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A NEW RECORD OF THE CRITICALLY ENDANGERED SMOOTHBACK ANGELSHARK *SQUATINA OCULATA* FROM ALGERIAN WATERS (GFCM-GSA 04): BIOLOGICAL DATA AND IMPLICATIONS FOR MANAGEMENT

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The Smoothback angelshark *Squatina oculata* is classified as Critically Endangered on the IUCN Red List of Threatened Species. It has been extirpated from much of its historical range, resulting in a significantly reduced and fragmented current distribution across the Mediterranean. New occurrence records, combined with biological data, are crucial to guide effective conservation measures in the basin. Here, we report the bycatch of a Smoothback angelshark off El Kala waters, at the extreme eastern boundary of Algeria (GFCM-GSA 4), in June 2025. The specimen was identified as a subadult female, measuring 857 mm in total length and weighing 5606.5 g. For the first time in this subarea, morphometric characteristics of an angel shark species were documented, complemented by the integration of Local Ecological Knowledge from fishermen. The possible establishment of a viable *S. oculata* population in the fishing grounds remains an optimistic hypothesis that cannot be excluded. This rare record from Algerian waters provides valuable insights to help fill knowledge gaps on the species in the southwestern Mediterranean and underscores the urgent need for targeted monitoring and conservation actions in the region.

Key words: Angel sharks, morphometric characteristics, Local Ecological Knowledge, Algeria, GFCM-GSA 4, conservation

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Sklat žutan *Squatina oculata* klasificiran je kao kritično ugrožena vrsta na Crvenom popisu ugroženih vrsta IUCN-a. Istrijebljen je iz većeg dijela svog povijesnog područja rasprostranjenosti, što je rezultiralo značajno smanjenom i fragmentiranom trenutnom rasprostranjenošću u Sredozemlju. Novi nalazi, u kombinaciji s biološkim podacima, ključni su za učinkovite mjere očuvanja. Rad donosi zapis o slučajnom ulovu sklata žutana u vodama El Kala, na krajnjoj istočnoj granici Alžira (GFCM-GSA 4), u lipnju 2025. godine. Primjerak je identificiran kao subadultna ženka, ukupne duljine 857 mm i težine 5606,5 g. Po prvi put u ovom potpodručju dokumentirane su morfometrijske karakter-

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istike vrste jednog sklata, dopunjene integracijom lokalnog ekološkog znanja od strane ribara. Moguće uspostavljanje održive populacije *S. oculata* u ovom ribolovnom području ostaje optimistična hipoteza koja se ne može isključiti. Ovaj rijedak nalaz iz alžirskih voda pruža vrijedne uvide koji pomažu u popunjavanju praznina u znanju o vrsti u jugozapadnom Sredozemlju, i naglašava hitnu potrebu za ciljanim praćenjem i akcijama zaštite u regiji.

Ključne riječi: sklatovi, morfometrijske karakteristike, Lokalno ekološko znanje, Alžir, GFCM-GSA 4, zaštita

INTRODUCTION

Angel sharks (*Squatina* spp., Duméril 1806) are commonly described as "bizarrely shaped" due to their dorsoventrally compressed, ray-like morphology, which distinguishes them from other elasmobranchs (Compagno, 1984; Nelson *et al*., 2016). As "lie-and-wait" ambush predators feeding on demersal prey, they are highly vulnerable to capture in bottom trawl and trammel net fisheries (Lawson *et al*., 2020). Consequently, the family Squatinidae is among the most threatened groups of chondrichthyans worldwide, with more than half of its 23 recognized species considered at moderate to severe risk of extinction (Dulvy *et al*., 2014, 2016; Gordon *et al*., 2019; Weigmann, 2023). In the Mediterranean, three congeneric species occur: the Sawback angelshark *Squatina aculeata* (Cuvier, 1829), the common angelshark *Squatina squatina* (Linnaeus, 1758) and the Smoothback angelshark *Squatina oculata* (Bonaparte, 1840), all listed as Critically Endangered on the IUCN Red List (Morey *et al*., 2019a, 2019b, 2019c). Their dramatic population declines have been driven primarily by intense fisheries pressure, both targeted and incidental (bycatch), combined with low biological productivity, limited abundance and fecundity, reduced genetic diversity, and habitat degradation (Miller, 2016; Zava *et al*., 2020; Lawson *et al*., 2020; Zava *et al*., 2022; Enajjar *et al*., 2025). As a result, remaining populations are thought to be small, fragmented, isolated and are likely undergoing continued depletion across their historical range (Miller, 2016; Gordon *et al*., 2019; Zava *et al*., 2020; Giovos *et al*., 2022, Santos *et al*., 2024; Enajjar *et al*., 2025).

Since the 1990s, more than 300 angel shark specimens have been examined in the Mediterranean, with most recent records clustering in the eastern basin (Geographic Sub Area 22 of the General Fisheries Commission for the Mediterranean, GSA 22) and the central Mediterranean (GSAs 12, 13, 14 and 15) (Giovos *et al*., 2022; Enajjar *et al*., 2025 and references therein; Hamza *et al*., 2025). These subareas appear to represent the main contemporary key habitats for Mediterranean Squatinidae. However, to contribute effectively to conservation efforts, monitoring new occurrences of angel sharks in the basin remains essential for updating critical data on their actual geographical distribution, habitat, and biology (Yiğin *et al*., 2019; Zava *et al*., 2020; Lawson *et al*., 2020; Zava *et al*., 2022).

In Algerian waters (GSA 04), recent observations of *S. aculeata*, *S. squatina*, and *S. oculata* remain rare and sporadic. Between 2008 and 2020, only six specimens were documented: two Sawback angelsharks (Hemida *et al*., 2024), one Angelshark (Ramdane & Trilles, 2008), and three Smoothback angelsharks (Capapé *et al*., 2023). The present study reports the most recent occurrence of angel sharks in GSA 4, documented in 2025. We provide a new record of a female *S. oculata* specimen, including its main

morphometric measurements and ontogenetic stage. We also discuss this capture in the context of assessing the species' current status along the Algerian coast.

MATERIALS & METHODS

On 16 June 2025, an individual of *Squatina oculata* (Fig. 1) was recorded in a fishmonger in El Kala region (Fig. 2). The specimen, according to the seller, had been caught as bycatch by a local trawler operating in the El Kala fishing ground (37°00'31.9"N 8°21'50.1"E), located at the extreme eastern boundary of GSA 4 immediately bordering GSA 12 (Northern Tunisia). The specimen was photographed, weighed to the nearest 0.1 g, and measured using either a digital caliper (±0.1 mm) or a tape measure (±1 mm) depending on the parameter measured according to Compagno (1984) and Last & White (2008). All procedures were conducted in situ prior to the specimen being sold eviscerated under the common name "Skwader" (Arabic: سكوادر) at a market price of 1200 Algerian dinars, approximately 9 USD per kilogram.

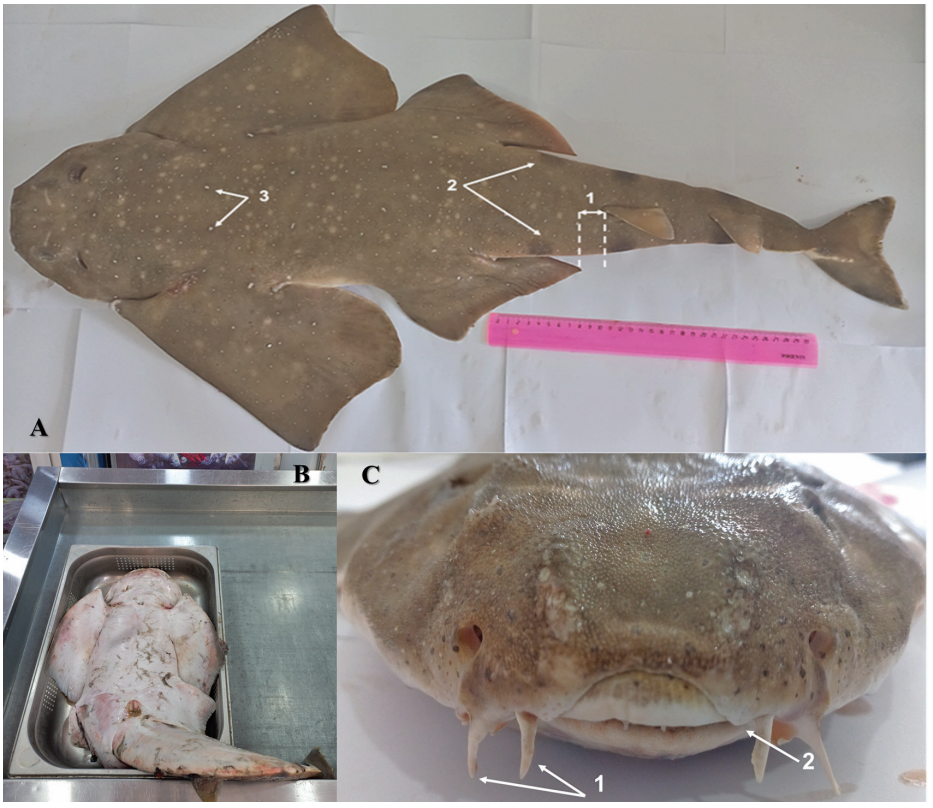


Fig. 1. Female *S. oculata* specimen incidentally caught in the El Kala fishing ground and displayed at a fishmonger's stall. **A**: dorsal view: specimen washed, wiped, and prepared for morphometric measurements (1: hind tip of pelvic fin not reaching the origin of the first dorsal fin; 2: brown bars on the tail; 3: symmetrical white spots on the dorsal surface); **B**: ventral view; **C**: frontal view of the head of *S. oculata* (1: barbels bordering a fringed median lobe; 2: dermal folds on the sides of the head, slightly undulate).

The studied specimen was identified to species following Compagno (1984), Serena (2005), and Kabasakal (2020). Its reproductive maturity was determined macroscopically by an accurate examination of photos taken during evisceration based on the criteria of Capapé *et al.* (1990, 2002) and Osaer *et al.* (2015).

In addition to the biological observations, photographs of *Squatina* spp. specimens were shown to a group of 19 professional fishers, either retired or still active, each with 25 to 40 years of experience in the El Kala fishing grounds. The interviews (June-July 2025) did not follow a strictly structured questionnaire but consisted of a series of targeted questions covering species recognition, past encounters, capture frequency, and whether the occurrence of angel sharks had changed over time. Because of the nature of the questions, the information collected was qualitative rather than quantitative. Each interview lasted approximately 15 to 30 minutes, sometimes longer for senior fishers whose recollections spanned several decades. Notes were taken manually during the conversations, and responses were recorded as summarized statements, with verbatim comments documented when particularly relevant. Qualitative data were subsequently analyzed using simple frequency counts and anecdotal thematic summaries to identify recurrent patterns in fishers' observations and experiences. The objective of applying Local Ecological Knowledge (LEK) was to complement our record with both recent and historical insights on the occurrence of *Squatina* spp. in the El Kala fishing grounds.

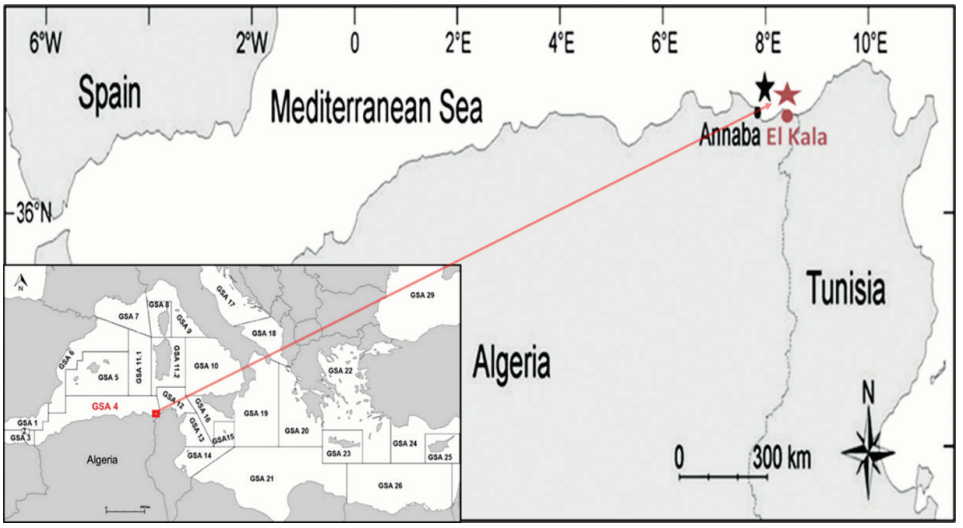


Fig. 2. Map showing the capture site of *S. oculata* along the Algerian coast (GSA 4) (red star: present study, black star: previous records from the Annaba fishing ground; modified from Capapé *et al.*, 2023).

RESULTS

The examined individual was identified as a female (absence of claspers) *Squatina oculata* based on key diagnostic features (Compagno, 1984; Serena, 2005; Kabasakal, 2020) such as: strong concavity between eyes, eyes diameter equal to spiracles, an-

terior nasal flaps with weakly bifurcated barbels bordering a fringed median lobe, large spines present on snout and above eyes and absent from dorsal surface, very broad tronc, pelvic fin tips not reaching the origin of the first dorsal fin, a greyish to grey-brown dorsal surface with small round black and symmetrical white spots, with brown bars on the tail, and a white/ beige ventral surface.

The specimen measured 857 mm in total length and 5606.5 g in total weight. Morphometric measurements of the various parts of the body, expressed as absolute values and percentages of total length (TL %), are summarized in Tab. 1. Despite time constraints, since the specimen was destined for sale, a maximum number of morphometric measurements were taken. Nevertheless, these represent the first reported morphometric data for angel sharks in GSA 4.

Moreover, the examined female specimen was categorized as sub-adult (immature) based on macroscopic observations. As shown in Fig. 3, the epigonal organ was predominant, and both ovaries were functional, with the left one more developed and containing more dispersed oocytes than the right. Small white translucent ovarian follicles were also present, and the maximum oocyte diameter did not exceed 7 mm.

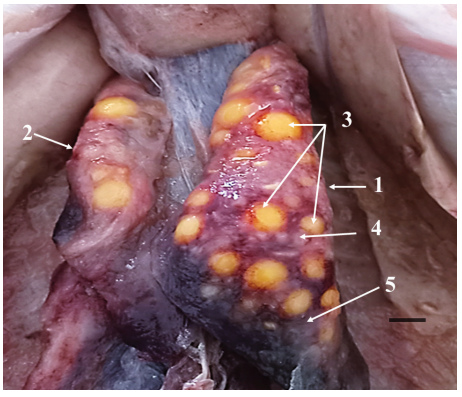


Fig. 3. Macroscopic view of the ovarian condition of the sub-adult *S. oculata* from the El Kala fishing ground (GSA 4) (1: left ovary, 2: right ovary, 3: group of small follicles, 4: primary white translucent follicle, 5: epigonal organ, scale bar = 5 mm).

Tab. 1. Body measurements (mm) and weights (g) of the female *S. oculata* specimen from the El Kala fishing ground (GSA 4)

Measurement	Value	% TL
Total length	857	100
Fork length	810	94.5
Standard length	747	87.2
Pre-first dorsal length	550	64.2
Pre-second dorsal-fin length	635	74.1
Prepelvic length	360	42
Prepectoral length	165	19.2
Prespiracular length	66.5	7.8
Eye length	16	1.9
Preorbital length	26	3
Head width	118	13.8
Mouth width	94	11
Interorbital space	59	6.9
Interspiracular space	55	6.4
Interdorsal space	68	7.3
Dorsal–caudal space	71	8.3
Width at pectoral origins	118	13.8
Trunk width	167	19.5
Tail width	103	12
Tail height	109	12.7
Pectoral-fin length	272	31.7
Pectoral-fin anterior margin	232	27.1
Pectoral-fin base length	84	9.8
Pelvic length	194	22.6
First dorsal-fin base length	33	3.9
First dorsal-fin height	53	6.2
First dorsal-fin anterior margin	68.5	8
Second dorsal-fin base length	29	3.4
Second dorsal-fin height	47	5.5
Caudal-fin height	99.1	11.6
Total body weight	5606.5	
Eviscerated weight	5073.3	

Concerning the LEK results, all 19 professional fishers interviewed reported recognizing angel sharks and confirmed having previously encountered them in their catches. Approximately 80% stated that such captures have occurred only rarely since the late 1980s, mainly as bottom-trawl bycatch, whereas the remaining ≃20% reported encountering the species more frequently, with approximately 2 to 4 captures per year over the past decade. However, all interviewed fishers were unaware of the angel sharks' protected status, highlighting a significant gap in local awareness.

In addition to the information gathered during the interviews, a historical photograph (Fig. 4) was identified on a private Facebook page dedicated to local community memory in El Kala. The image, dated to the 1970s, shows a fisher holding a *Squatina* spp. specimen in El Kala harbor. The specimen is clearly a male, as indicated by the presence of claspers; however, because only the ventral surface is visible, the species cannot be determined with certainty. Although this photograph cannot be considered a formal scientific record, it visually supports the testimonies indicating that angel sharks were encountered in the area several decades ago.

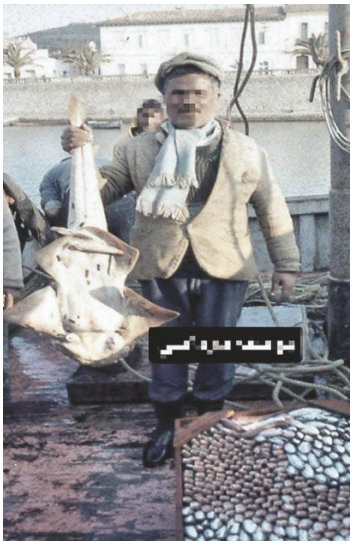


Fig. 4. A fisher from El Kala holding a *Squatina* spp. specimen in 1970s (a visual testimony of a once-documented presence, with the harbor of El Kala in the background (source: private Facebook page).

DISCUSSION

The Critically Endangered Smoothback angelshark *Squatina oculata*, was historically distributed throughout the eastern Atlantic, from southern Portugal to Namibia, and the entire Mediterranean Sea (Compagno, 1984; Miller, 2016; Zava *et al*., 2022). However, according to Morey *et al.* (2019b), the species' abundance has declined dramatically by at least 80 % over the past five decades, with nearly half of its original range extirpated, particularly in the north-western part of the basin (Miller, 2016; Lawson *et al*., 2020; Soldo & Lipej, 2022).

At the southern margin of the Mediterranean, within Algerian waters (GSA 4), *S. oculata* is considered rare and has only been reported sporadically. Contemporary

records (Tab. 2), including the occurrence documented in this study, provide valuable evidence that the species still persists locally, thereby supporting the "Extant" classification assigned by Lawson *et al.* (2020) to the Algerian coast. Moreover, the fact that our record concerns a solitary incidentally caught specimen is consistent with the solitary nature of the species, as previously observed in the eastern Mediterranean (Akyol *et al.*, 2023; Kabasakal & Kabasakal, 2004; Ergüden *et al.*, 2019). Similarly, a broader bycatch survey from various parts of the Mediterranean revealed that about 75 % of the species' captures were caught in bottom trawls, the remainder by trammel nets (Zava *et al.*, 2022). The 85.7 cm specimen captured off El Kala was classified as immature (subadult), which is consistent with the results of Capapé *et al.* (1990) on the reproduction stages of the species in Tunisian neighbouring waters. In contrast, Ergüden *et al.* (2019) and Ulman *et al.* (2024) observed that female individuals on the Turkish coasts matured at smaller sizes, 72.6 and 67 cm TL, respectively. These variations may result from the limited dispersal capacity of *Squatina* spp., which, combined with local environmental influences, can lead to detectable differences in life-history traits such as size at first maturity and maximum body length, even across relatively small geographic scales (Colonello *et al.*, 2007; Capapé *et al.*, 2002, 2004, 2005). Nevertheless, Capapé *et al.* (2002) also argue that some apparent intraspecific differences might simply be a result of insufficient sampling, particularly when size classes and sexual maturation stages are underrepresented.

Tab. 2. Documented occurrences of *S. oculata* along the Algerian coast (GSA 4) (M: male; F: female, BT: bottom trawl)

Date	Place	Sex	Maturity	TL (mm)	TW (kg)	Gear	Status	Source
Mar. 2012	Annaba	M	Adult	1555	25.5	BT	Sold	Capapé *et al.* 2023
Dec. 2016	Annaba	M	Adult	1520	21	BT	Sold	
Dec. 2020	Annaba	F	Adult	1600	27	BT	Sold	
Jun. 2025	El Kala	F	Sub-adult	857	5.6	BT	Sold	Present study

The LEK revealed that local fishermen recognized angel sharks and recalled them as relatively common until the late 1980s, after which they became rare. This agreement between fishermen's memories and scientific reports of *Squatina* spp. emphasizes the idea that the shared Annaba - El Kala fishing grounds (Fig. 2) still holds ecological conditions favourable for angel sharks. The concentration of all recent records within this region, including specimens of *S. aculeata* and *S. oculata* of both sexes and at various stages of sexual maturity (Capapé *et al.*, 2023; Hemida *et al.*, 2024; present study) supports this assumption. The area's high biodiversity, ranging from coralligenous assemblages to *Posidonia oceanica* seagrass meadows and extensive forests of *Cystoseira* and *Dictyopteris membranacea* algae, sustains a rich ichthyofauna (104 species) and crustacean communities (Grimes, 2005), that could provide essential resources and habitats for *Squatina* spp. However, according to Capapé *et al.* (2023) and Hemida *et al.* (2024), the biogeographic origin of the specimens recorded in Algerian waters remains speculative. These authors suggest either an easterly origin (Central Mediterranean) of the individuals although they cannot rule out a westerly migration into the basin through the Strait of Gibraltar. This uncertainty highlights the need for further investigations on angel sharks' movements along GSA 4. Additionally, as

also revealed by the LEK, fishers generally lack awareness of the threatened status of these species. Therefore, establishing an effective conservation strategy for angel sharks in Algeria will require coordinated efforts among fishers, scientists, and fisheries managers, as well as targeted actions supported by training programs in species identification, handling, safe release, and, more importantly, the reporting of incidental captures.

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