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FIRST RECORD OF *HIMANTURA* MÜLLER & HENLE, 1837 IN LIBYAN WATERS: A COMPREHENSIVE DISCUSSION OF MISIDENTIFICATION ISSUES AND ECOLOGICAL IMPLICATIONS IN THE MEDITERRANEAN SEA

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ABSTRACT

The Dasyatidae family encompasses about a hundred stingray species distributed across the Atlantic, Indian, and Pacific Oceans. In the Mediterranean Sea, six stingray species are documented, including Himantura uarnak. Despite records of the Himantura genus in the Mediterranean Sea since the 1950s, their existence remained largely unstudied until a comprehensive examination that revealed the presence of four species within the H. uarnak species complex, one of which is Himantura leoparda. This study marks the first documentation of the Himantura in Libyan waters. The finding was established based on three records between 2021 and 2023. Citizen science initiatives have played a significant role in detecting and tracking these stingray species in the Mediterranean. This research underscores the need for further investigation into the diversity and distribution of these enigmatic stingray species.

Key words: taxonomical approach, Lessepsian immigrants, elasmobranchs, citizen science, stingray, biological invasions

PRIMA DOCUMENTAZIONE DI *HIMANTURA* MÜLLER & HENLE, 1837 NELLE ACQUE LIBICHE: DISCUSSIONE COMPLETA DI PROBLEMI DI IDENTIFICAZIONE ERRATA E IMPLICAZIONI ECOLOGICHE NEL MEDITERRANEO

SINTESI

La famiglia Dasyatidae comprende circa cento specie di razze, distribuite negli oceani Atlantico, Indiano e Pacifico. Nel Mediterraneo sono documentate sei specie di trigoni, tra cui Himantura uarnak. Nonostante le segnalazioni del genere Himantura nel Mediterraneo fin dagli anni '50, la loro esistenza è rimasta in gran parte poco studiata fino ad un esame approfondito che ha rivelato la presenza di quattro specie all'interno del complex rappresentato da H. uarnak, tra cui Himantura leoparda. Questo studio segna la prima documentazione del genere Himantura nelle acque libiche. Tre avvistamenti tra il 2021 e il 2023 sono stati utilizzati per confermare questa scoperta. Le iniziative di citizen science hanno svolto un ruolo significativo nel rilevare e monitorare queste specie di trigoni nel Mediterraneo. Questa ricerca sottolinea la necessità di ulteriori indagini sulla diversità e distribuzione di queste enigmatiche specie di trigoni.

Parole chiave: approccio tassonomico, migranti lessepsiani, elasmobranchi, citizen science, trigoni, invasioni biologiche

INTRODUCTION

The Dasyatidae family comprises 107 species across 19 genera of coastal marine, brackish, and freshwater fishes. In the Mediterranean Sea, only two species of the *Himantura* genus have been recorded to date (Ali et al., 2010, 2013; Myers et al., 2021), namely, *Himantura leoparda* Manjaji-Matsumoto & Last, 2008, and *Himantura uarnak* (Gmelin, 1789). This genus is marine and predominantly found in the Indo–West Pacific region.

The honeycomb stingray, *H. uarnak*, is a widely distributed Indo-Pacific species, documented from the Indo-Pacific to the Red Sea, eastern Africa to northern Africa, and the Philippines (McEachran & Capapé, 1984). Recent observations indicate its expansion from the Red Sea into the eastern Mediterranean through the Suez Canal (Golani et al., 2002). This species is a Lessepsian immigrant, reported from Turkish waters (Ben-Tuvia, 1966; Başusta et al., 1988), the Egyptian coast (El Sayed, 1994), and the Levant Basin (Mouneimne, 1977; Golani, 2005; Ali et al., 2010). *H. leoparda* has a widespread distribution in the tropical Indo-Pacific region, spanning from South Africa, eastern India, and Sri Lanka, through southern India, including the Philippines, southern Japan, Taiwan, New Guinea, and northern Australia from Coral Bay to the Cape York Peninsula (Manjaji-Matsumoto & Last, 2008). Similarly to its close relative *H. uarnak*, *H. leoparda* has entered the Mediterranean Sea through the Suez Canal, with its first recorded appearance off the Turkish coast (Yucel et al., 2017). Subsequently, a second record was documented from the coast of Lebanon (Bariche et al., 2020).

These two species are part of the *H. uarnak* species complex that includes *H. leoparda*, *H. tutul*, *H. uarnak*, and *H. undulata* (Borsa et al., 2013; Last et al., 2016). The species of this complex, while exhibiting similar general morphological and chromatic characteristics, can be differentiated through accurate analysis of specific features (e.g., color pattern on dorsal surface, arrangement of mid-scapular denticles, disc shape).

Drawing from citizen science contributions, we report herein the first observation of the *Himantura* genus in Libyan waters. We discuss the likely introduction pathway of these specimens in the Mediterranean Sea, highlighting the importance of citizen science initiatives in the early detection and monitoring of non-native fishes in the region.

MATERIAL AND METHODS

Three separate occurrences of the *Himantura* genus have been documented in the waters off Libya between 2021 and 2023, using a combination of

citizen science and social media. The first record, reported on 15 July 2021, involved the capture of an individual by longline gear at a depth of 54 m near the Al-Tamim coastline in eastern Libya (Fig. 1a). A second sighting occurred on 12 July 2023, when a recreational fisherman shared a live stream on his Facebook account, revealing an adult male of the *Himantura* sp. caught in a set gill net at a depth of 15 m in the Gulf of Bomba (Fig. 1b). Most recently, on 18 August 2023, an underwater video footage by a spearfisher showed a *Himantura* sp. specimen swimming at a depth of 7 m off Ras Alteen in eastern Libya (see the video in supplementary material).

RESULTS

Given that all the three reports were documented solely through photos or videos, without the possibility of physically examining the animal, a cautious approach was warranted. This decision was influenced by the substantial difficulty arising from the great similarities displayed by the species within this genus and the identification errors that had occurred in previous studies. For these reasons, it was decided we would refrain from specifying the species and maintain identification at the genus level. All the specimens were captured/observed in coastal shallow waters, in the depth range of 7–54 m.

The genus *Himantura* is characterized by the following features (Last et al., 2016): large size, with adults reaching 130–160 cm disc width (DW); a robust, sub-oval to rhombic disc with a broadly rounded to narrowly angular pectoral-fin apex; snout broadly angular and moderately elongate (1.7–2.8 times combined orbit and spiracle length), the eye small and protruding. Nasal curtain broadly skirt-shaped, mouth narrow with 4–5 oral papillae (lateral papillae always present). Tail very long and whip-like (length 2.5–3.7 times disc width), with a narrow and oval to almost circular base in cross-section. Pelvic fins small and almost entirely concealed by the disc. Dorsal fold and ventral folds absent, caudal sting close to tail base (distance from pectoral-fin insertion to caudal sting base is 1.7–2.3 times interspiracular width). With 1–3 thorns in mid-scapular region or in row on nape, and no other scapular thorns present. Denticle band well-developed and with a diffused edge, patchy dermal denticles on the rest of the disc in adults. No enlarged median thorns on tail, but small thorns and denticles present posteriorly in adults. Dorsal surface with strong color pattern (spots, ocelli, and/or reticulations), ventral surface white. Posterior tail typically banded in young individuals.

Not all of these characteristics were visible or examinable in the available photos and video, due to the long distance at which the animal was observed



Fig. 1: New records of the genus *Himantura* in the Mediterranean Sea (Libya): a) specimen caught on 15 July 2021; b) specimen caught on 12 July 2023.

Sl. 1: Novi podatki o pojavljanju vrst iz rodu *Himantura* v Sredozemskem morju (Libija): a) primerek ulovljen 15. julija 2021; b) primerek ulovljen 12. julija 2023.

(video) and the fact that the specimens were unfortunately damaged and only visible dorsally (photos). Nevertheless, based on the discernible color pattern and the overall body morphology we could still confidently identify the genus as *Himantura*.

DISCUSSION

Although the number of cartilaginous alien fish recorded in the Mediterranean Sea is significantly lower than that of their bony counterparts, their impact on the ecosystem could be dramatically more substantial (Bradai *et al.*, 2012). The settlement of the *Himantura* in Libyan waters, documented through photographic and video materials, raises significant concerns regarding the repercussions of these non-native mesopredators on the native fauna of the coastal Mediterranean marine ecosystem. Mesopredators are organisms positioned in the middle of the food chain and are typically carnivorous (Peterson *et al.*, 2001; Tiralongo *et al.*, 2020a). The intrusion of non-native mesopredators into marine ecosystems can have multifaceted consequences (Ingeman, 2016). Firstly, the mesopredator can exert direct predation pressure on native species, potentially leading to changes in population dynamics and community structure. Native organisms lacking

evolutionary adaptations to cope with the alien predator may experience elevated predation risk, which can lead to population declines or changes in behavior and distribution patterns due to competition with non-indigenous species. Secondly, the ingress of a mesopredator can have indirect effects on native fauna through trophic interactions. Changes in the abundance or behavior of one species can trigger cascading effects throughout the ecosystem, influencing the abundance and behavior of other species.

Overall, the potential implications of such species for native fauna underscore the importance of closely monitoring the spread and impact of mesopredators like *Himantura* in the Mediterranean Sea. Understanding ecological interactions and dynamics is crucial for implementing effective management and conservation strategies aimed at mitigating any negative effects on the native marine ecosystem.

However, the main challenge lies in resolving the taxonomic ambiguity associated with the two *Himantura* species found in the Mediterranean, namely *H. leoparda* and *H. uarnak*. In fact, the morphological and color similarities between the two species compromise classification accuracy and have likely contributed to past misidentifications (Borsa *et al.*, 2013; Last *et al.*, 2016). Therefore, further taxonomic

investigations are required that will encompass both morphological and chromatic analyses, and, above all, genetic studies. This comprehensive approach is necessary to ensure proper species identification and determine the abundance and Mediterranean distribution of the species. Notably, the risk of misidentification may extend to other similar species within the genus *Himantura* currently unreported, but possibly present in the Mediterranean Sea. Knowledge about their distribution and behavior is crucial for informing effective management and conservation strategies and for a comprehensive understanding of the ecological impact of these elusive alien species on the Libyan marine ecosystem and the broader region. In this regard, some authors have already underscored the invaluable role of citizen scientists and the social media in data collection, enhancing

the understanding of marine ecosystems, and aiding in the detection of invasive species (Azzurro & Tiralongo, 2020; Tiralongo *et al.*, 2020b; Al Mabruk *et al.*, 2021). This collaborative effort not only promotes scientific engagement but also enriches the dataset of records on species of interest, offering a more comprehensive perspective on the presence, behavior, and potential ecological impacts of non-indigenous species in the Mediterranean Sea. Finally, the most plausible explanation for the presence of these species in Mediterranean waters, considering their natural distribution range, is their ingression through the Suez Canal.

Supplementary material: <https://archive.org/details/395291011-6731596236895022-4453523919132992277-n>

PRVI ZAPIS O POJAVLJANJU RODU *HIMANTURA* MÜLLER & HENLE, 1837 V LIBIJSKIH VODAH: CELOSTNA RAZPRAVA O PROBLEMU NAPAČNE IDENTIFIKACIJE IN EKOLOŠKIH POSLEDICAH V SREDOZEMSKEM MORJU

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POVZETEK

Morski biči (družina Dasyatidae) štejejo približno 100 vrst, ki so razširjene v Atlantskem, Indijskem in Tihem oceanu. Sredozemsko morje naseljuje šest vrst, vključno z vrsto *Himantura uarnak*. Čeprav obstajajo zapisi o pojavljanju vrst iz rodu *Himantura* v Sredozemskem morju že od leta 1950, je bilo pojavljanje tega rodu v veliki meri neraziskano, dokler ni celovita raziskava razkrila obstoj štirih vrst v kompleksu vrste *H. uarnak*, med katerimi je tudi vrsta *Himantura leoparda*. Pričujoča raziskava je obelodanila prvo pojavljanje vrst iz rodu *Himantura* v libijskih vodah. Temelji na treh najdbah v obdobju med 2021 in 2023. Pri odkrivanju in sledenju teh vrst morskih bičev v Sredozemskem morju je imela pomembno vlogo ljubiteljska znanost. Ta raziskava narekuje potrebo po nadaljnjih raziskavah pestrosti in razširjenosti teh enigmatičnih morskih bičev.

Ključne besede: taksonomski pristop, lesepske selivke, hrustančnice, ljubiteljska znanost, morski biči, bioinvazija

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