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Short Communication

When ghosts come to town: new records of the roughskin spurdog *Cirrhigaleus asper* (Merrett, 1973) from the southwestern Gulf of Mexico

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ABSTRACT. The roughskin spurdog *Cirrhigaleus asper* is a poorly known, deepwater elasmobranch of warm-temperate and tropical waters in the Indian, central Pacific, and western Atlantic Oceans. Basic distribution and trade usage data for this species are lacking or unknown. In April 2021, three female specimens were caught off Alvarado, Veracruz, Mexico, and transported to the Nueva Viga Fish Market in Mexico City to be sold as '*cazón*'. These records represent the first complete documentation of *C. asper* in Mexican waters and the first report of the species being sold in the country's capital for meat.

Keywords: *Cirrhigaleus asper*; deepwater sharks; *Cirrhigaleus*; fish market; Mexico; Gulf of Mexico

INTRODUCTION

Deepwater sharks have one of the slowest life histories among vertebrates, making them vulnerable to overexploitation if not carefully managed (Finucci et al. 2024). The family Squalidae (genera: *Squalus* and *Cirrhigaleus*) comprises deepwater species (Ebert et al. 2021). The genus *Cirrhigaleus* (Squaliformes: Squalidae) encompasses three data-poor shark species that typically occur in deep waters of the shelf, outer shelf, and upper slope of warm-temperate and tropical ocean basins (Kyne & Simpfendorfer 2010). The roughskin spurdog *Cirrhigaleus asper* (Merrett, 1973) has a wider but fragmented distribution than its congeners and occurs in three ocean basins: the western Atlantic (Polanco-Vásquez et al. 2022), the central Pacific (Finucci et al. 2020), and the Indian (Merrett 1973, da Silva et al. 2015). Despite being widely distributed, records of *C. asper* are mostly from scattered observations since its description. The species likely occurs in other areas of the region but has not been extensively studied. Further, it is speculated that the Pacific and the Western Atlantic forms may represent different species (Ebert et al. 2021); hence, the western Atlantic form may be undescribed, as the holotype from Merrett (1973) is from Seychelles, western Indian Ocean.

Limited literature exists for *C. asper*. The species reaches a maximum length of 128 cm (Polanco-Vásquez et al. 2022) and inhabits depths of 240 to 720 m (Auster et al. 2020). Females mature at larger sizes than males and have litters of 12 to 19 pups (Fischer et al. 2006). The International Union for the Conservation of Nature has globally assessed this species as Data Deficient due to lacking biological, taxonomic, and bycatch information (Finucci et al. 2020). This designation emphasized the urgent need for more information on species distribution, potential threats, and their fisheries. In the western Atlantic, the roughskin spurdog has been recorded in the USA (Auster

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et al. 2020), the Virgin Islands (Rohde et al. 1995), Guatemala (Polanco-Vásquez et al. 2022), Venezuela (Ehemann et al. 2019), and Brazil (Fischer et al. 2006). Meanwhile, in Mexico, documentation of *C. asper* has been limited, with only brief accounts and no photographic or museum evidence, with few records published before 2000.

In April 2021, three *C. asper* specimens were collected from small-scale bottom longline fisheries in the southwestern Gulf of Mexico (GoM) near Alvarado, Veracruz, Mexico (Fig. 1). Specimens were commercially eviscerated, refrigerated, and transported to the Nueva Viga Fish Market (hereafter, referred to as Nueva Viga) in Mexico City on April 15 (specimen 1) and April 21, 2021 (specimens 2 and 3) (Figs. 2a-c). The vendor at the fish market provided the general landing location. Castro (2011) was used for species identification, and Ebert et al. (2021) were consulted for morphometric measurements (Table S1). Specimens were photographed, and images of the dorsal head denticles and lower teeth were taken (Figs. 2d-e). Vertebra and tooth counts were performed after processing (Table S1).

Cirrhigaleus asper differs from other similar Squaliformes in the GoM by two nearly equal-sized dorsal fins with white bands at the back edge, a broad snout, prominent nasal flaps, vestigial or absent precaudal pits, and a stocky body (Castro 2011). The dorsal fins of the examined specimens had white bands that were wider at the apex and narrowed as they extended along the posterior margin of the dorsal fin to the rear margin. Two dorsal fins are similar in size; the first is slightly taller and broader than the second (Table S1). Dorsal spines were either damaged (specimen 1; Fig. 2a) or removed entirely (specimens 2 and 3; Figs. 2b-c) before examination. Precaudal pits were absent in all specimens. The upper and lower lobes of the caudal fin were white-tipped, and the upper lobe lacked a subterminal notch. Dermal denticles on the dorsal surface were larger than those on the ventral side. Dorsal head denticles present a central ridge (Fig. 2e). Upper and lower teeth were oblique, smooth, and similar in appearance (Fig. 2d). Tooth row counts consisted of 26 to 27 for upper and 23 for lower rows (Table S1). All specimens were female, with stretched total lengths (STL) ranging from 102 to 115 cm and total lengths (TL) between 95 and 113 cm. Eviscerated weights ranged from 3.6 to 5.7 kg. Maturity status was not assessed because of the removal of reproductive tracts. Still, based on the relationship between maturity and TL in Fischer et al. (2006) and Castro (2011), the three specimens were likely to be mature or close to it. Specimens were not deposited in a scientific collection as they were eviscerated and dissected to perform meristic counts.

The roughskin spurdog is undocumented from the Mexican shark-targeted fishery (Bonfil 1997, Pérez-Jiménez & Méndez-Loeza 2015, DOF 2022), although Del Moral-Flores et al. (2016) noted the species is rare, with less than a handful of records. Two specimens caught at 300 m depth in the Mexican Caribbean confirmed the species in Mexico for the first time, initially misidentified as Cuban dogfish *Squalus cubensis* Howell Rivero, 1936. Still, no further details were provided (Zárate & Basurto 1994). Before this study, three brief reports were available for *C. asper* in the GoM. A 114 cm TL specimen was caught in the southeastern GoM off Campeche Bank (Rohde et al. 1995), and surveys from 1983-1990 off Tuxtlas, Veracruz recorded its present (Schaldach et al. 1997). Similarly, artisanal fisheries surveys in the GoM (unknown location) from 1993-1994 listed this species among 34 shark species caught (Castillo-Géniz et al. 1998) (Table 1). Although systematic checklists include *C. asper* in Mexico's ichthyofauna (e.g. Espinosa-Pérez et al. 2004, Del Moral-Flores et al. 2016, Ehemann et al. 2018, Blanco-Parra & Niño-Torres 2022), the species has not been documented in the literature since 1994 before this study (Table 1). Scarce observations of this shark could be attributed to its deepwater environment preferences, which are inaccessible to most fisheries. It is unknown whether this species is a resident or migrant in Mexican waters. However, similar Squaliformes, like the Pacific spiny dogfish *Squalus suckleyi* (Girard, 1855), are known to migrate up to 7,000 km (McFarlane & King 2003).

Monitoring fish markets offers the opportunity to search for poorly known elasmobranchs (Last et al. 2010), such as documented here. The Nueva Viga is the largest in Latin America and the second largest in the world, handling about 1,500 t of fish and seafood daily, including deepwater shark species (Ballesteros-Hernández et al. 2019, Amos et al. 2022). This study is the first recorded case of *C. asper* trade at the Nueva Viga. The specimens were sold as '*cazón*', a term for shark meat destined for human consumption that can be sold whole, filleted, or dried/salted (Dorantes-González et al. 2023). All specimens were marketed whole and priced by kilogram. The roughskin spurdog may be sporadically traded at Nueva Viga when caught incidentally, but lack of market surveys and its similarity to other Squaliformes might have led to its underreporting.

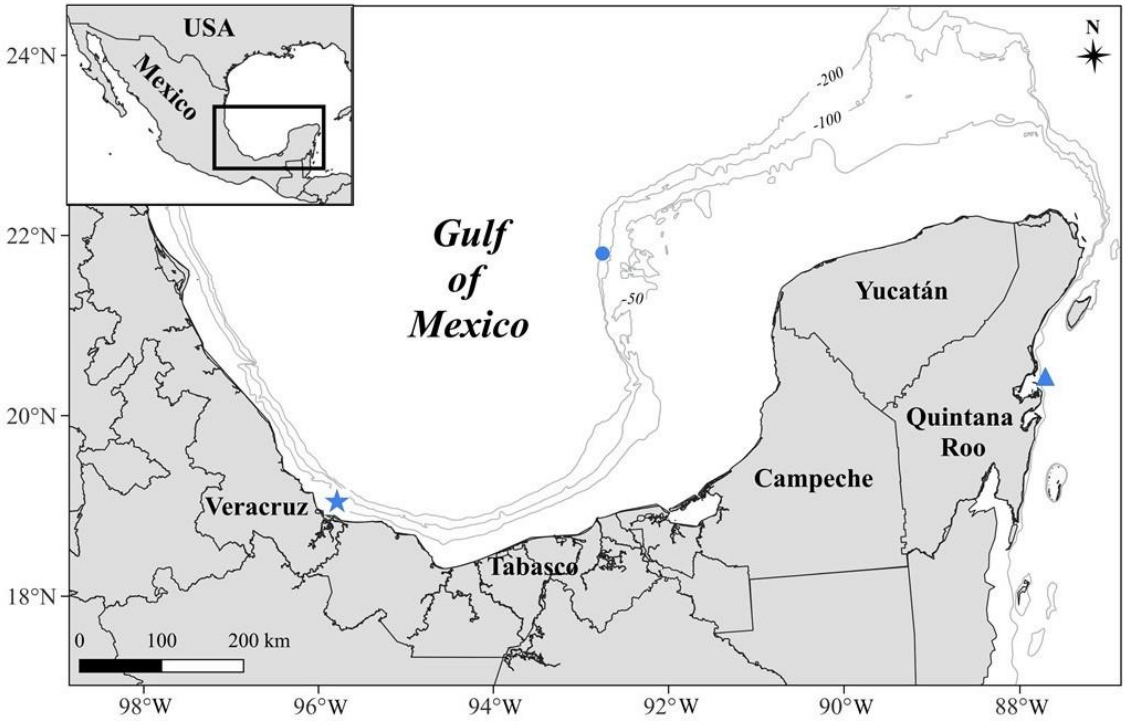

Figure 1. Locations where *Cirrhigaleus asper* individuals have been observed in Mexican waters. The blue triangle indicates the location of Zárate & Basurto (1994), the blue circle indicates the location of Rohde et al. (1995), and the blue star is the fishing location in Alvarado, Veracruz, where the individuals in this study were landed. Negative numbers represent the isobaths.

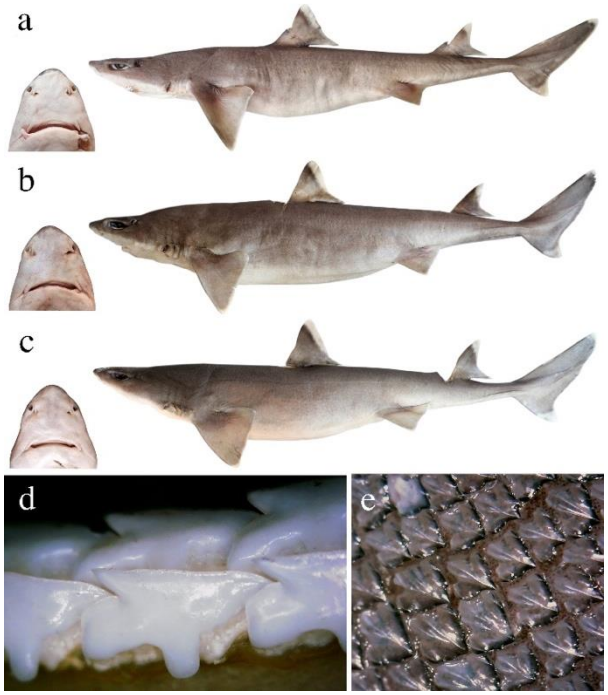

Figure 2. Three female roughskin spurdog *Cirrhigaleus asper* from the southwestern Gulf of Mexico. Snout and lateral view for: a) specimen 1, 102 cm stretched total length (STL), b) specimen 2, 115 cm STL, c) specimen 3, 101 cm STL, d) lower jaw teeth, and e) dorsal head denticles of specimen 2.

Table 1. Summary of the roughskin spurdog *Cirrhigaleus asper* records in Mexican waters. "?" indicates data unreported. TL: total length.

Date	Location	Information provided	Source
?	Off Bahía de la Ascensión, Quintana Roo	Two specimens caught at 300 m depth; no further information provided	Zárate & Basurto (1994)
1980	Off Campeche Bank	Reports one 114.4 cm TL specimen at 21°19'30"N, 92°29'W	Rohde et al. (1995)
1983-1990	Off Tuxtlas, Veracruz	Listed as one of the shark species observed during surveys from 1983 to 1990	Schaldach et al. (1997)
1993-1994	Gulf of Mexico (specific location unknown)	Listed as one of the 34 shark species caught in the Gulf of Mexico	Castillo-Géniz et al. (1998)
2021	Off Alvarado, Veracruz	Morphometrics, meristic counts, photographic evidence, and trade documentation	This study

Recording the trade of often-overlooked deepwater shark species is crucial for their conservation and management, given their slower growth, delayed maturity, and lower fecundity, which make them vulnerable to overfishing (Finucci et al. 2024). Confirming the presence of roughskin spurdog in Nueva Viga and other deepwater shark species (e.g. Ballesteros-Hernández et al. 2019) emphasizes the need for more extensive surveys. Future taxonomic and genetic studies are needed to clarify if *C. asper* comprises a species complex or if distinct populations can be identified across its circumglobal distribution, ultimately aiding in determining the species' current conservation status.

Credit author contribution

B.L. Huerta-Beltrán: conceptualization, validation, methodology, writing-original draft; M.R. Gibson: methodology corrected language, review, and editing; R.E. Lara-Mendoza: provided information, supervision, prepared the map, review and editing. All authors have read and accepted the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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SUPPLEMENTARY MATERIAL

Table S1. Morphometric and meristic counts and measurements, expressed in percentages (%) of the total length of the three female *Cirrhigaleus asper* specimens sold at Nueva Viga Fish Market, Mexico City, Mexico. The number of teeth for the upper and lower jaws was recorded from left to right. *Measurements were compromised as the dorsal spines were altered or removed completely.

Morphometric measurements	Specimen 1		Specimen 2		Specimen 3	
	cm	%	cm	%	cm	%
Eviscerated weight (kg)	3.6		5.8		3.6	
Stretched total length	102.0	106.9	115.8	102.3	101.1	101.2
Total length	95.4	100.0	113.2	100.0	99.9	100.0
Precaudal fin length	78.9	82.7	92.2	81.4	80.1	80.2
Pre-second dorsal fin length	62.5	65.5	74.1	65.5	63.5	63.6
Pre-first dorsal fin length	29.9	31.3	37.9	33.5	32.1	32.1
Head length	20.5	21.5	23.8	21.0	21.5	21.5
Prebranchial length	15.9	16.7	19.4	17.1	16.1	16.1
Prespiracular length	9.8	10.3	10.8	9.5	9.5	9.5
Pre-orbital length	4.7	4.9	6.0	5.3	5.7	5.7
Interdorsal space	25.4	26.6	27.4	24.2	24.9	24.9
Dorsal fin insert to caudal fin upper origin	9.3	9.7	10.5	9.3	10.4	10.4
Pre-pectoral fin length	19.4	20.3	20.7	18.3	19.8	19.8
Pre-pelvic fin length	51.2	53.7	61.2	54.1	54.6	54.7
Snout to vent	56.5	59.2	66.9	59.1	59.5	59.6
Pectoral fin insert to pelvic fin origin	28.0	29.4	35.1	31.0	31.1	31.1
Pelvic fin insert to caudal fin lower origin	23.2	24.3	22.9	20.2	23.7	23.7
Vent to caudal fin posterior tip	44.6	46.8	59.5	52.6	43.5	43.5
Interorbital space	7.6	8.0	8.4	7.4	7.6	7.6
Eye to spiracle length	0.7	0.7	1.1	1.0	1.1	1.1
Spiracle length	1.0	1.0	1.3	1.1	1.5	1.5
Head width	12.0	12.6	14.1	12.5	13.1	13.1
Tail width	6.6	6.9	8.1	7.2	6.7	6.7
Caudal fin-peduncle width	2.8	2.9	3.6	3.2	3.4	3.4
Anterior nasal-flap length	0.7	0.7	1.1	1.0	0.8	0.8
Nostril width	1.6	1.7	2.7	2.4	1.7	1.7
Upper labial-furrow length	1.7	1.8	2.0	1.8	1.4	1.4
Lower labial-furrow length	1.3	1.4	1.5	1.3	0.9	0.9
Internarial space	3.6	3.8	3.8	3.4	3.3	3.3
Mouth length	2.6	2.7	2.1	1.9	1.6	1.6
Mouth width	7.4	7.8	9.3	8.2	6.9	6.9
Prenarial length	2.9	3.0	4.7	4.2	3.6	3.6
Preoral length	6.0	6.3	8.0	7.1	7.4	7.4
Eye length	4.1	4.3	4.3	3.8	4.2	4.2
Eye height	0.9	0.9	1.3	1.1	1.3	1.3
First gill slit height	1.8	1.9	2.3	2.0	2.0	2.0
Fifth gill slit height	2.0	2.1	2.4	2.1	1.9	1.9

Continuation

Morphometric measurements	Specimen 1		Specimen 2		Specimen 3	
	cm	%	cm	%	cm	%
Intergill length	4.2	4.4	5.2	4.6	4.5	4.5
Pectoral fin anterior margin	13.4	14.0	14.4	12.7	13.9	13.9
Pectoral fin inner margin	7.0	7.3	7.0	6.2	7.1	7.1
Pectoral fin posterior margin	10.9	11.4	12.3	10.9	12.0	12.0
Pectoral fin height	12.0	12.6	13.3	11.7	12.3	12.3
Pectoral fin length	12.4	13.0	13.3	11.7	12.3	12.3
First dorsal fin anterior margin	12.6	13.2	*	*	*	*
First dorsal fin posterior margin	9.8	10.3	12.0	10.6	10.8	10.8
First dorsal fin height	8.5	8.9	9.1	8.0	8.5	8.5
First dorsal fin base	8.1	8.5	8.8	7.8	7.4	7.4
First dorsal fin inner margin	6.1	6.4	7.0	6.2	5.6	5.6
First dorsal fin length	14.2	14.9	16.9	14.9	14.0	14.0
Second dorsal fin anterior margin	13.3	13.9	*	*	*	*
Second dorsal fin posterior margin	8.4	8.8	7.1	6.3	8.8	8.8
Second dorsal fin height	7.6	8.0	8.8	7.8	7.6	7.6
Second dorsal fin base	6.4	6.7	7.9	7.0	*	*
Second dorsal fin inner margin	5.0	5.2	5.8	5.1	4.9	4.9
Second dorsal fin length	14.1	14.8	13.7	12.1	11.4	11.4
Pelvic fin anterior margin	7.4	7.8	8.1	7.2	8.6	8.6
Pelvic fin posterior margin	7.5	7.9	8.5	7.5	6.9	6.9
Pelvic fin height	6.0	6.3	7.1	6.3	6.4	6.4
Pelvic fin base	6.3	6.6	6.8	6.0	5.6	5.6
Pelvic fin inner margin	5.1	5.3	6.9	6.1	6.7	6.7
Pelvic fin length	11.3	11.8	12.5	11.0	10.5	10.5
Caudal fin dorsal margin	21.5	22.5	22.1	19.5	20.5	20.5
Caudal fin fork width	8.1	8.5	8.0	7.1	8.8	8.8
Caudal fin fork length	8.3	8.7	10.3	9.1	9.9	9.9
Caudal fin preventral margin	10.3	10.8	11.6	10.2	10.5	10.5
Caudal fin lower postventral margin	3.5	3.7	3.9	3.4	3.9	3.9
Precaudal vertebrae	88		85		89	
Caudal vertebrae	31		30		28	
Total vertebrae	119		115		117	
Tooth formula	14-13/12-11		13-13/12-11		13-14/11-12	