Wiley
Journal of Applied Ichthyology
Volume 2025, Article ID 4603648, 6 pages
https://doi.org/10.1155/jai/4603648

WILEY

Research Article

On the Occurrence of the *Epinephelus coioides* (Hamilton, 1822) in Western Mediterranean Waters

Antoni Lombarte,[1,2] **Alba Rojas**,[1,2] **Laura Recasens**,[1,2] **and Ernesto Azzurro**[3,4]

[1]*Department of Marine Resources, Institut de Ciències del Mar (ICM-CSIC), Passeig Marítim de la Barceloneta 37-49, Barcelona 08003, Catalonia, Spain*
[2]*Fisheries Assesoring Service, Institut Català de Recerca per a La Governança del Mar (ICATMAR), Passeig Marítim de la Barceloneta 37-49, Barcelona 08003, Catalonia, Spain*
[3]*National Research Council (CNR), Institute for Biological Resources and Marine Biotechnologies (IRBIM), Largo Fiera della Pesca, 2, Ancona 60125, Italy*
[4]*National Biodiversity Future Center (NBFC), Palermo, Italy*

Correspondence should be addressed to Antoni Lombarte; toni@icm.csic.es

Received 16 June 2025; Revised 20 October 2025; Accepted 30 October 2025

Academic Editor: Jacob Burbank

On May 8, 2024, a single specimen of *Epinephelus coioides* was captured alive by a commercial fisher in the waters off Mataró, along the Catalan Coast in the northwestern Mediterranean (LAT 41.534N; LONG 2.457E). In this report, we document this capture and explore potential introduction vectors, presenting evidence that suggests a possible new and independent introduction of this species.

1. Introduction

The number of nonindigenous species (NIS) in the Mediterranean Sea continues to rise, as expected in one of the most invaded marine regions globally [1]. To date, over 1000 NIS have been recorded in this basin [2], with fish species being among the most represented and best-monitored groups [3]. The primary pathways for the introduction of Mediterranean nonindigenous fishes include maritime traffic, aquarium trade, and, most notably, Lessepsian migration, i.e., the entry via the Suez Canal [4]. Additionally, the Strait of Gibraltar facilitates the active immigration of Atlantic fish species into this basin. These species, often referred to as "newcomers" (sensu [5]) or "neonatives" (sensu [6]), occupy a unique category that defies strict classification as either true aliens or NIS. Nevertheless, increasing efforts are being dedicated to monitoring their occurrence and tracking their progressive expansion.

Monitoring the occurrence of NIS is explicitly mandated by relevant policies [7] and legislative instruments, notably the European Union (EU) Biodiversity Strategy (EC, 2014) and the Marine Strategy Framework Directive [8]. Concurrently, early detection of these species, particularly in fisheries, has become a central focus of current research efforts.

Since 2018, the Institut Català de Recerca per a la Governança del Mar (ICATMAR) has implemented a long-term, locally based monitoring program to gather biological data on key fishing resources [9]. This dedicated effort, conducted in close collaboration with a network of local fishers has recently led to the detection of new fish species along the Catalan Coast (NW Mediterranean). These include two Atlantic species previously unrecorded in the Mediterranean, *Polymetme corythaeola* [10] and *Antigonia capros* [11], as well as *Acanthopagrus bifasciatus* [12], a species originating from the Red Sea and Indian Ocean.

In this study, we report a single occurrence of the Orange-spotted grouper, *Epinephelus coioides* (Hamilton, 1822), in Western Mediterranean Waters. This species is native to the Indo–West Pacific, with a distribution

extending from the Red Sea southward to Durban, South Africa, eastward to Palau and Fiji, northward to the Ryukyu Islands, and southward to the Arafura Sea [13]. Like most species in the *Epinephelinae* subfamily, *E. coioides* is a carnivorous fish and a protogynous hermaphrodite. It typically inhabits rocky substrates along continental shores, at depths of up to 100 m. The species was first recorded in the Mediterranean in 1966 near the coasts of Haifa, initially misidentified as *E. tauvina* [14]. Its introduction has historically been attributed to the Suez Canal [15], although other pathways, such as shipping and mariculture, remain plausible [4].

2. Material and Methods

On May 8th, 2024, a single specimen of *E. coioides* was captured alive (Figure 1) by a commercial fisher in waters off Mataró (in front Sant Simó creek), in the Catalan Coast (NW Mediterranean)—coordinates 41.534N and 2.457E - at 11–12 m of depth by trammel net. The fish was kept alive (Figure 2(a)) some days in an aquarium before it died. It was then transported to the laboratory of ICM, where it was photographed (Figure 2(b)), measured, and sexed. Otolith sagittae were extracted across the operculum opening without damaging the external structure of the fish. Meristic and morphometric analyses were performed in the laboratory following the taxonomic keys provided by [15, 16]. Finally, the specimen was fixed and preserved in ethanol 70% and deposited in the Reference Marine Biological Collections CBMR of ICM-CSIC under the accession number ICMCBMR-P002091 [17]. Standard anatomical terminology [18] was used for describing and identifying otoliths.

3. Results

The specimen under consideration was sexed as an immature female, measuring 295 mm in total length (TL), weighting 216 g and described as follows: elongated body, the depth contained 3.8 times in standard length (SL) and head length contained 2.4 times in SL; 11 dorsal fin spines and 14 rays, the third spine is longer than the last spine of the dorsal-fin; anal-fin with 3 spines and 8 rays; pectoral-fin with 18 rays; pelvic-fin with 1 spine and 5 rays (Table 1); SL = 251 mm; head length = 102, 1 mm, body depth = 64.9 mm; and caudal fin rounded. The body was olive-tan in color, lighter on the ventral side, with slightly darker transverse stripes. The entire body, including the fins, was uniformly covered with regular large brownish orange spots. The picture of the specimen taken immediately after capture (Figure 2(a)) led to distinguish five faint oblique dark bars, which bifurcate ventrally.

Sagitta otoliths (Figure 3) had an elliptic-oblong shape, with crenate dorsal and ventral margins and a peaked broad rostrum and short pointed antirostrum, defined by a small notch in the excisura osti. The sulcus acusticus was heterosulcoid with rectangular ostium and tubular and curved cauda. The biometrics of the left otolith sagitta were as follows: length = 9.2 mm; width = 4.2 mm; area = 26.6 mm^2; perimeter = 26.9 mm; aspect ratio (width/length) = 0.46; and relative length ([otolith length/TL fish] × 100) = 3.11%.

4. Discussion

Morphological characters and color patterns align with the description of *E. coioides* provided by [16], distinguishing it from other indigenous and nonindigenous groupers recorded in Mediterranean waters, including *E. malabaricus*, *E. tauvina*, *E. merra*, *E. fasciatus*, and *E. areolatus* [3, 4]. The distinction from indigenous serranids is clear, primarily due to the absence of a spotted color pattern [4]. However, the potential for confusion with other nonindigenous groupers warrants attention, particularly with *E. malabaricus* and *E. tauvina* that in the past have led to several misidentifications with *E. coioides* [15, 16]. The specimen in our study exhibits a color pattern typical of *E. coioides*, with uniform orange-brownish spots and darker spots in the lower opercular area (Figure 2). The color pattern of *E. malabaricus* and *E. tauvina* is similar to the one of *E. coioides*, but the dark spots of *E. malabaricus* are smaller and blackish brown (not reddish brown or brownish orange, as on *E. coioides*). *E. coioides* has no white spots, on the contrary, *E. malabaricus* has irregular white spots on the head and body [16]. Finally, the larger head length, along with the smaller interorbital width and upper jaw length, are key morphometric traits that distinguish *E. coioides* from *E. tauvina* [15]. Additionally, *E. tauvina* is often characterized by a black blotch on the body at the base of the last four dorsal-fin spines, extending onto the lower part of the fin [16, 19], and a longer jaw (upper jaw length 21%–24% of SL) compared with *E. coioides* (17%–20% of SL) [16]. In the present specimen, the upper jaw length was measured at 18% of SL. Meristic characters were consistent with those reported in the *Atlas of Exotic Fishes in the Mediterranean Sea* [4], as well as with the meristic and morphometric data available for *E. coioides* specimens from Turkish waters [20, 21]. A difference was observed in the number of dorsal soft rays: 14 in the present specimen, compared with 13 reported by Erguden et al. [21] and 8 by Gökoğlu and Özvarol [20]. According to the *Atlas of Exotic Fishes in the Mediterranean Sea*, the number of dorsal soft rays in *E. coioides* typically ranges from 13 to 16, indicating that the value reported by Erguden et al. [21] falls within the expected intraspecific range. In contrast, the count of 8 dorsal soft rays reported by Gökoğlu and Özvarol [20] appears anomalous and would likely require re-examination of the preserved specimen. The otolith shape of specimen under consideration exhibited features as a rectangular ostium and a small but well-defined antirostrum, which align with those observed in other *E. coioides* individuals in Pacific [22] and Indian Ocean [23, 24]. The relative otolith length index was 3.11%, which is closer to *E. coioides* (2.43%–3.06%) than *E. malabaricus* (3.42%–3.76%) [25]. Considering that females of *E. coioides* mature after the size of 35 cm [26], the sexual stage of our specimen (an immature female measuring 29.5 cm) aligns with the life cycle described for this species.

To the best of our knowledge, since its first sighting in 1966 [14], *E. coioides* has been reported only few times from the Mediterranean Sea (Table 2 and Figure 1), primarily in the eastern sectors of the basin [3, 4, 27]. In

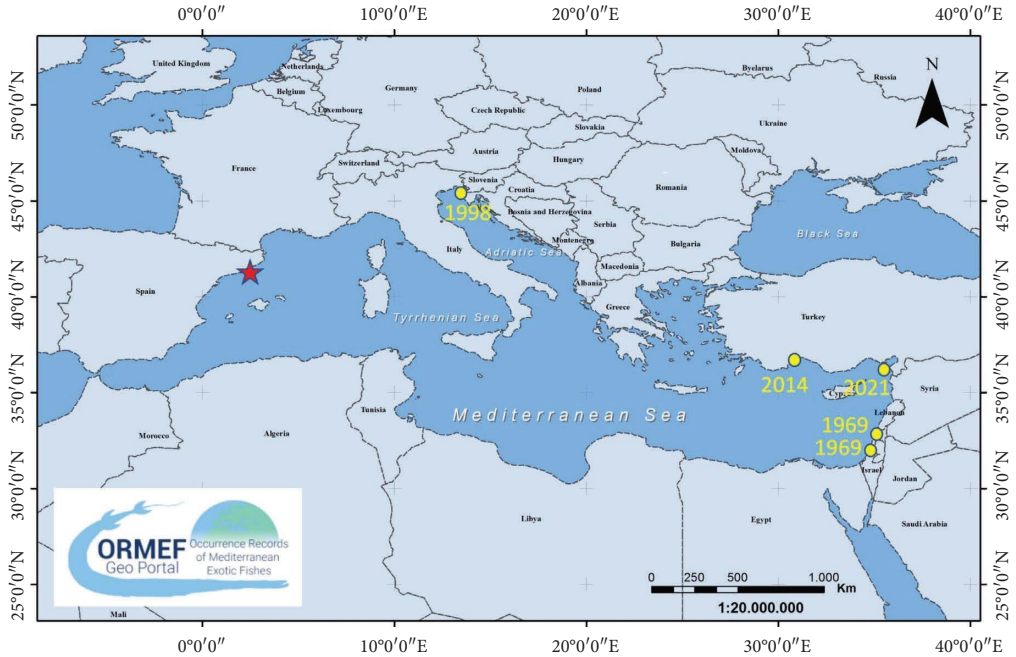

FIGURE 1: Capture location of the present *Epinephelus coioides* specimen in the Western Mediterranean (red star) and previous published records (yellow dots) extracted from the ORMEF database (http://www.ormef.eu), with observation years.

(a) (b)

FIGURE 2: (a) Examined specimen just after being caught (picture by Oriol Cespedes). (b) Preserved specimen. Scale bar means 10 cm.

TABLE 1: Morphometric measurements of the specimen of *Epinephelus coioides* found in Catalan waters (NW Mediterranean).

***Epinephelus coioides* studied specimen in mm**			**Gökoğlu and Özvarol**		**Erguden et al.**	
Total length	295		560		150	
Standard length (SL)	251	**SL %**	489	**SL %**	130	**SL %**
Body depth	64.9	25.5	143	29.2	38	28.1
Head length (HL)	102.1	40.7	183	37.4	49	36.2
Predorsal length	98.1	39.1	175	35.8		
Prepectoral length	88.1	35.1				
Prepelvic length	94.1	37.5				
Pectoral fin base	17.9	7.1				
Preanal length	47	58.6	325	66.5		
Dorsal fin base	129.7	51.7				
Anal fin base	37.7	15				
Peduncle length	26.6	10.6				
Peduncle depth	27.2	10.8	55	11.2		
Peduncle depth	11.1	4.4	55	11.2		
		HL%				

Table 1: Continued.

Epinephelus coioides studied specimen in mm			Gökoğlu and Özvarol	Erguden et al.	
Upper jaw length	45.6	44.7			
Lower jaw length	42.8	41.9			
Bony orbital width	16.8	16.5			
interorbital width	16.6	16.3		10.5	7.8
Preorbital length	23.5	23			
Dorsal-fin rays	XI + 14			XI + 8	XI + 13
Anal-fin rays	III + 8			III + 8	III + 8
Pectoral-fin rays	18				18
Pelvic-fin rays	I + 5				
Lateral-line scales	59				
Gill rakers	9 + 16				

Note: SL %, percentage in relation with standard length. HL %, percentage in relation with head length.

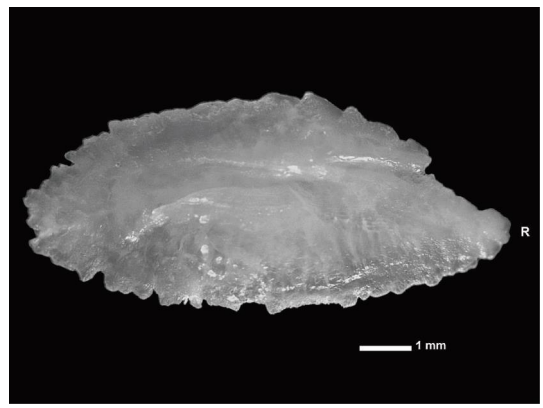

Figure 3: Inner side of the left otolith sagitta. Scale bar means 1 mm. R, rostral or anterior margin.

Table 2: Published records of *Epinephelus coioides* in the Mediterranean Sea and present sighting.

Authors	Year of publication	Month	Year	Locality	Country	Decimal LAT	Decimal LONG	Gear	Depth
Ben-Tuvia A. and Lourie A.	1969	—	1966	Haifa Bay	Israel	32.8410	35,0500	—	—
Ben-Tuvia A. and Lourie A.	1969	—	1969	Haifa Bay	Israel	32,8410	35,0500	—	—
Ben-Tuvia A. and Lourie A.	1969	—	1969		Israel	32,0760	34,7320	—	—
Parenti P. and Bressi N.	2001	5	1998	Trieste Gulf	Italy	45,5600	13,5700	—	—
Gökoğlu M. and Özvarol Y.	2015	11	2014	Antalya Harbour	Turkey	36,8346	30,6109	Pots	7
Erguden et al.	2021	11	2021	Konacık	_	36,3883	36,9172	Hooks	52
Present study	2025	5	2024	off Mataró	Spain	41.534N	2.457	Trammel net	12

1998, the capture of a juvenile in the Gulf of Trieste in Italy [28] and the collection in 2014 of another individual in the port of Antalya [20] and in 2001, in Konacik [21] (both localities in Turkey), suggested the possibility of secondary introductions for this species, likely via shipping. Similarly, the capture location of the present specimen, far from the eastern Mediterranean, makes it unlikely that this occurrence resulted from dispersal from an established Lessepsian population. Even if the capture locality is not very close to commercial routes and harbors [29], the introduction of this individual, like other species [30], could be associated to the movements of ships or oil platforms. Indeed, this vector resulted particularly effective for the translocation of small groupers over large distances [31–33]. This can be also the case of other nonindigenous fish found along the Catalan coast [12, 34]. Nevertheless, the role of other possible vectors, primarily aquarium release, cannot be completely excluded.

5. Conclusion

The observed occurrence of *E. coioides* supports the possibility of a new and independent introduction of this species, likely unrelated to Lessepsian migration. Our findings also confirm the value of engaging strict collaboration with local

fishers for the continuous monitoring of NIS introductions and their early detection.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

Funding

This work was supported by the Catalan Institute for Ocean Governance Research (ICATMAR), and trawl surveys were financed by European Maritime and Fisheries Fund (EMFF) and Generalitat de Catalunya by project CGCAT (ARP140/20/000006). We also acknowledge the Italian Ministry of University and Research funded by the European Union–NextGenerationEU, Award Number: Project code CN_00000033, Concession Decree No. 1034 of 17 June 2022, adopted by the Italian Ministry of University and Research, CUP D33C22000960007.

Acknowledgements

We thank the fisherman Oriol Cespedes and fishmonger Jordi Ballbona for capturing, keeping, and donate the studied specimen. This work was supported by the Catalan Institute for Ocean Governance Research (ICATMAR), and trawl surveys were financed by European Maritime and Fisheries Fund (EMFF) and Generalitat de Catalunya by project CGCAT (ARP140/20/000006). We are very thankful to all fishers for their support throughout the project. We also acknowledge the Italian Ministry of University and Research funded by the European Union–NextGenerationEU, Award Number: Project code CN_00000033, Concession Decree No. 1034 of 17 June 2022, adopted by the Italian Ministry of University and Research, CUP D33C22000960007.

References

[1] D. Edelist, G. Rilov, D. Golani, J. T. Carlton, and E. Spanier, "Restructuring the Sea: Profound Shifts in the World's Most Invaded Marine Ecosystem," *Diversity and Distributions* 19, no. 1 (2013): 69–77, https://doi.org/10.1111/ddi.12002.

[2] A. Zenetos and M. Galanidi, "Mediterranean Non Indigenous Species at the Start of the 2020s: Recent Changes," *Marine Biodiversity Records* 13 (2020): 10–17, https://doi.org/10.1186/s41200-020-00191-4.

[3] E. Azzurro, S. Smeraldo, and M. D'Amen, "Spatio-Temporal Dynamics of Exotic Fish Species in the Mediterranean Sea: Over a Century of Invasion Reconstructed," *Global Change Biology* 28, no. 21 (2022): 6268–6279, https://doi.org/10.1111/gcb.16362.

[4] D. Golani, E. Azzurro, J. Dulčić, E. Massutí, and L. Orsi Relini, in *Atlas of Exotic Fishes in the Mediterranean Sea*, 2nd ed ed., ed. F. Briand (CIESM Publishers, 2021).

[5] J. Evans, E. Arndt, and P. J. Schembri, "Atlantic Fishes in the Mediterranean: Using Biological Traits to Assess the Origin of Newcomer Fishes," *Marine Ecology Progress Series* 643 (2020): 133–143, https://doi.org/10.3354/meps13353.

[6] F. Essl, P. Pyšek, and D. M. Richardson, "Neonatives and Translocated Species: Different Terms Are Needed for Different Species Categories in Conservation Policies," *NeoBiota* 68 (2021): 101–104, https://doi.org/10.3897/neobiota.68.72849.

[7] S. Vanderhoeven, E. Branquart, J. Casaer, et al., "Beyond Protocols: Improving the Reliability of Expert-Based Risk Analysis Underpinning Invasive Species Policies," *Biological Invasions* 19, no. 9 (2017): 2507–2517, https://doi.org/10.1007/s10530-017-1434-0.

[8] K. Tsiamis, A. Palialexis, K. Stefanova, et al., "Non-Indigenous Species Refined National Baseline Inventories: A Synthesis in the Context of the European Union's Marine Strategy Framework Directive," *Marine Pollution Bulletin* 145 (2019): 429–435, https://doi.org/10.1016/j.marpolbul.2019.06.012.

[9] M. Carreton, E. Galimany, M. Blanco, et al., "Understanding the Spatio-Temporal Variability of Fisheries Data for Better Bottom Trawling Management Practices in the Catalan Margin (NW Mediterranean Sea)," *Marine Policy* 172 (2025): 106512, https://doi.org/10.1016/j.marpol.2024.106512.

[10] A. Lombarte, M. Balcells, C. Barría, and E. Azzurro, "First Record of the Benthopelagic Species Polymetme Corythaeola (Alcock, 1898) in the Mediterranean Sea," *Journal of Applied Ichthyology* 38 (2022): 551–556.

[11] A. Fortič, R. Al-Sheikh Rasheed, Z. Almajid, et al., "First Record of *Antigonia Capros* Lowe, 1843 (Teleostei, Caproidae) in the Mediterranean Sea," in *New Records of Introduced Species in the Mediterranean Sea*, ed. A. Fortič, R. Al-sheikh Rasheed, Z. Almajid, et al. (2023).

[12] A. García-de-Vinuesa, A. Lombarte, and E. Azzurro, "The Twobar Seabream *Acanthopagrus bifasciatus* (Teleostei: Sparidae) in the Western Mediterran Sea: A Likely Ship Born Introduction," *Bioinvasions Records* 9, no. 3 (2020): 570–573, https://doi.org/10.3391/bir.2020.9.3.12.

[13] R. Froese and D. Pauly, "FishBase 2000, Concepts, Design and Data Sources" (ICLARM Contrib. No.1594. International Center for Living Aquatic Resources Management (ICLARM), 2000).

[14] A. Ben-Tuvia and A. Lourie, "A Red Sea Grouper *Epinephelus tauvina* Caught on the Mediterranean Coast of Israel," *Israel Journal of Zoology* 18 (1969): 245–247.

[15] P. C. Heemstra and D. Golani, "Clarification of the Indo-Pacific Groupers (Pisces: Serranidae) in the Mediterranean Sea," *Israel Journal of Zoology* 39 (1993): 381–390.

[16] P. C. Heemstra and J. E. Randall, "FAO Species Catalogue," *Groupers of the World. Family Serranidae, (Subfamily Epinephelinae). an Annotated and Illustrated Catalogue of the Grouper, Rockcod, Hind, Coral Grouper and Lyretail Species Known to Date* (FAO Fisheries Synopsis No. 125, 1993).

[17] E. Guerrero, P. Abelló, A. Lombarte, et al., "Biological Reference Collections ICM-CSIC. v1.28," *Institute of Marine Sciences (ICM-CSIC): GBIF Dataset/Occurrence* (2020): https://doi.org/10.15470/qlqqdx.

[18] V. M. Tuset, A. Lombarte, and C. A. Assis, "Otolith Atlas From the Western Mediterranean, North and Central Eastern Atlantic," *Scientia Marina* 72, no. S1 (2008): 198.

[19] M. T. Craig, Y. J. Sadovy de Mitcheson, and P. C. Heemstra, *Groupers of the World. A Field and Market Guide* (2011).

[20] M. Gökoğlu and Y. Özvarol, "*Epinephelus coioides* (Actinopterygii: Perciformes: Serranidae)—A New Lessepsian

Migrant in the Mediterranean Coast of Turkey," *Acta Ichthyologica et Piscatoria* 45, no. 3 (2015): 307–309, https://doi.org/10.3750/aip2015.45.3.09.

[21] D. Erguden, M. Gürlek, and C. Turan, "First Record of Orange Spotted Grouper *Epinephelus coioides* (Hamilton, 1822) in the Southeastern Mediterranean, Turkey," *Natural and Engineering Sciences* 6 (2021): 2018–2022.

[22] C. H. Lin and C. W. Chang, "Otolith Atlas of Taiwan Fishes," *National Museum of Marine Biology and Aquarium, Pingtung, Taiwan* (2012): 415.

[23] S. Sadighzadeh, V. M. Tuset, M. R. Dadpour, J. L. Otero-Ferrer, and A. Lombarte, *Otolith Atlas from the Persian Gulf and the Oman Sea Fishes* (Lambert Academic Publishing, Aarbrücken, 2012).

[24] C. Dowling, K. Smith, E. Lek, and J. Brown, *Otoliths of South-Western Australian Fish: A Photographic Catalogue* (Department of Primary Industries and Regional Development, 2021).

[25] A. Lombarte, Ò. Chic, V. Parisi-Baradad, R. Olivella, J. Piera, and E. García-Ladona, "A Web-based Environment for Shape Analysis of Fish Otoliths. The AFORO Database," *Scientia Marina* 70, no. 1 (2006): 147–152, https://doi.org/10.3989/scimar.2006.70n1147.

[26] C. P. Mathews, M. Samuel, and M. K. Baddar, "Sexual Maturation, Length and Age in Some Species of Kuwait Fish Related to Their Suitability for Aquaulture," *Kuwait Bulletin of Marine Science* 8 (1986): 243–256.

[27] Azzurro E. Editors. (2023). ORMEF. World Wide Web Electronic Publication. http://www.ormef.eu.

[28] P. Parenti and N. Bressi, "First Record of the Orange-Spotted Grouper, *Epinephelus coioides* (Perciformes-Serranidae) in the Northern Adriatic Sea," *Cybium* 25 (2001): 281–284.

[29] K. G. Aarsæther and T. Moan, "Estimating Navigation Patterns From AIS," *Journal of Navigation* 62 (2009): 587–607.

[30] J. Ben-Souissi, M. Rifi, R. Ghanem, W. Boughedir, C. Capapé, and E. Azzurro, "First Record of the "Twobar Sea Bream" *Acanthopagrus bifasciatus* (Teleostei: Sparidae) in the Mediterranean Sea," *Mediterranean Marine Science* 15, no. 2 (2014): 437–439, https://doi.org/10.12681/mms.774.

[31] P. Guidetti, F. Giardina, and E. Azzurro, "A New Record of *Cephalopholis taeniops* in the Mediterranean Sea, With Considerations on the Sicily Channel as a Biogeographical Crossroad of Exotic Fish," *Marine Biodiversity Records* 3 (2010): e13, https://doi.org/10.1017/s1755267210000023.

[32] J. Evans and P. J. Schembri, "On the Occurrence of *Cephalopholis hemistiktos* and *C. taeniops* (Actinopterygii, Perciformes, Serranidae) in Malta, With Corrections of Previous Misidentifications," *Acta Ichthyologica et Piscatoria* 47, no. 2 (2017): 197–200, https://doi.org/10.3750/aiep/02064.

[33] R. Triay Portella, J. M. González Pajuelo, J. A. González Pérez, et al., "Oil Platforms as Introduction Vector of Non-Native Marine Fish Species to the Canary Islands Waters (Central-Eastern Atlantic)," in *Conference Abstract: XIX Iberian Symposium on Marine Biology Studies* (Frontiers in Marine Science, 2016).

[34] E. Azzurro, E. Broglio, F. Maynou, and M. Bariche, "Citizen Science Detects the Undetected: the Case of *Abudefduf saxatilis* From the Mediterranean Sea," *Management of Biological Invasions* 4, no. 2 (2013): 167–170, https://doi.org/10.3391/mbi.2013.4.2.10.