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Rare records of the critically endangered Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758) from the marine ecosystem of the Gaza Strip, Palestine

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Abstract
The Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758) is a rare, bathydemersal, and harmless squaliform shark considered endangered in the Mediterranean Sea. Despite its broad but fragmented Mediterranean distribution, no prior scientific records confirmed its presence in Palestinian Mediterranean waters. This study reports the first verified records of the Angular Roughshark as bycatch in the Gaza Strip, based on photographic and observational data collected from news sources, social media, and consultations with the General Directorate of Fisheries at the Ministry of Agriculture and local fishermen. Over the past two decades, at least 14 specimens (40-90 cm) were recorded to be by-caught, primarily by bottom trawling, and less frequently by gillnets or longlines, with two photographed and documented in 2011 and 2023, Morphology matched published descriptions. Although Gazans commonly consume cartilaginous fishes, this species, locally referred to as *Alfar* (mouse) or *Aleursa* (rat), is typically discarded due to its unattractive appearance, rough skin and flesh, and rarity. Awareness is limited among fishermen, while fisheries authorities recognize its conservation status.

Keywords: Angular Roughshark, *Oxynotus centrina*, Mediterranean Sea, bycatch, bottom trawling, consumption, discard, rarity, conservation status, Gaza Strip, Palestine

1. Introduction
Chondrichthyes or cartilaginous fish (sharks, rays, and chimeras) are particularly vulnerable to fishing in many parts of the world. These fish are characterized by their long lifespans, delayed maturity, low fecundity, and slow growth [1, 2]. Sharks, in particular, play pivotal roles as both predators and scavengers, maintaining the health and balance of diverse marine ecosystems, making their global conservation of paramount importance [3-5], even though they may attack, injure, or kill humans [6]. The diversity of sharks and rays in the Mediterranean Sea is particularly seriously threatened [7]. This sea is said to be the most dangerous sea in the world for cartilaginous fish [8]. In fact, the Mediterranean Sea is home to 51 species of sharks, following rare records of Whale Shark (*Rhincodon typus* Smith, 1828) specimens over the past five years in four Mediterranean coasts: Turkey (2021) [9], Spain (2022), Syria (2025) and Palestine (2025) [10].
The Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758), a pig-faced shark (Figure 1), is a deep-sea or bathydemersal species belonging to the family Oxynotidae and the order Squaliformes, is a rare and endangered species in the Mediterranean Sea, as records of it are scarce throughout this region [2, 11, 12]. This species has been found throughout the Mediterranean Sea from east to west, although sightings are rare [13], and extends north to the Sea of Marmara [14]. The body length of Angular Roughsharks can reach 1.5 meters when fully grown. It is a solitary species that swims slowly. It is characterized by its compact, triangular body in cross-section and its broad, flat head. Its snout is flat and not pointed, and its

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overall shape gives it an appearance similar to a fur-bearing pig [15]. It is commonly called a "pig fish" because it makes a purring sound when it comes out of the water [15].

Fig 1: The deep-sea Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758) is a rare and endangered species in the Mediterranean Sea. Its body is covered with rough, teeth-like scales known as denticles (Source: [15])

The Angular Roughshark has two relatively large dorsal fins that are sail-like, each with a sharp spine, and with the first fin placed far forward above the head, and no anal fin. The body of the fish is covered with rough, teeth-like scales known as denticles (Figure 1). Its color scheme is grey-brown dorsally with dark blotched on its head sides. It is a slow-moving, harmless shark found above the continental shelf and upper slope at depths ranging from ~60 meters to hundreds of meters in the Mediterranean Sea [16], where it is an uncommon bycatch in deep-sea benthic fisheries [13]. A study conducted in France showed that this species feeds on bottom-dwelling organisms, and its diet consists of marine worms, crustaceans, molluscs, Teleostei, and occasionally echinoderms [15, 17]. Some observations suggest they might scavenge or feed on shark eggs [18].

The primary threat to the Angular Roughshark is incidental capture (bycatch) in deep-sea fisheries, particularly bottom trawling, gillnets, and longlines [12]. When caught, Angular Roughsharks have no commercial value and are usually discarded. The fish is occasionally consumed by humans, typically processed as smoked, dried, or salted fish. However, the species is currently listed as endangered by the International Union for Conservation of Nature (IUCN) as pointed out by Abdul Malak *et al*. [19]. This is naturally due to its scarcity and accidental capture during deep-sea trawling and bottom-longline fisheries. There is no doubt that protecting this species helps to preserve deep-sea biodiversity because deep-sea ecosystems are often fragile, slow to recover, and less studied than coastal ecosystems.

In the Mediterranean region, several studies have been carried out to reveal some biological and ecological aspects of the Angular Roughshark [17, 18, 20-31]. In fact, this unusual fish has been recorded, sometimes for the first time, off the coasts of many Mediterranean countries, including its eastern basin [11, 23, 24, 32-39]. Up to date, sightings of the Angular Roughshark have been extremely rare in the eastern Mediterranean waters including the waters of Palestine. There are no published or peer-reviewed scientific records of confirmed catches or sightings of Angular Roughsharks off the coast of the Gaza Strip, Palestine. Accordingly, this paper presents rare records of the Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758) by-caught in the marine ecosystem of the Gaza Strip, Palestine. This study is significant because it is the first to address this unusual and rare fish in the marine environment of Palestine. Because this species lives in deep waters and rarely surfaces, many inhabitants of Mediterranean countries even those living nearby, such as Gazans—are unfamiliar with it. Therefore, its rarity means that every confirmed sighting or catch is considered valuable scientific data.

2. Methodology

The current descriptive study relied on collecting data and photos related to the rare documentation of Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758) in the Mediterranean Sea off the Gaza Strip. This was achieved through reviewing news websites and social media platforms, as well as communicating and engaging in dialogue with various stakeholders, such as the General Directorate of Fisheries at the Ministry of Agriculture and some local fishermen. Rare photographs of the fish were obtained. The Gaza Strip is a strip of Palestinian land, ranging from arid to semi-arid, located in the southeastern Mediterranean. It is 42 kilometers long and covers an area of 365 square kilometers. Its current population exceeds 2.4 million, making it one of the most densely populated areas in the world. More than 4,500 fishermen work in the fishing sector, using over 1,800 fishing vessels of varying sizes, speeds, and functions. Fishing methods are diverse, including different types of nets, longlines, and other equipment.

3. Results

3.1. Accidental capture of Angular Roughsharks in the Gaza Strip

Despite its extreme rarity in the Mediterranean Sea off the Gaza Strip, where Gazan fishermen can access it during various fishing operations ranging from 3 to 6 nautical miles, and rarely beyond that, Angular Roughshark *Oxynotus centrina* (Linnaeus, 1758) is not a target species for fishermen. However, it may occasionally be caught as bycatch by bottom trawls, gillnets or longlines, with bottom-trawling was the main fishing gear. Over the past twenty years, and following discussions held by researchers with both staff of the General Directorate of Fisheries at the Ministry of Agriculture and some local fishermen, at least 14 specimens of this bottom-dwelling shark, ranging in length from 40 to 90 centimeters, have been recorded. Of these samples, two were already photographed and documented in November 2011 and September 2023 (Figures 2 & 3).

Fig 2: A specimen of the bottom-dwelling Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758) was caught by a trawl net in Khan Younis, southern Gaza Strip on November 22, 2011

3.2. Local description of the Angular Roughshark

In general, the Angular Roughshark is an unusual-looking

species of deep-sea sharks. Specimens of Angular Roughsharks caught incidentally in the Mediterranean Sea off the Gaza Strip (see Figures 2 and 3) are characterized by a compact, triangular body in cross-section and a broad, flattened head. The snout is flat and blunt. The eyes are high on the side of the head. The spiracles are very large compared to most locally known sharks and are located directly behind the eyes, at the top of the head. The gill slits, which have a respiratory function, are five pairs and are very large. The skin is covered with large, rough dermal denticles; giving the body sandpaper-like texture, hence its name "rough". Their relatively large dorsal fins are sail-like, each with a strong spine. This shark lacks an anal fin. As with other known sharks, its tail bears an asymmetrical bilobed fin: the upper lobe is larger than the lower. The back is grey-brown to almost black with dark spots on the head and sides.

3.3. Did Gazans eat Angular Roughsharks?

Gazans are accustomed to eating all cartilaginous fish, including sharks. However, the Angular Roughshark, which resembles a pig and is locally called *Alfar* (mouse) or *Aleursa* (rat), is thrown away by Gazan fishermen, as shown in a very short video posted on social media platforms. Contacts made by researchers with the General Directorate of Fisheries at the Ministry of Agriculture and a number of Gazan fishermen revealed several reasons why the Angular Roughshark is undesirable for consumption:

1. Gazan fishermen avoid eating the Angular Roughshark because its appearance is unappealing to them, resembling a mouse, rat, or even a pig.
2. Gazan fishermen claimed that the skin of this species of fish is thick and that its flesh is described as unappetizing because it is rough and tough.
3. Some experienced fishermen claimed that the Angular Roughshark has low nutritional and commercial value compared to other species, and that its taste is not as delicious as it is believed to be in many Arab countries.
4. This species of fish is very rare, as it is a bottom-dwelling fish and rarely gets caught in fishing gear. Consequently, it is unknown to most fishermen or even the general population of the Gaza Strip. Moreover, Gazan fishermen emphasize that it has never been, and will never be, their target.

Fig 3: Another specimen of the bottom-dwelling Angular Roughshark (*Oxynotus centrina* Linnaeus, 1758) was by-caught in a trawl net near the fishing port of Gaza City on September 8, 2023

3.4 Are Gazan fishermen aware of the international conservation status of the Angular Roughshark?

The Angular Roughshark is a very rare demersal species in the Gaza Strip's marine ecosystem. The General Directorate of Fisheries at the Ministry of Agriculture is aware of the species and its global conservation status, but most fishermen are unaware of it and may never have even heard of it. A very limited number of fishermen reported that they learned from some social media sites and websites that the Angular Rough Shark is a globally endangered species and deserves protection.

4. Discussion

The Mediterranean coastline off the Gaza Strip, which is approximately 42 kilometers long, is receding at a relatively rapid rate, exceeding 100 meters [40], and a suitable deep-sea environment for the Angular Rough Shark may exist. However, the area suffers from a lack of regular marine surveys. This is due, of course, to the scarcity of marine scientists and marine biologists, limited financial and technical resources, and the Israeli occupation's control over the marine environment and fishing zone. Gazans are prohibited from fishing and diving in depths far from the shore for security reasons, as claimed by the Israeli occupation [41, 42]. Many recent marine biodiversity studies around the Gaza Strip focus on more attractive or commercially important species such as fish [43-47], sea turtles [48-52], and some marine mammals [53-56].

Again, the limited scientific record of the Angular Roughshark in the Palestinian Mediterranean can be attributed to the scarcity of specimens that can be collected from the deep sea, which itself is a consequence of limited marine biology research. This scarcity stems from a lack of specialists, limited technical resources, and the inability to navigate and dive in deep waters due to Israeli occupation measures. Therefore, the scarcity or absence of records for any fish or other marine species in the Gaza Strip does not necessarily mean that the species is not present. This can be proven by the fact that Gazans have recorded many rare or first appearances over the years of marine creatures such as the Striped Dolphin (*Stenella coeruleoalba* Meyen, 1833) [56], the Mediterranean Monk Seal (*Monachus monachus* Hermann 1779) [53, 54], the Ocean Sunfish (*Mola mola* Linnaeus 1758) [57], the Coral Stonefish (*Synanceia verrucosa* Bloch and Schneider, 1801) [58], the Whale Shark (*Rhincodon typus* Smith 1828) [10], and others.

As a deep-sea fish, it is often caught incidentally using gear designed for demersal species. Locally, it was sometimes caught incidentally using bottom trawls, gillnets, or longlines, with bottom trawling being the primary fishing method. However, some individuals may be caught using different fishing gear. Kabasakal [32] reached similar conclusions, finding that bottom trawling was the main fishing tool for the species concerned, followed by beam-trawls, gillnets, and longlines. Özdemir *et al*. [37] noted that this species has been caught incidentally in trawls. Gajić *et al*. [35] reported that specimens of this species have indeed been caught in trawls, longlines, or drift nets, and a single adult fish was caught using a float and hook. Şen & Özekinci [59] showed that the species was caught by trammel nets in the Southern coasts of the Marmara Sea, Turkey. Based on the above, it can be concluded that the large spiny dorsal fins and relatively large body size of the Angular Roughsharks make them prone to getting entangled in various types of nets as confirmed by Ebert & Stehmann [1] and Smith [15].

The results of this study indicated that at least 14 specimens of the Angular Roughshark were caught incidentally in the marine ecosystem of the Gaza Strip over the past twenty years, based on meetings with staff of the General Directorate of Fisheries at the Ministry of Agriculture. In fact, this figure seems reasonable given the rarity of this species and its benthic lifestyle in the Gaza Strip, which has a Mediterranean coastline of no more than 42 km, in addition to reasonable records on the long coastlines of other Mediterranean countries. For example, a total of 20 specimens of the species were recorded between May 2015 and September 2021 in the eastern Adriatic Sea. Nineteen of these were in Croatian territorial waters and one in Montenegrin territorial waters. Juveniles, sub-adults, and adults were reported [35].

According to Koehler [60], two individuals of the Angular Roughshark (male and female) were caught southeast of Malta in 2018 at a depth of 60-100 meters < 5 kilometers from the shore. Similarly, Capapé *et al*. [21] documented the capture of two juvenile specimens (male and female) of this species off the northern coast of Tunisia after an absence of two decades. Kabasakal & Kabasakal [61] recorded only one specimen of the species during an extensive survey of sharks in the northern Aegean Sea between 1995 and 2004. In addition, Kabasakal & Bilecenoğlu [62] surveyed online media sources related to Turkish sharks and identified 268 specimens representing 10 families and 16 species, including only one specimen of the Angular Roughshark, indicating its extreme rarity. Although the results of the current study, in addition to other studies concerning the presence of the fish in question, have confirmed the rarity of this species in the eastern Mediterranean, Serena & Relini [63] confirmed that this species is more common in the western Mediterranean than in the east. It can be concluded that the distribution of Angular Roughsharks in the Mediterranean Sea varies from region to region. They may be absent from some Mediterranean coasts, while specimens are still caught sporadically and rarely off the coasts of other Mediterranean countries, in small but varying numbers. In fact, most sightings of the Angular Roughshark have been recorded off the Turkish coast due to the diversity of its marine environments, which include the Black Sea, the Sea of Marmara, the Aegean Sea, and the Mediterranean Sea. This is supported by several studies cited in this research.

As for the local description of the Angular Roughshark, due to its deep-sea habitat, it has larger spiracles. This is, of course, due to the low oxygen levels at those depths, as these larger spiracles make it easier for fish to draw in enough water to ventilate its gills without using the mouth [1, 64]. The Angular Roughshark is distinguished by two prominent dorsal fins, each bearing a powerful spine. These fins are among its most distinctive features. They are high, triangular in shape, and have sharp angles [28, 65], which has earned this species its common name, "angular shark". The spines likely provide defensive protection against predators in its slow-moving benthic lifestyle as was pointed out by Smith [15]. With regard to coloration, the dark color of the species is actually attributed to its benthic lifestyle in deep or murky waters. Dark coloration, as an ecological adaptation, is useful for the fish in terms of camouflage on the seabed, thus reducing detection by predators and prey. A generally dark body offers better concealment from multiple viewing angles [1].

In fact, the Angular Roughshark is rarely consumed by humans, mainly due to its low commercial value, limited catch, and generally undesirable meat characteristics. Consequently, this species is typically discarded when caught as bycatch in bottom trawls and bottom fishing gear [13, 66-68]. Although it has never been consumed in the Gaza Strip, according to local sources, it is not a target for local fishermen; it has no nutritional value compared to other species of sharks that are caught locally and that fishermen compete to catch [6, 46]. In an extremely rare incident in the Gaza Strip, a live shark, measuring between seven and eight meters in length, was caught in Khan Younis, in the southern Gaza Strip, on October 17, 2025. Its meat was distributed to between 3,000 and 4,000 Gazans, and was consumed entirely [10]. Although rarely consumed in the Mediterranean, the Angular Roughshark has been reported to be occasionally utilized for human consumption in other parts of its distribution range [13, 66]. In short, this species of fish has little commercial value worldwide, and if by-caught, it is either discarded or used in low-value ways rather than forming targeted food fisheries as pointed out by Kabasakal & Bilecenoğlu [62].

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