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A FURTHER RECORD OF THE BARRED KNIFEJAW, *OPLEGNATHUS FASCIATUS* (TEMMINCK & SCHLEGEL, 1844), A PACIFIC SPECIES, FROM THE MEDITERRANEAN: A NEW RECORD FROM BENGHAZI, LIBYA

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ABSTRACT

The occurrence of the barred knifejaw, Oplegnathus fasciatus*, has been documented for the first time in Libyan waters, south Mediterranean Sea. This species is native to the Northwestern and central-eastern Pacific and its presence in the Mediterranean has been reported through previous scattered records. A single specimen was captured on 3 February 2023 of the coast of Benghazi at a depth of approximately 12 m using a trammel net. Both morphological and meristic examinations as well as a genetic validation via the mitochondrial COI gene were used for species identification. This report discusses the potential pathways for the species' arrival in the southern Mediterranean. A key forthcoming objective is to leverage citizen science, enhancing public awareness and improving the capacity for early detection of alien species.*

Key words: non-indigenous species, mitochondrial COI, Oplegnathidae, shipping

ULTERIORE SEGNALAZIONE DEL PESCE PAPPAGALLO GIAPPONESE (*OPLEGNATHUS FASCIATUS* (TEMMINCK & SCHLEGEL, 1844)), SPECIE DEL PACIFICO, NEL MEDITERRANEO: NUOVA OSSERVAZIONE A BENGASI, LIBIA

SINTESI

La presenza del pesce pappagallo giapponese, Oplegnathus fasciatus*, è stata documentata per la prima volta nelle acque libiche del Mediterraneo meridionale. Specie originaria del Pacifico nord-occidentale e centro-orientale, era già stata segnalata sporadicamente nel Mediterraneo. Un esemplare è stato catturato il 3 febbraio 2023 al largo di Bengasi, a circa 12 m di profondità, mediante rete da imbrocco-tramaglio. L'identificazione è stata confermata tramite analisi morfologiche, meristiche e genetiche del gene mitocondriale COI. Lo studio discute le possibili vie di introduzione della specie nel Mediterraneo meridionale e sottolinea l'importanza della scienza partecipativa per aumentare la consapevolezza pubblica e favorire l'individuazione precoce delle specie aliene.*

Parole chiave: specie non-indigene, COI mitocondriale, Oplegnathidae, trasporto marittimo

INTRODUCTION

The Mediterranean Sea is widely recognized as a global hotspot for marine bio-invasions (Rilov & Galil, 2009; Edelist *et al.*, 2013). It stands as the world's most invaded marine basin, with non-indigenous species (NIS) now representing nearly every major taxonomic group, including fishes (Streftaris *et al.*, 2005; Azzurro *et al.*, 2022a; Galanidi *et al.*, 2023). Considering fishes, in recent decades, at least 188 fish species have been introduced into the basin with an accelerating pace that has triggered significant environmental, social, and economic consequences (Azzurro *et al.*, 2022b). Most of these introduced fishes originate from the Red Sea/Indo-West Indian Ocean and entered into the Mediterranean via the human-made Suez Canal, other species entered through natural range expansion from the eastern Atlantic via the Strait of Gibraltar, while other arrived via direct and indirect human-mediated transport such as aquaculture, the aquarium trade, and shipping, generally from regions far from the eastern Atlantic or the Red Sea/Indo-West Indian Ocean (Galil, 2007; Katsanevakis *et al.*, 2014; Golani *et al.*, 2021; Azzurro *et al.*, 2022b).

Within this context, the Libyan coastline remains one of the Mediterranean's least-explored regions (Coll *et al.*, 2010). Its native fish fauna is still poorly documented (Quignard & Tomasini, 2000; Elbaraasi *et al.*, 2019), and records of non-indigenous fishes appear to date limited (Nour *et al.*, 2022).

The barred knifejaw, *Oplegnathus fasciatus* (Temminck & Schlegel, 1844) (Oplegnathidae), is a benthopelagic species indigenous to rocky reefs in the Northwest Pacific (Japan, Korea, China) and the Eastern Pacific (Hawaii) (Nakabo, 2002). The occurrence of this species has recently been documented beyond its native range, including the Pacific coast of North America. Its initial arrival in North America is linked to the 2011 Japanese earthquake and tsunami, whose transoceanic debris is believed to have transported specimens, leading to subsequent observations in Washington, Oregon, and California waters. In the Mediterranean Sea, this species was reported from Malta (Schembri *et al.*, 2010), from Italy and the Adriatic Sea (Ciriaco & Lipej, 2015), and Dulčić *et al.* (2016) from the Adriatic Sea. These occurrences underscore the species' capacity for long-distance dispersal via ocean rafting on marine debris, highlighting a significant mechanism for invasive species expansion beyond their historical boundaries (Ta *et al.*, 2018). Reaching a maximum length of 80 cm and a weight of 6.4 kg in its natural range, it preys chiefly on hard-shelled invertebrates like crustaceans and mollusks. Juveniles are strongly associated with floating objects; they are a dominant species found with drifting seaweed and have been recorded accompanying oceanic debris. The barred knifejaw is of commercial importance, supports aquaculture operations, and is valued as a game fish (Nakabo, 2002; Schembri *et al.*, 2010; Froese & Pauly, 2026).

This work documents the first finding of the barred knifejaw, *O. fasciatus*, from Libyan waters, south Mediterranean Sea, and discusses the potential pathways of its introduction.

MATERIAL AND METHODS

On 3rd February 2023, a single subadult *Oplegnathus fasciatus* was captured in a trammel net set at a depth of approximately 12 meters off the coast of Benghazi (32.1194° N, 20.0868° E), Libya (Fig. 1) alongside various demersal fish species like *Pagellus erythrinus*, *Diplodus sargus*, and *Mullus surmuletus*. The specimen was immediately placed on ice and transported to the Aquaculture and Fisheries Laboratory within the Department of Zoology, Faculty of Science, University of Benghazi.

In the laboratory, the specimen was photographed, and standard morphometric and meristic analyses were conducted (Fig. 2). It was measured to the nearest mm and weighed to the nearest 0.1 g. The individual was identified based on its distinctive pattern of light and dark vertical bands, following the taxonomic key of Nakabo (2002). Finally, the specimen was preserved and accessed into the Museum Collection of the Department of Zoology, University of Benghazi under the catalogue number Z9388.

A tissue sample was excised from the caudal fin using sterilized scissors and preserved in 95% ethanol for genetic analysis. At the genetics laboratory, DNA was amplified using the cytochrome c oxidase subunit I (COI)

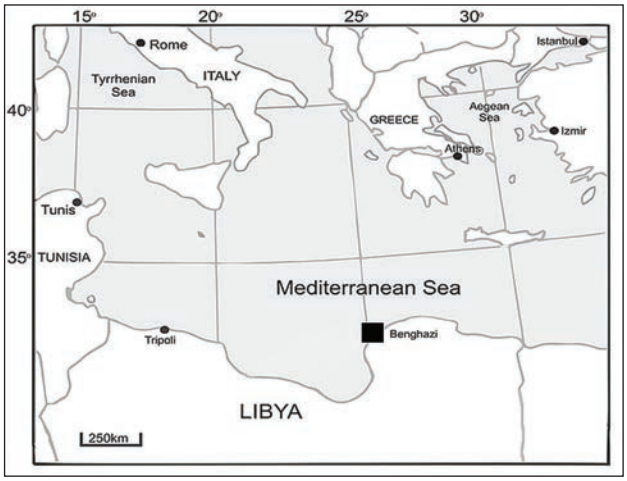

Fig. 1: Capture location of** Oplegnathus fasciatus **(141 mm TL) off the coast of Benghazi, Libya (32.1194 N, 20.0868 E). Black square showing the locality of the fish collection.

Sl. 1: Zemljevid obravnavanega območja z lokacijo ulova cunami ribe (141 mm TL) ob obali Bengazija v Libiji (32.1194 S, 20.0868 V). Črn kvadrat prikazuje mesto vzorčenja (ulova) ribe.

gene primers described by Ward *et al.* (2005): forward 5′-TCAACCAACCACAAAGACATTGGCAC-3′ and reverse 5′-TCGACTAATCATAAAGATATCGGCAC-3′. The resulting consensus sequence was deposited in the GenBank database under accession number PX317154.

For phylogenetic reconstruction, 11 additional COI sequences for *O. fasciatus* were downloaded from GenBank, along with three sequences from related species as outgroups. All sequences, including the Libyan sample, were trimmed to a uniform length of 534 bp. Phylogenetic trees (Maximum Likelihood (ML) and Neighbour-Joining (NJ)) were constructed using MEGA v10.0.5. The ML tree was built using the Kimura 2-parameter model to calculate genetic distances, while the NJ tree was constructed using the Maximum Composite Likelihood model. Branch support for both trees was assessed with 1,000 bootstrap replicates.

RESULTS AND DISCUSSION

The specimen measured 141 mm in total length and weighed 66.3 g. Table 1 presents a comparison of its principal morphometric and meristic characteristics with those of specimens from other geographic regions.

The body is relatively deep and laterally compressed, tapering to a small head with a pointed snout (Fig. 2). The mouth is small and terminal, with the jaw failing to extend to the anterior margin of the eye. The operculum bears a single spine, while the preopercular margin is distinctly serrated. A single dorsal fin is present, marked by a deep notch separating the spinous anterior portion from the soft-rayed posterior section; the membranes between the spines exhibit a pronounced incision. The anal fin is triangular, and the caudal fin is truncated with rounded lobes. The body is uniformly covered with small ctenoid scales.

The coloration consists of seven bold, black vertical bars set against a bluish-grey background. The first band is through the eye, followed by four bars approximately equal in width to the pale intervals separating them, while the final two bars are narrower, one on the caudal peduncle and one at the base of caudal fin (Fig. 2). The soft-rayed portions of the dorsal and anal fins, along with the entirety of the pelvic fins, as well as the outer portion of caudal fin are jet black. Pectoral fin is transparent.

The Maximum Likelihood (ML) phylogenetic tree based on a 534-bp fragment of the mitochondrial COI gene (Fig. 3) revealed that the Libyan *O. fasciatus* sample (PX317154) clustered with specimens from East Asia, specifically Japan, South Korea, and Taiwan. All *O. fasciatus* sequences formed a well-differentiated, coherent cluster that was clearly distinct from the outgroup species (*Kyphosus sydneyanus* and *Acanthistius* spp.). A Neighbour-Joining (NJ) tree constructed from the same dataset showed a nearly identical topology, with the Libyan sequence again grouping with those from East Asia. In both analyses, the outgroup taxa were positioned outside the *O. fasciatus* cluster.

Following Golani *et al.* (2021), the barred knifejaw, *O. fasciatus* is distinguished from *Abudefduf spp*. by its seven vertical bars, in contrast to the five typically found in the latter, while species within the families Scaridae, Tetraodontidae, and Diodontidae are easily differentiated from *O. fasciatus* by their complete lack of vertical body bars. The total length (141 mm) falls within the Mediterranean range (140 mm Malta, Schembri *et al.*, 2010) estimated 140 mm in Italian Adriatic, Ciriaco & Lipej, 2015, 100 mm Croatia, Dulčić *et al.*, 2016). This similarity among Mediterranean specimens reflects a comparable

Fig. 2: *Oplegnathus fasciatus* ***specimen (141 mm TL) collected off the coast of Benghazi, Libya, in the southern Mediterranean Sea (Photo by H. Elbaraasi).***
Sl. 2: Primerek cunami ribe (141 mm TL), ulovljen ob obali Bengazija v Libiji v južnem Sredozemskem morju (Fotografija: H. Elbaraasi).

Tab. 1: Biodata of specimen of** Oplegnathus fasciatus **caught in the Libyan coast of the Mediterranean Sea at the coast of Benghazi City.
Tab. 1: Biološki podatki o primerku vrste** Oplegnathus fasciatus **(cunami riba), ulovljenem ob libijski obali Sredozemskega morja blizu mesta Bengazi.

Morphometric (mm)/ Meristic characters	**Present study**	**Jordan & Fowler (1902)**	**Schembri *et al*. (2010)**	**Ciriaco & Lipej (2015)**	**Dulčić *et al*. (2016)**
Total length (TL)	141	-	130, 200	140	100
Standard length (SL) (% in TL)	120 (85.1)	-	-	-	75(75%in TL)
Head length HL (%SL)	41 (34.2)	-	-	-	27 (27% in TL)
Eye diameter (%HL)	8 (19.5)	-	-	-	8 (29.65in HL)
Preorbital length (%HL)	9 (22)	-	-	-	8 (29.6% in HL)
Postorbital length (%HL)	18 (43.9)	-	-	-	12 (44.4% in HL)
Interorbital distance (%HL)	10 (24.4)	-	-	-	7 (25.9% in HL)
Predorsal length (%SL)	39 (32.5)	-	-	-	32(32% in TL)
Length of dorsal fin base (%SL)	75 (62.5)	-	-	-	51 (51% in TL)
Prepelvic length (%SL)	47 (39.2)	-	-	-	32 (32% in TL)
Preanal length (%SL)	87 (72.5)	-	-	-	54 (54% in TL)
Length of anal fin (%SL)	35 (29.2)	-	-	-	22 (22% in TL)
Length of pectoral fin (%SL)	26 (21.7)	-	-	-	18 (18% in TL)
Length of pelvic fin (%SL)	27 (22.5)	-	-	-	19 (19% in TL)
Body depth (%SL)	69 (57.5)	-	-	-	47 (47% in TL)
Depth of caudal peduncle (%SL)	17 (14.2)	-	-	-	9 (9% in TL)
Total weight (g)	66.3	-	-	-	18.1 18.1% in TL)
Dorsal fin spine and ray counts	XII, 15	XI-XII, 17-18	-	-	XII, 16
Pectoral fin ray count	15	I, 16	-	-	18
Anal fin ray count	III, 13	III, 12-13	-	-	III, 13
Pelvic fin ray count	I, 5	I, 5	-	-	I, 5
Caudal fin ray count	14	-	-	-	15

juvenile ontogenetic stage, recent introduction history (early 2000s), and possible sampling bias toward smaller individuals (Schembri *et al.*, 2010; Froese & Pauly, 2026). The difference from the native range is due to ontogenetic maturity—the 700 mm specimen is a fully grown adult—and the Mediterranean population's early establishment stage, lacking sufficient time or conditions to reach large sizes (Froese & Pauly, 2026).

Several morphometric proportions showed close agreement with the Croatian specimen (Dulčić *et al.*, 2016), including postorbital length (43.9% vs. 44.4% HL) and interorbital distance (24.4% vs. 25.9% HL), reflecting developmental stability, low environmental sensitivity, and genetic constraint (Nakabo, 2002; Froese & Pauly, 2026). Eye diameter varied (19.5% vs. 29.6% HL), which is best explained by allometric growth, smaller juveniles have proportionally larger eyes (He *et al.*, 2012), along with measurement methodology differences and natural intraspecific variation.

The meristic counts of the Libyan specimen (Table 1) generally aligned with native range records (Jordan & Fowler, 1902) reflecting genetic stability and developmental canalization (Froese & Pauly, 2026). Slight deviations—15 pectoral rays vs. 16, and 15 dorsal soft rays vs. 16–17—are unlikely to indicate taxonomic distinction and are attributable to intraspecific variation (1–2 ray difference is common), counting errors, fin regeneration or damage, specimen size, and geographic clines such as Jordan's Rule (Jordan, 1891; He *et al.*, 2012; Froese & Pauly, 2026).

Phylogenetic reconstruction of *O. fasciatus* using 534 bp of the mitochondrial COI gene, via both maximum likelihood and Neighbour-Joining methods (Fig. 3), indicates limited genetic divergence. The analyses place the Libyan sample within a cohesive group comprising East Asian specimens from Japan, South Korea, and Taiwan, failing to support a deeply isolated lineage. In contrast, broader phylogeographic studies (Chen *et al.*, 2017) have documented three major, well-differentiated mtDNA clades across northern and

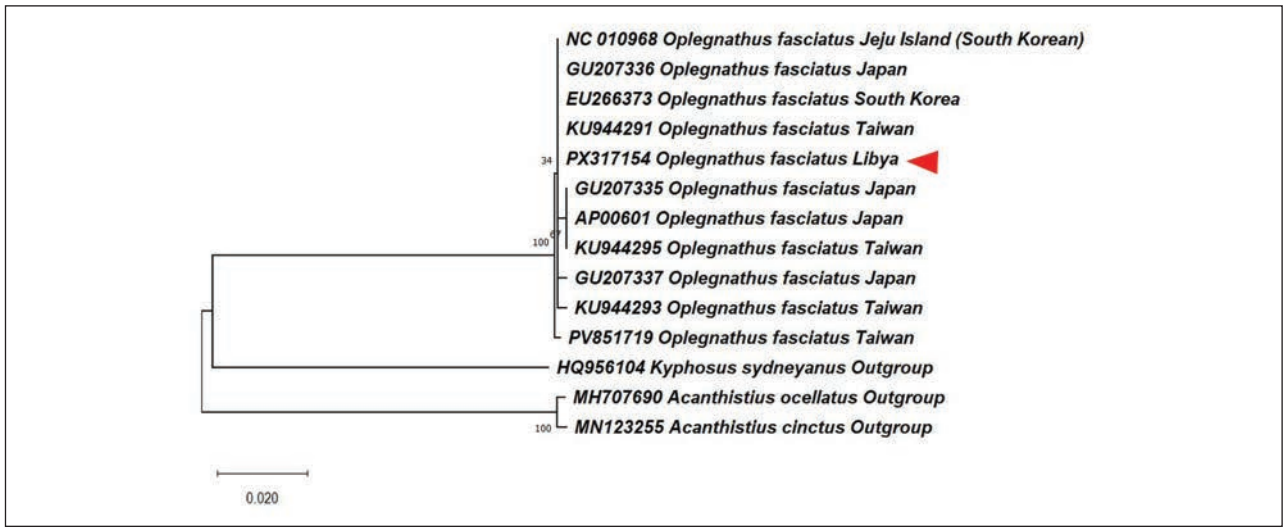

Fig. 3: A maximum likelihood phylogenetic tree, based on 534 bp of the mitochondrial COI gene, shows the relationships among *Oplegnathus fasciatus* ***samples from East Asia and Libya. The red arrow indicates the Libyan sample. Outgroup species include*** *Kyphosus sydneyanus* ***and two species of*** *Acanthistius***. Bootstrap values (expressed as percentages) are shown at the nodes.***
Sl. 3: Filogenetsko drevo po metodi največjega ujemanja, zasnovano na 534 baznih parih (bp) mitohondrijskega gena COI, prikazuje sorodstvene odnose med vzorci vrste *Oplegnathus fasciatus* ***iz Vzhodne Azije in Libije. Rdeča puščica označuje libijski vzorec. Zunanje skupine (outgroup) vključujejo vrsto*** *Kyphosus sydneyanus* ***in dve vrsti iz rodu*** *Acanthistius***. Na vozliščih so prikazane vrednosti 'bootstrap' (izražene v odstotkih).***

southern China, attributed to historical biogeographic barriers and subsequent population expansions.

Since the known Pacific Ocean native range of *O. fasciatus* is at a great distance from the Mediterranean, transport due to human activity, mainly shipping, was considered as the most plausible explanation for the introduction of the species in the waters of Malta and later in the North Adriatic Sea (Schembri *et al.*, 2010; Dulčić *et al.*, 2016; Golani *et al.*, 2021). Due to the scarce number of records in the Mediterranean and the large distance between them, to date it is unknown if the species was able to successfully colonize some Mediterranean regions, allowing the dispersion of individuals in other areas (Azzurro *et al.*, 2022b). This fish lives in shallow waters and being the juvenile aspect easy distinguishable from other native or introduced species, it is unlikely that other individuals were undetected or neglected by fishermen.

Thus, on the basis of the current knowledge, the occurrence of one sub-adult barred knifejaw *O. fasciatus* in Libyan waters is likely due to another independent introduction through human activities such as shipping, that have enabled this Pacific species to traverse the globe and to be released into the wild in the Mediterranean. The literature gives examples of introductions via shipping as a vector for long-distance translocations of fish like the present case (*e.g.*, Mastrototaro *et al.*, 2007; Goren *et al.*, 2009; Insacco & Zava, 2017; Azzurro *et al.*, 2022b). On the other hand, as already mentioned above, it is unknown whether established populations of the species exist in the basin. If exist, we cannot exclude that juveniles associated with floating objects or drifting seaweeds or debris arrived at Libyan waters.

The complexity of the environmental management of introduced species is a pressing concern, especially since the Libyan Mediterranean coast lacks dedicated research to evaluate the impacts of alien fishes on native ecosystems. This is compounded by an insufficiency of ongoing monitoring programs in critical zones, such as major ports, which are recognized hotspots for the introduction of non-indigenous organisms. Consequently, a key forthcoming objective is to leverage citizen science to raise public awareness and improve the probability of detecting non-indigenous species along areas where the capacity for conventional scientific monitoring surveys is still in its nascent state (*e.g.* north African – Nour *et al.*, 2022).

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NOVI ZAPIS O VRSTI *OPLEGNATHUS FASCIATUS* (TEMMINCK & SCHLEGEL, 1844), PACIFIŠKI VRSTI, V SREDOZEMLJU: NOVA NAJDBA IZ BENGAZIJA V LIBIJI

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POVZETEK

Avtorji poročajo o prvem pojavljanju cunami ribe, Oplegnathus fasciatus*, v libijskih vodah v južnem Sredozemskem morju. Ta vrsta domuje v severozahodnem in osrednjem vzhodnem Tihem oceanu, o njeni prisotnosti v Sredozemlju pa so poročali že v prejšnjih posameznih zapisih o pojavljanju. Primerek te vrste je bil ulovljen 3. februarja 2023 ob obali Bengazija na globini približno 12 m s triplastno stoječo mrežo. Za identifikacijo vrste so avtorji uporabili tako morfološke in meristične analize kot tudi genetsko potrditev s pomočjo mitohondrijskega gena COI. Avtorji nadalje razpravljajo o možnih poteh vnosa te vrste v južno Sredozemsko morje. Ključni prihodnji cilj je usmerjen v izkoriščanje potenciala ljubiteljske znanosti za krepitev ozaveščenosti javnosti in izboljšanje zmogljivosti za zgodnje odkrivanje tujerodnih vrst.*

Ključne besede: tujerodne vrste, mitohondrijski COI, Oplegnathidae, ladijski promet

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