presente momento, sabe-se que 50 espécies de elasmobrânquios ocorrem em águas ao largo do Estado do Ceará. O objetivo do presente estudo foi de atualizar o registro de ocorrência de peixes cartilaginosos ao largo do Ceará. Os novos registros foram obtidos durante monitoramento a bordo de pescarias industriais, bem como do monitoramento de desembarque de pescarias industriais e artesanais e um cruzeiro de pesquisas. Este esforço foi complementado com examinação de espécimens de uma coleção ictiológica local, registros de literatura e fotográficos. Os oito novos registros são:* Cirrhigaleus asper, Breviraja *cf.* spinosa, Dipturus *sp.*, Dasyatis geijskesi, Himantura *cf.* schmardae, Manta birostris, Mobula thurstoni *e* Hydrolagus *sp. Além disto, obteve-se também informação sobre a ocorrência* Rhinobatos lentiginosus *no Estado. Esses novos registros representam um aumento de 18% no número de registros de peixes cartilaginosos para o Estado, que agora somam 59 espécies.*

***Palavras-chaves**: tubarão, raia, quimera, novo registro, faixa de distribuição.*

### *ABSTRACT*

*Currently, approximately 1,100 species of Chondrichthyes (sharks, batoids and chimaeras) are known worldwide. The most recent checklist for Brazilian waters compiled 160 elasmobranch species (sharks and rays). Nevertheless, the full extent of knowledge about Chondrichthyan species richness in Brazil is far from being reached, since faunal inventories are still lacking. This is due to insufficient funding for research and conservation. Cartilaginous fishes are low priority for research funding because they are usually non-target species in fisheries. Until now, 50 elasmobranch species were known to occur in waters off Ceará State, Northeastern Brazil. The goal of this study was to update the record of cartilaginous fishes occurring off Ceará. The new records were obtained during industrial fisheries on-board monitoring as well as industrial and small-scale fisheries landings monitoring, and one research cruise. This was complemented with examination of specimens at one local ichthyological collection, literature records, and photographs. The eight new records are:* Cirrhigaleus asper, Breviraja *cf.* spinosa, Dipturus *sp.*, Dasyatis geijskesi, Himantura *cf.* schmardae, Manta birostris, Mobula thurstoni, *and* Hydrolagus *sp. In addition, information on the occurrence of* Rhinobatos lentiginosus *was also obtained. These new records presented represent a 18% increase in the number of cartilaginous fish species reported for the State, which now sums up to a total of 59 species.*

***Key words**: shark, batoid, chimaera, new record, distribution range.*

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## INTRODUCTION

Approximately 1,100 species of cartilaginous fishes, sharks, batoids and chimaeras (Class Chondrichthyes) are known worldwide (Compagno *et al*., 2005). The most recent checklist for Brazilian waters compiled 160 elasmobranch species (sharks and batoids) (Soto, 2006). Nevertheless, the full extent of cartilaginous fishes species richness in Brazil may be far from being reached, since faunal inventories are still lacking. This is due to insufficient funding for research and conservation. Cartilaginous fishes are usually of low priority because they are not usually target species in fisheries (Lessa, 2006).

The interest in shark fisheries has risen globally due to high international prices for fins (Bonfil, 1994, Lack and Sant, 2008). Given this increasing fishing pressure and lack of knowledge of which species are caught (fisheries monitoring are not implemented in most of Brazil), research on species inventory are a vital step in order to permit any management before overfishing occurs. In fact, in Brazil several elasmobranch species faced drastic reductions in population size due to overfishing before any management measurement could be implemented (Vooren and Klippel, 2005).

Recently, the Northeastern Brazil became one new and promising shark-finning hotspot, attracting the attention of Asian markets. Consequently, there was an expansion in shark fin trade in the region. The State of Ceará, with a coastline extension of 574 km and where many different small-scale fisheries activities occur, has become one of the most productive in fisheries overall. In Ceará, the decline of traditional fisheries, mainly lobster and red snapper, was followed by a rise in fishing effort to alternative resources (Fonteles-Filho, 1989). Sharks and batoids are among these "alternative resources". In addition to the interest for shark fins, which applies to all Northeastern region, locally the use of batoid meat for typical dishes had also increased. The exact species involved in all these activities are not known.

Currently, 50 elasmobranch species are known to occur in waters off Ceará (Rocha, 1948; Lessa *et al.* 1999; Gadig *et al*. 2000; Santander-Neto *et al*., 2007). However, during monitoring of fisheries activities, specimens of species previously unreported for the State were observed. This prompted the authors to review historical occurrence accounts and compile new records in an update of the chondrichthyan fauna occurring off the Ceará State.

## MATERIAL AND METHODS

Captures of sharks, rays, and chimaeras off Ceará State waters were recorded during research cruise and fisheries activities monitoring (Figure 1). (1) Small-scale fisheries using hook and line and gillnets sampled a depth range from 10 to 70 m (primarily down to 50 m) on the internal continental shelf off central Ceará coastline. Landings at the Mucuripe Embayment, Fortaleza, were monitored weekly from September, 2006 to November, 2008. (2) Industrial fisheries using bottom longlines ranged from a 44 - 200 m depth (primarily down to 100

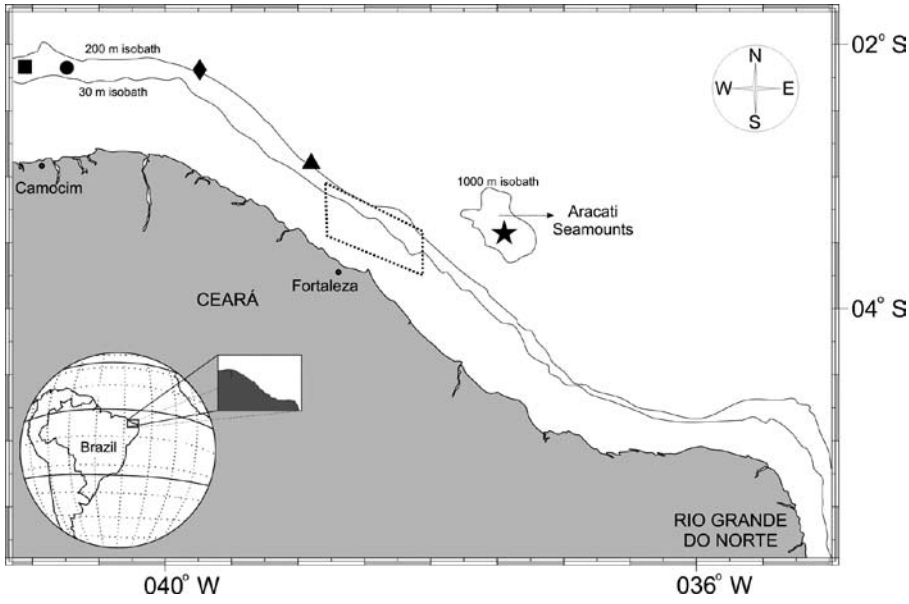


Figure 1: Collection sites for eight species previously unknown to occur off Ceará State, Northeastern Brazil. Geometric symbols indicate central point of fishing/sampling activity or fishing area. ● = *Dasyatis geijskesi*; ◆ = *Dipturus* sp., ▲ = *Cirrhigaleus* asper, ⬚ = *Himantura* cf. *schmardae*, *Manta birostris*, and *Mobula thurstoni*; ★ = *Breviraja* cf. *spinosa* and *Hydrolagus* sp. One additional record of a rare species, previously known to occur off Ceará, is also shown: ■ = *Scyliorhinus* sp.

m on the continental slope) off the State's coastline. Sixteen landings at Fortaleza, Mundaú and Camocim of one same vessel and crew were monitored from November, 2004 to July, 2006. (3) Industrial fisheries using otter trawl ranged from 300 to 400 m around Aracati Seamounts, off eastern Ceará State (between 03°00'S and 3°39'S; 37°10'W and 37°45'W). One fishing trip was on-board monitored in December, 2003. (4) Finally, one research cruise using longlines sampled a depth range from 100 to 230 m off Fortaleza, between March 9th and 14th, 2006. A total of 2500 hooks were used during 4 days of effective sampling activities.

Besides field activities, information was also gathered from other sources. This included: (1) museum vouchers from the icthyological collection of the Instituto de Ciências do Mar (LABOMAR) from the Federal University of Ceará (Universidade Federal do Ceará - UFC); (2) reliable literature records; and (3) photographs provided by colleagues. In all cases, specimens were identified following Bigelow & Schroeder (1948, 1953), Figueiredo & Menezes (1977), Compagno (1984a, 1984b), Gadig (2001), Santos *et al.* (2004), and Compagno *et al.* (2005). Capture location and depth were recorded for each specimen. When possible, specimens were sexed, photographed and morphometric data were recorded. Morphometric measurements, at least total length (TL) or disc width (DW) in most cases, followed Compagno *et al.* (2005) and Bigelow & Schroeder (1953).

Specimens collected during field activities were deposited at the ichthyological collections of the Grupo de Estudo de Elasmobrânquios do Ceará – ELACE, UFC (specimens identified with a ELC number) and the Universidade Estadual Paulista "Júlio de Mesquita Filho"- UNESP, Campus Experimental do Litoral Paulista São Vicente, SP (specimens identified with a UNESP/CLP number).

## RESULTS

***Small-scale fisheries off central Ceará coastline (hook and line and gillnets).*** Three new records were obtained. (1) One specimen of the Chupare stingray (DW aprox. 100 cm) *Himantura* cf. *schmardae*, was landed on March 2008 (Figure 2). Since the specimen was not complete (it misses the head, pelvic fins, and tail), identification could not be precise. Nevertheless, all visible morphological characters suggested *H. schmardae*. Besides, this is the only *Himantura* species known to occur in the West Atlantic. (2) One female Smooth-tail mobula (DW= 132 cm), *Mobula thurstoni*, was landed in June 2008 (Figure 3). According to local fishermen, landings of this species are rare. The specimen is deposited at ELACE's ichthyological collecton (ELC 0164). (3) Two specimens of the Giant manta (LD= 207 cm), *Manta birostris*, were landed on March 2007 and January 2008. One specimen was a female (LD= 207 cm) (Figure 4). The second specimen was traded before additional data could be taken.

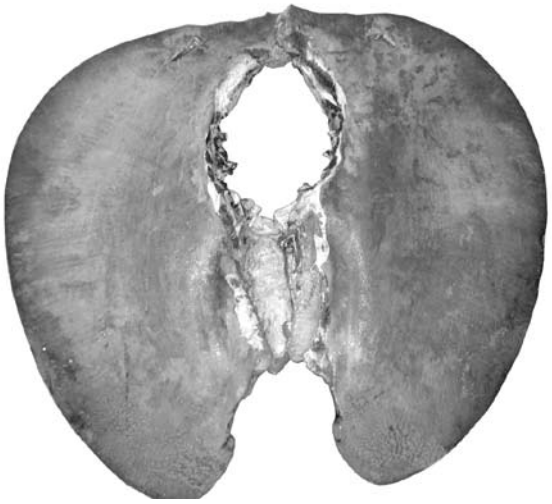

Figure 2. *Himantura* cf. *schmardae* specimen (DW aprox. 100 cm). (Photo by J. Santander-Neto).


Figure 3. *Mobula thurstoni* specimen (DW=132 cm). (Photo by J. Santander-Neto).

Figure 4. *Manta birostris* specimen (DW=207 cm). (Photo by J. Santander-Neto).

***Industrial fisheries off the State's coastline (bottom longlines).*** No new record was obtained from this type of fisheries (most specimens could not be identified at the species level because were landed already dressed). However, one rare account was noted. One male catshark specimen (TL= 36.5 cm), *Scyliorhinus* sp., was captured in 2006 over the external continental shelf, in depths between 110 e 140 m (between 02°05'S and 2°15'S; and 40°55'W and 41°05'W) (Figure 5). The specimen examined fits with the characteristics of an undescribed species, already cited by Gadig *et al.* (2000) and Gadig (2001), including occurrence off Ceará. It is known to occur only off northeastern Brazil, usually at depths greater than 200 m. This undescribed species is distinguished from *S. haeckelii* and *S. besnardi* by the general color pattern, which is dark brown with light spots on the dorsal surface and dark grey on the ventral surface of preserved specimens (Gadig, 2001). The examined specimen is deposited at the ELACE's ichthyological collection (ELC 0005).

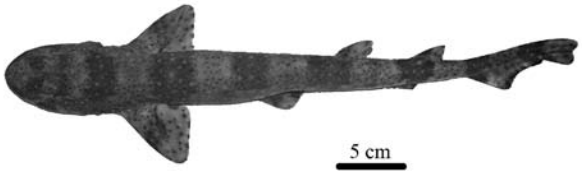


Figure 5 - *Scyliorhinus* sp. specimen (TL= 36.5 cm). (Photo by B. Jucá-Queiroz).

***Industrial fisheries around Aracati Seamounts (otter trawl).*** Two new records were obtained during the on-board monitoring of otter trawl fisheries around Aracati Seamounts. One male chimaera (TL = 48 cm), *Hydrolagus* sp., that is likely not an undescribed species (Otto Gadig, pers. comm.) (Figure 6). The specimen is deposited at the Universidade Estadual Paulista "Júlio de Mesquita Filho" - UNESP, Campus Experimental do Litoral Paulista São Vicente, SP (UNESP/CLP 0001). In addition, one Spinose skate (DW = 15 cm), *Breviraja* cf. *spinosa*, was also captured (Figure 7). This specimen throughout the upper surface of the disc was light brown and had irregular rows of thorns, except along the midline. The thorns were regularly spaced at the margins of the disc. This specimen is also deposited at UNESP (UNESP/CLP 0002).

Figure 6 - *Hydrolagus* sp. specimen (TL=48 cm). (Photo by R. S. Medeiros).

Figure 7 - *Breviraja* cf. *spinosa* specimen (DW=15 cm). (Photo O. B. F. Gadig).

***Research cruise (bottom longlines).*** One adult male skate (TL= 71 cm), *Dipturus* sp., was captured at depths ranging from 200 to 350 m off Itarema, (between 02°05'S and 2°15'S; and 40°55'W and 41°05'W) (Figure 8). This deep water skate is apparently the same species identified as an undescribed *Dipturus* sp. captured off Pernambuco State, Northeastern Brazil (depth range: 350 to 500 m) and presented by Rincon & Lessa (2000) at a scientific meeting. The claspers and the caudal fin of the specimen are deposited at the ELACE Ichthyological collection (ELC 0011).

***Specimens at LABOMAR/UFC icthyological collection.*** Two specimens of the Roughskin spurdog, *Cirrhigaleus asper*, were examined: one female (TL= 63.5 cm, with provisional catalog number: 62) and one male (TL= 77.5 cm, with provisional catalog number: 63) (Figure 9). The specimens were captured with bottom longlines during research cruises conducted over the continental slope (between 2°53,315'S and 2°53,528'S; 38°53,786'W and 38°55,741'W), in depths between 114 e 122 m.

***Photographic record***. One specimen of the Sharpsnout stingray, *Dasyatis geijskesi*, was captured during coastal fisheries and landed in Bitupitá (02°53'S; 41°16'W), Western Ceará State, in March 2005 (Figure 10). No capture of this species has been recorded in Central or Eastern Ceará. The western region of Ceará's State is likely its southeastern most distribution range limit.

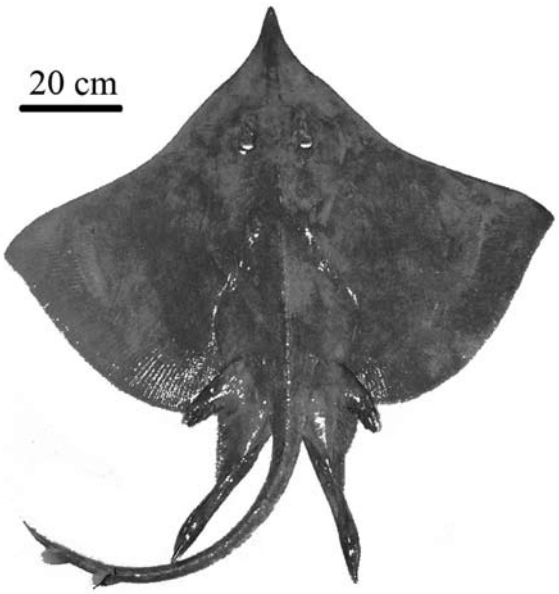


Figure 8 - *Dipturus* sp. specimen (TL=71 cm). (Photo B. Jucá-Queiroz).

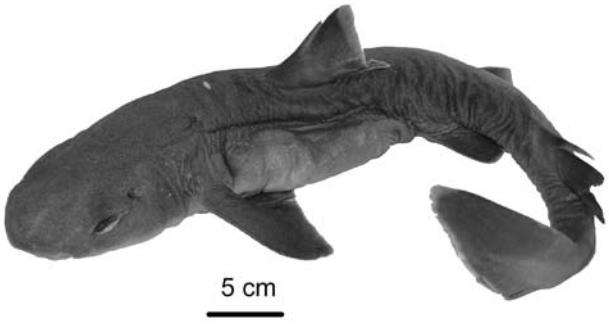


Figure 9 - *Cirrhigaleus asper* specimen (TL=77.5 cm). (Photo by G. Rincon).

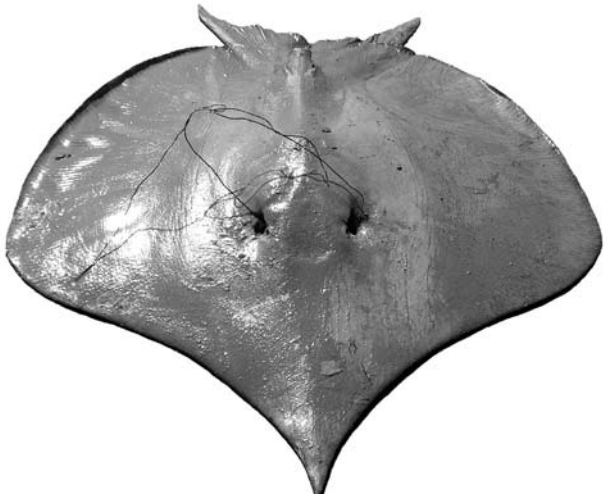

Figure 10 - *Dasyatis geijskesi* specimen (Photo by R. N. Conceição).

## DISCUSSION

**Species composition and richness.** In a pioneer research on the vertebrate fauna of Ceará State, Rocha (1948) published the first account of elasmobranchs for the State, recording 23 species. Of these 23, 19 species are considered valid records (Table I), and 4 are synonymy or misidentifications (Table II). Almost 40 years after Rocha's seminal work, a series of contributions about occurrence and fisheries of elasmobranchs off Ceará were published (Bezerra *et al*., 1987, 1991; Feitosa & Furtado-Neto 1999; Arthaud, 1999). Nevertheless, up to this point, records of elasmobranchs occurring in the region were scattered. This was changed with Gadig *et al*. (2000) synthesis of Ceará elasmobranchs, which added 14 new species records for the State. In total, previously to the present study, at least 50 species of sharks and batoids, and no chimaera, were reported for Ceará's waters [Rocha (1948): n=19, Menezes (1966): n=1, Bezerra *et al.* (1987, 1991): n= 9; Lessa *et al*. (1999): n=5; Gadig *et al*. (2000): n=14; Santander-Neto *et al*. (2007): n=2]. Besides these records, Rosangela Lessa (pers. comm.) also confirmed the presence of the Atlantic guitarfish, *Rhinobatos lentiginosus*, in Ceará waters. The new records presented represent a 18% increase in the number of cartilaginous fish species reported for the State, which now sums up to a total of 59 species (Table I).

The new records provided some remarks regarding range extensions. *Scyliorhinus* sp. and *Dipturus* sp. were caught before only off Pernambuco State, Northeastern Brazil. The record of these species on the continental margin and slope off Ceará may suggest a continuous distribution between these two states, setting ground for first distribution considerations for these species. The records of *Dasyatis geijskesi* and *Himantura* cf. *schmardae* are suggestive that western Ceará State may be the southeastern most distribution range for some coastal species found mainly on the northern coast of Brazil. Northern Brazil is characterized by estuarine environments with dense mangrove forests and high freshwater outflow. In fact, this is the first occurrence of *Himantura* cf. *schmardae* in Northeastern Brazil and its occurrence off Northern Brazil has just being reported (Almeida *et al*., 2008). Other important note is over the fist record for *Mobula thurstoni*. This record is not only the first for Ceará, but also for Northeastern Brazil coastal waters (Gadig, *pers. com.*).

### Notes on literature records

**Rocha (1948).** Several species names used in Rocha (1948) are not considered valid today. Based

Table I: Checklist of chondrichthyan species known to occur off Ceará State, Brazil, Western Equatorial Atlantic.

| Family | Species | Record Type | 1st-record |
|---|---|---|---|
| Chimaeridae | *Hydrolagus* sp. | COL | Present study |
| Hexanchidae | *Heptranchias perlo* | COL | Santander-Neto *et al*. (2007) |
| | *Hexanchus griseus* | COL | Santander-Neto *et al*. (2007) |
| Squalidae | *Cirrhigaleus asper* | MUS | Present study |
| | *Squalus cubensis* | COL | Gadig *et al*. (2000) |
| | *Squalus mitsukurii* | LIT | Gadig *et al*. (2000) |
| Etmopteridae | *Etmopterus bigelowi* | COL | Gadig *et al*. (2000) |
| Somniosidae | *Centroscymnus owstoni* | LIT | Lessa *et al*. (1999) |
| Dalatidae | *Isistius brasiliensis* | LIT | Gadig *et al*. (2000) |
| Ginglymostomatidae | *Ginglymostoma cirratum* | COL | Rocha (1948) |
| Rhincodontidae | *Rhincodon typus* | LIT | Gadig *et al*. (2000) |
| Pseudocarchariidae | *Pseudocarcharias kamoharai* | COL | Gadig *et al*. (2000) |
| Alopiidae | *Alopias superciliosus* | LIT | Gadig *et al*. (2000) |
| Lamnidae | *Carcharadon carcharias* | LIT | Rocha (1948) |
| | *Isurus oxyrinchus* | COL | Rocha (1948) |
| Triakidae | *Mustelus canis* | COL | Rocha (1948) |
| | *Mustelus higmani* | LIT | Lessa *et al*. (1999) |
| Scyliorhinidae | *Scyliorhinus* sp. | LIT | Gadig *et al*. (2000) |
| Carcharhinidae | *Carcharhinus acronotus* | COL | Bezerra *et al*. (1987) |
| | *C. falciformis* | COL | Bezerra *et al*. (1987) |
| | *C. leucas* | COL | Rocha (1948) |
| | *C. limbatus* | COL | Rocha (1948) |
| | *C. longimanus* | LIT | Bezerra *et al*. (1991) |
| | *C. obscurus* | COL | Rocha (1948) |
| | *C. perezi* | LIT | Bezerra *et al*. (1987) |
| | *C. plumbeus* | COL | Bezerra *et al*. (1987) |
| | *C. porosus* | LIT | Rocha (1948) |
| | *C. signatus* | COL | Lessa *et al*. (1999) |
| | *Galeocerdo cuvier* | COL | Rocha (1948) |
| | *Negaprion brvirostris* | LIT | Bezerra *et al*. (1991) |
| | *Prionace glauca* | LIT | Rocha (1948) |
| | *Rhizoprionodon lalandei* | COL | Bezerra *et al*. (1987) |
| | *R. porosus* | COL | Bezerra *et al*. (1987) |
| Sphyrnidae | *Sphyrna lewini* | COL | Bezerra *et al*. (1987) |
| | *S. mokarran* | COL | Menezes (1966) |
| | *S. tudes* | LIT | Rocha (1948) |
| | *S. tiburo* | LIT | Rocha (1948) |
| | *S. zygaena* | COL | Rocha (1948) |
| Pristidae | *Pristis perotteti* | LIT | Rocha (1948) |
| | *P. pectinata* | LIT | Rocha (1948) |
| Narcinidae | *Narcine brasiliensis* | COL | Rocha (1948) |
| Rhinobatidae | *Rhinobatos lentiginosus* | LIT | Lessa, pers. com. to Juca-Queiroz |
| | *R. percellens* | COL | Gadig *et al*. (2000) |
| Rajidae | *Dipturus* sp. | COL | Present study |
| | *Breviraja* cf. *spinosa* | COL | Present study |
| Urolophidae | *Urotrygon microphthalmum* | LIT | Gadig *et al*. (2000) |
| Dasyatidae | *Dasyatis americana* | COL | Lessa *et al*. (1999) |
| | *D. guttata* | COL | Lessa *et al*. (1999) |
| | *D. marianae* | MUS | Gadig *et al*. (2000) |
| | *D. geijskesi* | PHO | Present study |
| | *Pteroplatrygon violacea* | LIT | Gadig *et al*. (2000) |
| | *Himantura* cf. *schmardae* | COL | Present study |
| Gymnuridae | *Gymnura altavela* | LIT | Rocha (1948) |
| | *Gymnura micrura* | COL | Gadig *et al*. (2000) |
| Rhinopteridae | *Rhinoptera bonasus* | COL | Gadig *et al*. (2000) |
| | *Rhinoptera brasiliensis* | COL | Rocha (1948) |
| Myliobatidae | *Aetobatus narinari* | COL | Rocha (1948) |
| Mobulidae | *Manta birostris* | COL | Present study |
| | *Mobula thurstoni* | COL | Present study |

Record Type: COL = Collected; LIT = literature; MUS = Museum Voucher; PHO = Photograph.

on the work of Bigelow & Schroeder (1953) and Mould (1997), whenever possible, accepted valid scientific names were assigned to each non-valid name or synonymy (Table II). Most species can be directly assigned, even though some cases are special. The record of *Carcharias melanopterus* is a misidentification, considering that this species do not occur in the Atlantic. The genus *Pteroplatea* was suppressed favoring *Gymnura*. The genus *Scoliodon* was suppressed favoring *Rhizoprionodon*, and the presence of *R. terranovae* in Brazil as distinct from *R. porosus* is currently under debate. *Pristis perotteti* is considered the valid name for the record of *Pristis pristis*, following Charvet-Almeida & Faria, 2008).

Table II: Non-valid species and synonymies mentioned by Rocha (1948) and its corresponding valid species.

| Rocha (1948) | Valid record? | Nomenclatural status and comments |
|---|---|---|
| *Scoliodon terranova* | No | *Rhizoprionodon porosus* or *R. terranovae*? |
| *Galeocerdo maculatus* | Yes | *Galeocerdo cuvieri* |
| *Carcharias lamia* | Yes | *Carcharhinus leucas* |
| *Carcharias melanopterus* | No | It can not be assigned to any *Carcharhinus* sp. |
| *Carcharias limbatus* | Yes | *Carcharhinus limbatus* |
| *Cynias canais* | Yes | *Mustelus canis* |
| *Pristis pristis* | No | Considered as *Pristis perotteti* |
| *Pteroplatea altavela* | Yes | *Gymnura altavela* |
| *Dasyatis orbiculares* | No | It can not be assigned to any *Dasyatis* sp. |
| *Rhinoptera jussieui* | Yes | *Rhinoptera brasiliensis* |

**Lessa *et al.* (1999).** Six *Echinorhinus brucus* were mentioned as captured between the States of Ceará and Bahia, Northeastern Brazil. Unfortunately though, since no capture locality was provided, it is not know if any of those were actually captured off Ceará waters. Previously to Lessa 1999, *E. brucus* was only known to occur in Southern Brazil (Compagno, 1984a).

**Compagno *et al.* (2005).** The authors of the present study are not aware of records for six species shown as distributed over Ceará's continental shelf in this impressive volume on sharks of the world. The Tresher, *Alopias vulpinus,* and Mako sharks, *Isurus paucus,* may in fact occur off Ceará. Specimens of these two species have already been recorded in neighboring waters. Therefore, the lack of formal records may be due to poor monitoring of industrial oceanic fisheries. The requiem sharks *Carcharhinus altimus* and *C. brevipinna* are large coastal-pelagic species. They are known to occur in waters off Central, Southeastern and South Brazil. It is not known if these two species indeed occur in Ceará. Finally, the Hammerhead *Sphyrna media* and the Daggernose shark *Isogomphodon oxyrhynchus* are two coastal species, occurring preferably in muddy waters of northern Brazil estuaries. In the past decades, several damns were constructed along Ceará's rivers, causing severe impacts on estuaries. It is unknown if specimens from these two species disappeared from Ceará waters before any formal record was taken.

**Vaz (2005).** In a study of molecular markers on Dasyatidae specimens landed in Fortaleza, the author cited the occurrence of one *Dasyatis centroura* specimen. However, external morphological features revealed by the photograph of the referred specimen [page 21 in Vaz (2005)] shows it is in fact *Dasyatis americana*. This was mistake was published in Vaz *et al*. (2006).

## Concluding remarks

The western region of Ceará remains practically unexplored in terms of its chondrichthyan fauna. Given its vast mangrove and estuarine environments, under low human impact levels, it is possible that this region remains as the last refuge in the State for species such as *Pristis perotteti*, *Sphyrna tudes*, and *Negaprion brevirostris*. Also, as noted by Gadig *et al*. (2000) and later by Santander-Neto *et al.* (2007), the knowledge of the State's demersal fauna is still very incipient. Additional research surveys and fisheries monitoring are needed in order to obtain a more complete assessment of the Ceará's cartilaginous fish fauna.

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