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SHORT COMMUNICATION

The first record of smallscale codlet, *Bregmaceros nectabanus* Whitley, 1941 (Teleostei: Bregmacerotidae) in Montenegrin waters and a review of previous Mediterranean records

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Abstract: The smallscale codlet, *Bregmaceros nectabanus* Whitley, 1941, is a small gadiform fish native to the Indo-West Pacific and the Red Sea. It is considered non-indigenous in the Mediterranean Sea, with its first records appearing in the early 2000s. This paper reports the first confirmed occurrence of *B. nectabanus* in Montenegrin waters. The specimen was caught by beach seine in the interior of Boka Kotorska Bay at a depth of less than 20 m. Morphometric measurements were compared with existing Adriatic and Mediterranean records, revealing general consistency, although minor deviations were attributed to intraspecific variability, ontogeny, or ethanol-induced shrinkage. An updated overview of Mediterranean records from 2002 to 2024 is provided. While the overall distribution pattern supports a Lessepsian migration pathway, the occurrence of the species in areas of intensive maritime traffic suggests that secondary dispersal *via* ballast water may contribute to its spread. These findings extend the known range of *B. nectabanus* in the Adriatic Sea, indicating an ability to exploit shallow coastal environments. Further monitoring and genetic studies are recommended to clarify the mechanisms underlying its ongoing expansion.
Keywords: *Bregmaceros nectabanus*; smallscale codlet; Boka Kotorska Bay; Montenegro; Adriatic Sea

Sažetak: PRVI ZABILJEŽENI NALAZ SITNOLJUSKAVOG BAKALARČIĆA, *BREGMACEROS NECTABANUS* WHITLEY, 1940 (TELEOSTEI: BREGMACEROTIDAE), U CRNOGORSKIM VODAMA I PREGLED RANIJIH NALAZA U SREDOZEMNOM MORU. Sitnoljuskavi bakalarčić, *Bregmaceros nectabanus* Whitley, 1941, je mala riba iz reda bakalara (Gadiformes), prirodno rasprostranjena u Indijskom i zapadnom Tihom oceanu, te Crvenom moru. U Sredozemnom moru smatra se alohtonom vrstom, pri čemu su prvi nalazi zabilježeni početkom 2000-ih godina. Ovaj rad donosi prvi potvrđeni nalaz vrste *B. nectabanus* u crnogorskim vodama. Jedinka je ulovljena obalnom mrežom potegačom – srdelarom u unutrašnjem dijelu Boke kotorske, na dubini manjoj od 20 m. Morfometrijska mjerenja uspoređena su s postojećim podacima za Jadransko i Sredozemno more, pri čemu je utvrđena opća podudarnost, uz manja odstupanja koja se mogu pripisati varijabilnosti unutar vrste, ontogenetskim čimbenicima ili skupljanju tkiva uslijed konzervacije u etanolu. Donosi se ažurirani pregled nalaza iz Sredozemnog mora u razdoblju od 2002. do 2024. godine. Premda obrazac rasprostranjenosti podupire hipotezu o lesepsijskoj migraciji, prisutnost vrste u područjima intenzivnog pomorskog prometa upućuje na mogućnost sekundarnog unosa putem balastnih voda. Ovi nalazi proširuju poznati areal rasprostranjenosti vrste *B. nectabanus* u Jadranskom moru, te ukazuju na sposobnost naseljavanja plićih obalnih staništa. Daljnje praćenje i genetička istraživanja preporučuju se kako bi se razjasnili mehanizmi koji podupiru širenje ove vrste.
Ključne riječi: *Bregmaceros nectabanus*; sitnoljuskavi bakalarčić; Boka kotorska; Crna Gora; Jadransko more

INTRODUCTION

The smallscale codlet, *Bregmaceros nectabanus* Whitley, 1941, is a small gadiform fish native to the Indo-West Pacific and Red Sea, typically associated with continental shelf and upper slope habitats at depths of up to 350 m, and occasionally deeper (Aydin and Akyol, 2013; Harold and Golani, 2016). In the Mediterranean Sea, it is recognised as a non-indigenous species, with initial records appearing in the early 2000s. Although initially misidentified as *Bregmaceros atlanticus*, subsequent taxonomic clarification confirmed all Mediterranean specimens as *B. nectabanus* (Harold and Golani, 2016).

The taxonomy of the genus *Bregmaceros* remains unresolved and in need of a comprehensive revision. Historically, numerous nominal species were synonymized without direct examination of type material, often under an overly broad interpretation of *B. mcclellandi*, leading to confusion in species-level identification and distribution records. Torii *et al.* (2023) demonstrated that *B. mcclellandi*, in its proper definition, is more narrowly defined than previously assumed and does not correspond with many past identifications. Additional work

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by Torii *et al.* (2004) and Ho *et al.* (2020a, 2020b) has described several new species formerly misidentified as other taxa, underscoring the underestimated diversity within the genus. Most recently, Harold and Baltzegar (2023) reviewed the state of the genus and recognized 15 valid species, highlighting cases of unsupported synonymy and the existence of additional undescribed forms. They emphasized the pressing need for a thorough systematic revision to stabilize the taxonomy of *Bregmaceros* and support accurate species identification in ecological and biogeographic studies.

The presence of *B. nectabanus* in the Mediterranean is primarily attributed to Lessepsian migration *via* the Suez Canal. However, secondary spread through anthropogenic vectors, such as ballast water discharge, remains a plausible concern. Since its initial detection, *B. nectabanus* has exhibited a progressive westward and northward expansion (Aydin and Akyol, 2013; Dulčić *et al*., 2020; Orfanidis *et al.*, 2021; Palermino *et al*., 2022; Capezzuto *et al*., 2024), with an increasing number of records from the eastern and central Mediterranean. The first Adriatic record was reported off Mola di Bari, Italy, in 2019 (Dulčić *et al*., 2020), followed by further occurrences in Croatian and Albanian waters (Orfanidis *et al.*, 2021; Palermino *et al.*, 2022). Most Mediterranean records have been from depths greater than 30 m, though some specimens have been collected at shallower depths, including 20 m in İzmir Bay (Turkey) (Özgül and Akyol, 2017) and 29 m off Rashid (Egypt) (Zenetos *et al.*, 2015).

Non-indigenous species represent one of the most significant ecological stressors in Mediterranean marine ecosystems, where they have altered native community composition, food web dynamics, and fisheries productivity (Zenetos *et al.*, 2012; Galil *et al.*, 2015). In the Adriatic Sea alone, over 140 non-indigenous marine species have been recorded to date, with ongoing introductions continuing to reshape benthic and pelagic communities (Sulić-Šprem *et al.*, 2014; Katsanevakis *et al.*, 2023). Understanding the mechanisms and spatial patterns of their introduction remains a critical challenge for regional biodiversity conservation and policy compliance under EU Marine Strategy objectives.

This paper reports the first confirmed occurrence of *B. nectabanus* in Montenegrin waters. In addition, it documents this record, compares the morphometric characteristics of the specimen with previous studies, and discusses its potential implications for understanding the species' ongoing range expansion within the Adriatic Sea.

MATERIAL AND METHODS

The smallscale codlet specimen was caught during fishing operations by small scale fishers in Boka Kotorska Bay on 23 October 2024, off the locality of Peluzica, near the village of Muo (42°26′ N, 18°46′ E) (Fig. 1). This terminal part of the Bay is relatively shallow, with depths predominantly below 20 m. The fishers were using a beach seine for European pilchard *Sardina pilchardus*,

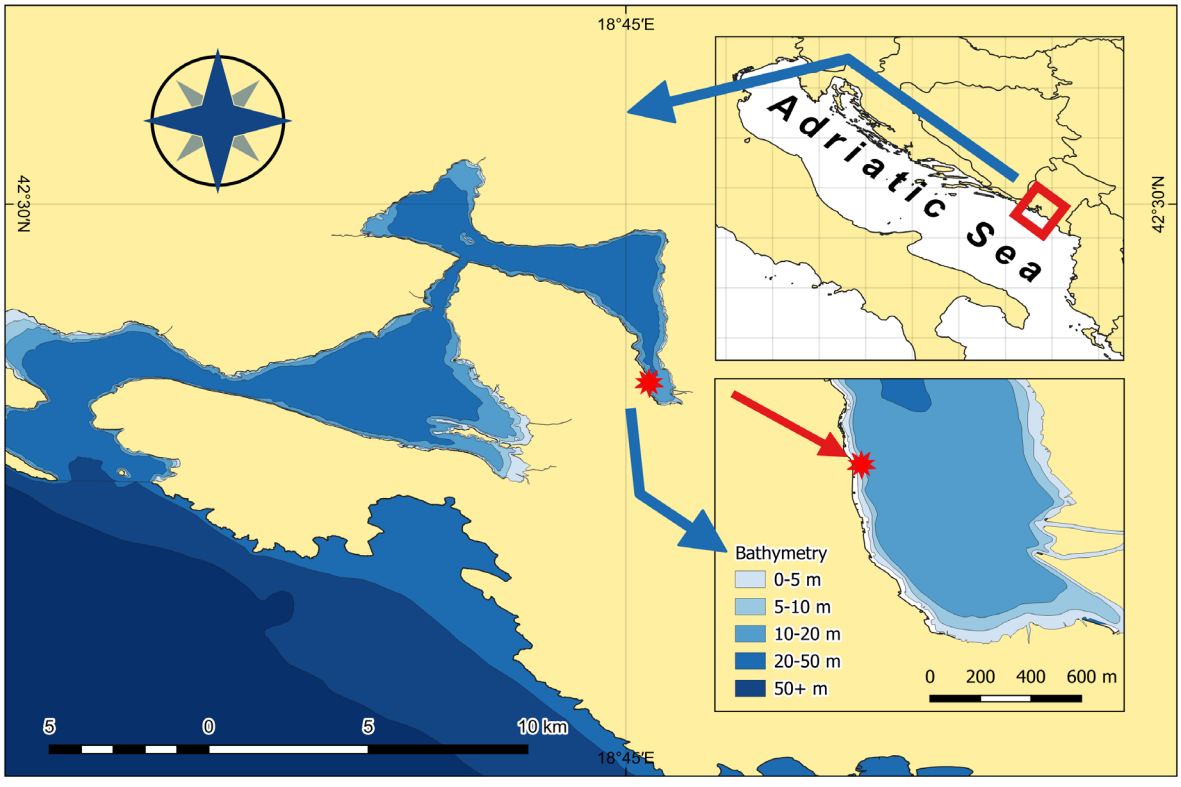

Fig. 1. Geographic location of the catch of *Bregmaceros nectabanus* in Boka Kotorska Bay, Montenegro.

"srdelara" (from *srdela* – European pilchard), when they spotted a single *Bregmaceros nectabanus* specimen among their *Atherina* sp. catch.

The specimen was delivered to the Institute of Marine Biology fresh and immediately preserved in 96% ethanol for later examination and study. The specimen was kept in ethanol until it was processed for this study (April 2025), approximately six months.

Subsequently, in the laboratory, the specimen was examined in detail, weighed, and the following morphometric measures were taken: total length, standard length, pre-pectoral, pre-anal, pre-dorsal, pre-pelvic lengths, head length, pre-orbital length, eye diameter, inter-orbital width, minimum and maximum body depth (height), as well as dorsal and pelvic fin base lengths. Due to ethanol exposure, the specimen was thoroughly dehydrated, affecting its body and fins.

Species identification was based on D'Ancona and Cavinato (1965), Harold and Golani (2016), and Dulčić *et al.* (2020). The specimen is currently deposited at the Institute of Marine Biology, University of Montenegro, under catalogue number IBMK-FIS-WET-2025-0001.

RESULTS AND DISCUSSION

The observed morphological features of the specimen permitted its identification as *Bregmaceros nectabanus.* In addition to the fin formula and pigmentation pattern, the presence of a distally fimbriate opercular spine represents the primary diagnostic feature distinguishing *B. nectabanus* from *B. atlanticus* (Harold and Golani, 2016). In addition, maximum body depth was 16% in TL or 18% in SL (Table 1). According to Harold and Golani (2016), *B. atlanticus* is more elongated, with a typical body depth of 12.4% to 14.4%, whereas *B. nectabanus* typically has a body depth of 13.2% to 17.5%. *B. atlanticus* is also described as very darkly pigmented (Harold and Golani, 2016), which does not correspond with the specimen from this study.

The morphometric measurements taken on the specimen (Fig. 2) are presented in Table 1. The values presented in Table 1 are generally consistent with those reported for other Adriatic specimens of *B. nectabanus* (Dulčić *et al.*, 2020; Palermino *et al.*, 2022), although some variation was observed. Comparison of the morphometric measurements obtained in this study with those reported by Dulčić *et al*. (2020) suggests overall consistency, particularly regarding standard and total length, body depth, and head proportions. Minor deviations were noted, including a lower pre-anal length relative to standard length (31% versus 42%) and a slightly smaller eye diameter relative to head length (26% versus 31.4%). Comparable variability has also been noted in Mediterranean material by Harold and Golani (2016), particularly proportions of pre-dorsal length and head length in SL, and eye diameter and interorbital width in HL (Table 1), and Capezzuto *et al.* (2024). The observed variation may be attributable to natural intraspecific variability, ontogenetic factors, minor measurement error, or tissue shrinkage due to preservation effects. Ethanol

Table 1. Morphometric measurements and total body weight of *Bregmaceros nectabanus* caught in Boka Kotorska Bay, Montenegro. Measurements are presented in absolute values (mm or g) and as proportions relative to total length (TL), standard length (SL), and head length (HL), where applicable. Note: Measurements may be affected by dehydration and shrinkage associated with ethanol preservation.

Morphometric parameter	Measurement	Unit	Proportion in TL	Proportion in SL	Proportion in HL
Total length	67.0	mm	1.00	1.13	—
Standard length	59.5	mm	0.89	1.00	—
Pre-pectoral length	11.9	mm	0.18	0.20	—
Pre-anal length	18.5	mm	0.28	0.31	—
Pre-dorsal length	25.5	mm	0.38	0.43	—
Pre-pelvic length	23.8	mm	0.36	0.40	—
Head length	11.6	mm	0.17	0.19	—
Pre-orbital length	2.8	mm	0.04	0.05	0.24
Eye diameter	3.0	mm	0.04	0.05	0.26
Interorbital width	3.4	mm	0.05	0.06	0.29
Maximum body depth	10.6	mm	0.16	0.18	—
Minimum body depth	3.3	mm	0.05	0.06	—
Dorsal fin base length	35.8	mm	0.16	0.17	—
Pelvic fin base length	35.5	mm	0.13	0.15	—
Pectoral fin length	6.6	mm	0.10	0.11	—
Total weight	1.03	g	—	—	—

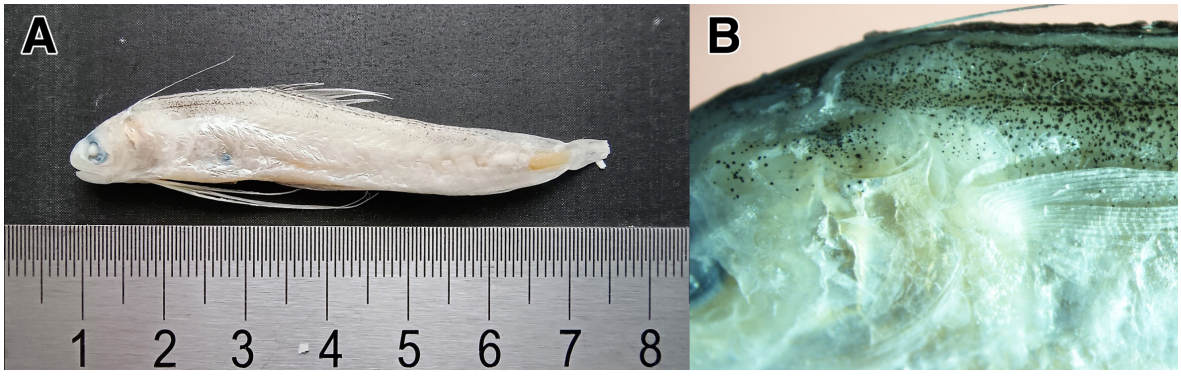

Fig. 2. Specimen of smallscale codlet, *Bregmaceros nectabanus*, caught on 23 October 2024 in Boka Kotorska Bay (ref. 03–167) and preserved in 96% ethanol **(A)**; detailed view of the upper posterior operculum, highlighting key diagnostic features **(B)** (Photos: Z. Ikica).

fixation has been demonstrated to induce measurable shrinkage in preserved fish specimens, particularly affecting soft tissue-based linear measurements such as body depth and standard length (Sotola *et al*., 2019). Further observations on freshly collected material would be valuable to more precisely characterise the morphometric ranges of Mediterranean *B. nectabanus* populations.

In its native range, *B. nectabanus* is typically associated with continental shelf and upper slope habitats, occurring most commonly at depths down to 350 m, but has been reported at depths of up to 850 m (Aydin and Akyol, 2013; Harold and Golani, 2016). In the Mediterranean, the species has most often been recorded at depths greater than 30 m (Table 2), although individuals have also been found at shallower depths. The shallowest records in the Mediterranean Sea were reported at the surface, at locations offshore Termoli and offshore Durrës, during the MEDIAS survey (Palermino *et al.,* 2022). Özgül and Akyol (2017) reported a *B. nectabanus* record at 20 m depth in Izmir Bay, Turkey, in 2014, with additional records at 29 m depth from Rashid, Egypt (Zenetos *et al.*, 2015) and 30 m in the Gulf of Antalya (Yılmaz *et al*., 2004) (Table 2). Such records, though uncommon, indicate that *B. nectabanus* is capable of exploiting coastal shelf environments when conditions permit.

Table 2. Records of *Bregmaceros nectabanus* in the Mediterranean Sea, 2002–2024. Asterisk (*) denotes specimens originally reported as *Bregmaceros atlanticus*, but reliably considered *B. nectabanus*, a dagger (†) denotes a record found in stomach contents of another species, and double dagger (‡) indicates that the record is from the Adriatic Sea. The size is given as total length (TL) or standard length (SL).

No	Location	Date	Coordinates	Depth (m)	No. of individuals	Size (mm)	Fishing gear	References
1*†	Gulf of Antalya, Turkey	Oct 2002	N/A	30	2	30.0-34.0 TL	Bottom trawl	Yılmaz *et al.* (2004)
2	Off Iskenderun, Turkey	Sep 2005	36°31′ N 35°37′ E	70	4	N/A	Dredge	Katsanevakis *et al.* (2020)
3*	Off Palmahim, Israel	Sep 2004	31°05′ N 34°03′ E	35	1	46.5 SL	Not given	Goren and Galil (2008)
4*†	Kuşasdası Bay, Turkey	Feb 2005	N/A	150	1	39.0 TL	Not given	Filiz *et al.* (2007)
5*	Off Palmahim, Israel	May 2006	31°05′ N 34°03′ E	35	3	47.0-62.0 SL	Not given	Goren and Galil (2008)
6*	Off Iskenderun, Turkey	Dec 2010	35°57′ N 35°59′ E	120	5	70.7-102.0 TL	Purse seine	Turan *et al.* (2011)
7*	Izmir Bay, Turkey	Dec 2011	38°28′ N 26°47′ E	50	1	66.0 TL	Trammel net	Aydin and Akyol (2013)
8*	Gulf of Saronikos, Greece	July 2014	37°50′ N 23°29′ E	90	1	53.0 TL	Bottom trawl	Zenetos *et al.* (2015)

Table 2. Continuation

No	Location	Date	Coordinates	Depth (m)	No. of individuals	Size (mm)	Fishing gear	References
9*	Gulf of Saronikos, Greece	Aug 2014	37°50′ N 23°20′ E	98	7	54.0-64.0 TL	Bottom trawl	Zenetos *et al.* (2015)
10*	Rashid, Egypt	Sep 2014	N/A	29	1	76.0 TL	Not given	Zenetos *et al.* (2015)
11	Izmir Bay, Turkey	Sep 2014	38°23′ N 26°46′ E	20	1	95.0 TL	Trammel net	Özgül and Akyol (2017)
12	Patraikos Gulf, Greece	Nov 2016	38°14′ N 21°37′ E	100	1	74.0	Purse seine	Chartosia *et al.* (2018)
13	Kerkyraios Gulf, Greece	Nov 2016	39°29′ N ~20°02′ E	57-59	2	66.0-82.0	Purse seine	Chartosia *et al.* (2018)
14	Kerkyraios Gulf, Greece	Dec 2016	~39°31′ N ~20°01′ E	55-67	3	37.0-64.0 TL	Bottom trawl	Chartosia *et al.* (2018)
15†	Güllük Gulf, Turkey	Jan 2017	37°16′ N 27°31′ E	30	1	3.47 cm SL	Not listed	Kastanevakis *et al.* (2020)
16†	Syrian coast	Aug 2018	35°41′ N 35°47′ E	100	12	19.0-53.0 TL	Purse seine	Stern *et al.* (2019)
17	Güllük Gulf, Turkey	Mar 2019	37°15′ N 27°16′ E	60	1	4.4 cm TL	Bottom trawl	Kastanevakis *et al.* (2020)
18‡	Mola di Bari, Italy	Dec 2019	41°09′ N 17°02′ E	100	2	73.4-114.2 TL	Bottom trawl	Dulčić *et al.* (2020)
19‡	Off Mljet Island, Croatia	Jul 2020	43°37′ N 17°47′ E	138	1	58.0-74.0 TL	Bottom trawl	Orfanidis *et al*. (2021)
20‡	Neretva Channel, Croatia	Nov 2020	43°02′ N 17°19′ E	45	2		Gillnet	Orfanidis *et al.* (2021)
21‡	Off Termoli, Italy	Jul 2020	42°01′ N 16°00′ E	0	1	55.1 TL	Mid-water trawl	Palermino *et al*. (2022)
22	Off Bari, Italy	Jan 2021	41°07′ N 17°18′ E	50	1	N/A	Purse seine	Ragkousis *et al.* (2023)
23‡	Off Durrës, Albania	May 2021	41°10′ N 19°18′ E	0	5	53.0.-68.0 TL	Mid-water trawl	Palermino *et al*. (2022)
24†	San Giacomo, N Ionian Sea	Sep 2021	39°21′ N 16°31′ E	63	1	61.0 SL	Bottom trawl	Capezzuto *et al.* (2024)
25†	Crotone, N Ionian Sea	Sep 2021	39°04′ N 17°08′ E	240	1	40.0 TL	Bottom trawl	Capezzuto *et al.* (2024)
26	Izmir Bay, Turkey	Mar 2022	35°35′ N 26°46′ E	30	2	53.0-63.0	Purse seine	Akyol (2022)
27‡	Boka Kotorska Bay, Montenegro	Oct 2024	42°26′ N 18°45′ E	<20	1	67.0 TL	Beach seine	This report

In general, the vast majority of records of *B. nectabanus* in the Mediterranean consist of one to three individuals (Table 2), while reports of five or more individuals are rare. The highest recorded number (12 individuals) was reported in a study on the diet composition of *Trachurus trachurus* in Syria. The *T. trachurus* specimens were caught using purse seines between August and December 2018 at two stations along the Syrian coast (Burj Islam and Ras Albasir), and *B. nectabanus* was identified in their stomachs (Stern *et al.*, 2019).

On the other hand, the seven individuals reported by Zenetos *et al.* (2015) were caught during the Mediterranean International Bottom Trawl Survey (MEDITS 2014) in the Saronikos Gulf, Greece, using the GOC37

trawl employed in MEDITS surveys. This trawl has a codend mesh size of 20 mm stretched mesh (equivalent to 10 mm mesh side length) (MEDITS, 2013), which is considerably smaller than the mesh-sizes used in commercial bottom trawls (40 mm square mesh or 50 mm diamond mesh).

The relatively small size of the smallscale codlet and the minimum mesh sizes used in Mediterranean fishing nets may account for its infrequent reporting in fishery catches, as individuals are likely to escape capture. This pattern is consistent with broader underreporting trends for small-bodied alien species across the Mediterranean (Katsanevakis *et al.*, 2020). This was also evident in the present case: the specimen was caught using a traditional beach seine ("srdelara") deep within the Boka Kotorska Bay. This gear, commonly used to target juvenile *S. pilchardus* and *Engraulis encrasicolus*, operates with a minimum legal mesh size of 12 mm (Official Gazette of Montenegro, 2011, 2014), and likely retains small individuals more effectively than typical commercial trawls. However, the same small body size renders the species highly susceptible to predation by larger organisms. The repeated detection of *B. nectabanus* in the stomach contents of predatory fishes, despite the limited number of specimens typically subjected to dietary analysis, supports the hypothesis that the species is more widely established in the Adriatic and eastern Mediterranean than direct catch records alone would suggest. Furthermore, the true occurrence of *B. nectabanus* in predator diets is likely underestimated, as heavily digested or fragmented individuals may remain unrecognised during laboratory examinations. Even isolated or low-abundance records, such as single individuals or stomach-content finds, are essential for accurately delineating alien species' biogeographies, particularly when baseline faunal data are sparse (Katsanevakis *et al.*, 2020).

The area of the Boka Kotorska Bay where the specimen was recorded experiences heavy cruise ship traffic from March to late October, with up to five large cruise ships entering the interior part of the bay *per* day during peak season, and over 400 passenger vessels and nearly 800 yachts visiting annually in 2022 and 2023 (Port of Kotor, 2024). The discovery of a single *B. nectabanus* specimen in the interior of the Bay, with no prior records near the entrance, in close proximity to a seasonally high-traffic cruise ship port, raises the question of whether maritime traffic, including ballast water discharge, may contribute to its dispersal. As only a single specimen was recorded in the present study, any conclusions regarding the role of maritime vectors must remain tentative. While port proximity and maritime traffic may facilitate detection or secondary transport, the increasing number of confirmed records along a continuous geographical gradient from the eastern Mediterranean remains consistent with a species undergoing natural range expansion.

In the Mediterranean, the Suez Canal is identified as the primary pathway for the introduction of non-indigenous species, accounting for over 50% of recorded introductions, while shipping (transport-stowaway) ranks second (Zenetos *et al*., 2012; Katsanevakis *et al*., 2023). In contrast, in other European seas such as the North-East Atlantic, Baltic Sea, and Black Sea, shipping is the dominant introduction pathway for non-indigenous species (Katsanevakis *et al.*, 2023). However, even within the Mediterranean, the Suez Canal is the dominant pathway primarily in the eastern Mediterranean, while the central and western Mediterranean appear to be shipping-dominated (Nunes *et al*., 2014; Katsanevakis *et al*., 2023). Both Nunes *et al*. (2014) and Katsanevakis *et al*. (2023) report the importance of pathways for first-time records *per* country, with shipping identified as the dominant method for non-indigenous species introduction in both Italy and Croatia. Nevertheless, in the specific case of *B. nectabanus*, the combination of its Red Sea origin, east-to-west range expansion, and absence of outlier records in isolated western ports lend stronger support to a Lessepsian origin with possible anthropogenic facilitation.

Harold and Golani (2016) demonstrated that all verifiable Mediterranean records previously attributed to *B. atlanticus* were misidentified specimens of *B. nectabanus*, based on consistent morphological and pigmentation features with material from the Indo-West Pacific and Red Sea. While the taxonomic identity of the species is now well established, its introduction pathway remains debated. The species is widely regarded as a Lessepsian migrant, introduced *via* the Suez Canal, although some authors have suggested the possibility of anthropogenic introduction *via* ballast water (Özgul and Akyol, 2017). Such dual-pathway scenarios align with recently standardised criteria for non-indigenous species introduction mechanisms in the EU Mediterranean, which treat natural and anthropogenic vectors as potentially co-acting (Ragkousis *et al.*, 2023).

In the Adriatic Sea, *B. nectabanus* has so far been recorded predominantly in areas associated with substantial maritime traffic activity, particularly near commercial and cruise ports (Dulčić *et al.*, 2020; Orfanidis *et al.*, 2021; Palermino *et al.*, 2022; Capezzuto *et al.*, 2024), as shown in Fig. 3.

According to vessel tracking data, between 240 and 1200 ships passed through the Adriatic in 2019, with traffic density highest along established shipping corridors and around major ports (Martínez de Osés and Uyà Juncadella, 2021). Notably, even the record near Termoli, where port infrastructure is limited, lies along an active maritime traffic corridor between Bari and Ancona, suggesting that regional vessel movement may facilitate secondary spread independently of direct port introductions. This spatial overlap raises the possibility that secondary spread *via* shipping vectors, such as ballast water discharge, may have contributed to the species' dispersal in the basin. Nevertheless, natural dispersal cannot be excluded, particularly given the species' steady westward and northward spread. The infrequent nature of Mediterranean records, often involving only

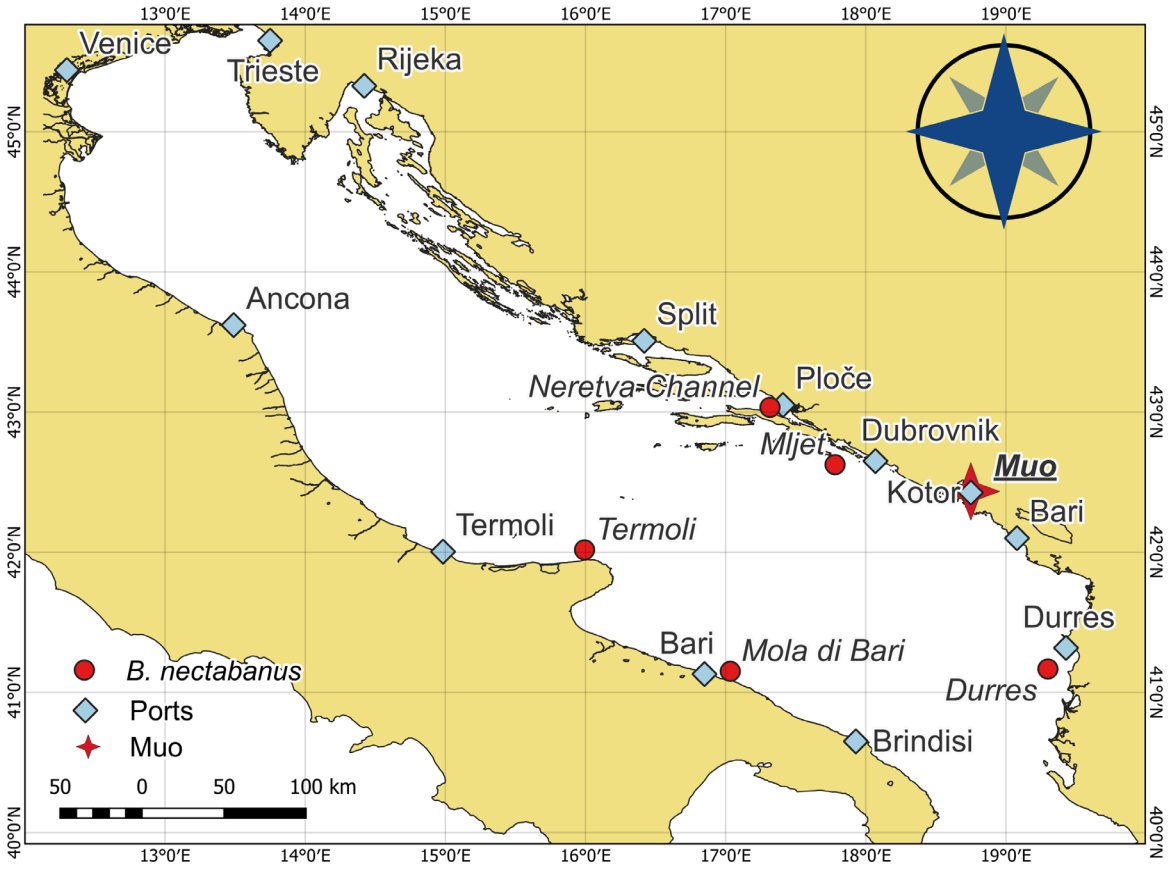

Fig. 3. Locations of *Bregmaceros nectabanus* records in the Adriatic Sea (red marks, italics) shown along the major seaports of the Adriatic Sea (blue marks). The location of the record presented here is given as a red star (Muo).

single individuals or a handful of specimens (Dulčić and Dragičević, 2023), may reflect low detectability, rather than absence.

Croatia has 20 first-time records of non-indigenous species reported in the Adriatic Sea, while Italy has 122 first-time records (Nunes *et al.*, 2014; Katsanevakis *et al.*, 2023). However, it is not specified how many of Italy's records originate from the Adriatic, as the country, due to its central position, borders all four Mediterranean regions. In this context, the progressive documentation of *B. nectabanus* in Adriatic localities, from Bari to Durrës to Boka Kotorska, appears consistent with an ongoing range expansion along coastal corridors.

These findings extend the known distribution of *B. nectabanus* in the Adriatic Sea and the Mediterranean. The species' expanding range is consistent with a Lessepsian migration pathway from the Red Sea, though its occurrence in areas of high maritime traffic raises the possibility that shipping may facilitate secondary dispersal. Its ecological flexibility, including tolerance for shallow and stratified environments, may support persistence in newly colonised areas. Further monitoring and genetic analyses could help clarify the relative importance of natural and anthropogenic vectors in the species' ongoing spread.

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AUTHOR CONTRIBUTION

Zdravko Ikica: Conceptualisation; Investigation; Data Curation; Formal Analysis; Writing-Original Draft; Visualisation; Writing-Review and Editing. Branka Pestorić: Methodology; Investigation; Writing-Review and Editing. Ilija Ćetković: Conceptualisation; Data Curation; Investigation. Ana Pešić: Data Curation; Investigation; Writing-Review and Editing. Aleksandar Joksimović: Supervision; Project Administration.

REFERENCES

Akyol, O. 2022. The recent capture of *Bregmaceros nectabanus* (Bregmacerotidae) from purse-seine fishery in Izmir Bay, NE Aegean Sea. Aquatic Research, 5(4), 319-323. https://doi.org/10.3153/AR22031

Aydin, I., Akyol, O. 2013. New record of the antenna codlet, *Bregmaceros atlanticus* Goode and Bean, 1886 (Gadiformes: Bregmacerotidae), from the northern Aegean Sea (Izmir Bay, Turkey). Journal of Applied Ichthyology, 29, 245-246. https://doi.org/10.1111/jai.12009

Capezzuto, F., Turco, C., Galasso, G., Sion, L., D'Onghia, G. 2024. The spread of the non-indigenous species *Bregmaceros nectabanus* Whitley, 1941 (Osteichthyes: Bregmacerotidae) in the eastern Mediterranean. Mediterranean Marine Science, 25(1), 67-72. https://doi.org/10.12681/mms.35429

Chartosia, N., Anastasiadis, D., Bazairi, H., Crocetta, F., Deidun, A., Despalatović, M., Di Martino, V., *et al.* 2018. New Mediterranean biodiversity records (July 2018). Mediterranean Marine Science, 19(2), 398-415. https://doi.org/10.12681/mms.18099

D'Ancona, U., Cavinato, G. 1965. The fishes of the family Bregmacerotidae. Dana Report, 64, 1-92.

Dulčić, J., Bello, G., Dragičević, B. 2020. *Bregmaceros nectabanus* Whitley, 1941 (Teleostei: Bregmacerotidae), a new Lessepsian migrant in the Adriatic Sea. BioInvasions Records, 9(4), 808-813. https://doi.org/10.3391/bir.2020.9.4.14

Dulčić, J., Dragičević, B. 2023. Handbook on alien decapod crustaceans and new fishes of the Adriatic Sea. FAO Fisheries and Aquaculture Circular No. 1267. Rome, FAO, 102 pp. https://doi.org/10.4060/cc7154en

Filiz, H., Akçinar, S.C., Ulutürk, E., Bayhan, B., Taşkavak, E., Sever, T.M., Bilge, G., *et al.* 2007. New records of *Bregmaceros atlanticus* (Bregmacerotidae), *Echiodon dentatus* (Carapidae), and *Nemichthys scolopaceus* (Nemichthyidae) from the Aegean Sea. Acta Ichthyologica et Piscatoria, 37(2), 107-112. https://doi.org/10.3750/AIP2007.37.2.07

Galil, B.S., Boero, F., Campbell, M.L., Carlton, J.T., Cook, E., Fraschetti, S., Gollasch, S., *et al*. 2015. 'Double trouble': the expansion of Suez Canal and marine bioinvasions in the Mediterranean Sea. Biological Invasions, 17, 973-976. https://doi.org/10.1007/s10530-014-0778-y

Goren, M., Galil, B.S. 2008. Additional records of *Bregmaceros atlanticus* in the eastern Mediterranean—an invasion through the Suez Canal or in ballast water? Marine Biodiversity Records, 1, e42. https://doi.org/10.1017/S1755267206004593

Harold, A.S., Golani, D. 2016. Occurrence of the smallscale codlet, *Bregmaceros nectabanus* in the Mediterranean Sea, previously misidentified as *B. atlanticus* in this region. Marine Biodiversity Records, 9, 71. https://doi.org/10.1186/s41200-016-0071-0

Harold, A.S., Baltzegar, C.W. 2023. A new species of *Bregmaceros* (Gadiformes: Bregmacerotidae) from the eastern Pacific Ocean, with comments on *B.atlanticus* and *B.japonicus*. Zootaxa, 5352(2), 266-278. https://doi.org/10.11646/zootaxa.5352.2.7

Ho, H.-C., Endo, H., Lee, C.-L., Chu, T.-W. 2020a. *Bregmaceros anchovia* sp.nov., a new codlet species from the western Pacific Ocean (Gadiformes: Bregmacerotidae). Zootaxa, 4801(3), 559-569. https://doi.org/10.11646/zootaxa.4801.3.8

Ho, H.-C., Endo, H., Chu, T.-W. 2020b. A new species of the codlet genus *Bregmaceros* from the western Pacific Ocean (Gadiformes: Bregmacerotidae). Zootaxa, 4786(4), 565-573. https://doi.org/10.11646/zootaxa.4786.4.8

Katsanevakis, S., Poursanidis, D., Hoffman, R., Rizgalla, J., Bat-Sheva Rothman, S., Levitt-Barmats, Y., Hadjioannou, L., *et al.* 2020. Unpublished Mediterranean records of marine alien and cryptogenic species. BioInvasions Records, 9(2), 165-182. https://doi.org/10.3391/bir.2020.9.2.01

Katsanevakis, S., Olenin, S., Puntila-Dodd, R., Rilov, G., Stæhr, P.A.U., Teixeira, H., Tsirintanis, K., *et al.* 2023. Marine invasive alien species in Europe: 9 years after the IAS regulation. Frontiers in Marine Science, 10, 1271755. https://doi.org/10.3389/fmars.2023.1271755

Martínez de Osés, F.X., Uyà Juncadella, À. 2021. Global maritime surveillance and oceanic vessel traffic services: towards the e-navigation. WMU Journal of Maritime Affairs, 20, 3-16. https://doi.org/10.1007/s13437-020-00220-0

MEDITS. 2013. International bottom trawl survey in the Mediterranean. Instruction manual. MEDITS-Handbook. Version 7. MEDITS Working Group, 120 pp.

Nunes, A.L., Katsanevakis, S., Zenetos, A., Cardoso, A.C. 2014. Gateways to alien invasions in the European seas. Aquatic Invasions, 9(2), 133-144. https://doi.org/10.3391/ai.2014.9.2.02

Official Gazette of Montenegro. 2011. Pravilnik o osnovnim konstruktivno-tehničkim karakteristikama, načinu upotrebe, vremenu, namjeni, količini i vrsti ribolovnih alata i opreme koja se smije upotrebljavati u velikom i malom privrednom ribolovu. https://www.sluzbenilist.me/propisi/31DF736C-0451-4F84-9D36-6E8F76F37D3E (accessed 30 June 2025).

Official Gazette of Montenegro. 2014. Pravilnik o izmjenama Pravilnika o osnovnim konstruktivno-tehničkim karakteristikama, načinu upotrebe, vremenu, namjeni, količini i vrsti ribolovnih alata i opreme koja se smije upotrebljavati u velikom i malom privrednom ribolovu. https://www.sluzbenilist.me/propisi/29B89F25-0FCA-4A45-B1D2-B6F9969D316B (accessed 30 June 2025).

Orfanidis, S., Alvito, A., Azzurro, E., Badreddine, A., Ben Souissi, J.B., Chamorro, M., Crocetta, F., *et al.* 2021. New alien Mediterranean biodiversity records (March 2021). Mediterranean Marine Science, 22(1), 180-198. https://doi.org/10.12681/mms.25294

Özgül, A., Akyol, O. 2017. On the occurrence of the smallscale codlet, *Bregmaceros nectabanus* (Bregmacerotidae), off the Urla coast in Izmir Bay (Aegean Sea, Eastern Mediterranean). Annales, Series Historia Naturales, 27(1), 69-74. https://doi.org/10.19233/ASHN.2017.10

Palermino, A., Centurelli, M., De Felice, A., Canduci, G., Biagiotti, I., Costantini, I., Leonori, I. 2022. New records of smallscale codlet, *Bregmaceros nectabanus* Whitley, 1941 (Gadiformes: Bregmacerotidae), in the Adriatic Sea. BioInvasions Records, 11(3), 796-802. https://doi.org/10.3391/bir.2022.11.3.21

Port of Kotor. 2024. Statistics. https://www.portofkotor.com/en/cruise-ships/statistics/ (accessed 26 April 2025).

Ragkousis, M., Zenetos, A., Ben Souissi, J., Hoffman, R., Ghanem, R., Taşkin, E., Muresan, M., *et al.* 2023. Unpublished Mediterranean and Black Sea records of marine alien, cryptogenic, and neonative species. BioInvasions Records, 12(2), 339-369. https://doi.org/10.3391/bir.2023.12.2.01

Sotola, V.A., Craig, C.A., Pfaff, P.J., Maikoetter, J.D., Martin, N.H., Bonner, T.H. 2019. Effect of preservation on fish morphology over time: Implications for morphological studies. PLOS ONE, 14(3), e0213915. https://doi.org/10.1371/journal.pone.0213915

Stern, N., Badreddine, A., Bitar, G., Crocetta, F., Deidun, A., Dragičević, B., Dulčić, J., *et al.* 2019. New Mediterranean biodiversity records (July 2019). Mediterranean Marine Science, 20(2), 409-426. https://doi.org/10.12681/mms.20602

Sulić-Šprem, J., Dobroslavić, T., Kožul, V., Kuzman, A., Dulčić, J. 2014. First record of *Lagocephalus sceleratus* in the Adriatic Sea (Croatian coast), a Lessepsian migrant. Cybium, 38(2), 147-148. https://doi.org/10.26028/cybium/2014-382-005

Torii, A., Javonillo, R., Ozawa, T. 2004. Reexamination of *Bregmaceros lanceolatus* Shen, 1960 with description of a new species *Bregmaceros pseudolanceolatus* (Gadiformes: Bregmacerotidae). Ichthyological Research, 51(2), 106-112. https://doi.org/10.1007/s10228-003-0202-6

Torii, A., Harold, A.S., Ozawa, T., Iwatsuki, Y. 2023. Redescription of *Bregmaceros mcclellandi* Thompson, 1840 (Gadiformes: Bregmacerotidae). Ichthyological Research, 50, 129-139. https://doi.org/10.1007/s10228-002-0148-0

Turan, C., Yağhoğlu, D., Gürle, M., Ergüden, D. 2011. A new record of antenna codlet *Bregmaceros atlanticus* Goode & Bean, 1886 (Bregmacerotidae: Gadiformes) from the Northeastern Mediterranean coast of Turkey. Journal of the Black Sea/Mediterranean Environment, 17(2), 186-192.

Yılmaz, R., Bilecenoğlu, M., Hoşsucu, B. 2004. First record of the antenna codlet, *Bregmaceros atlanticus* Goode & Bean, 1886 (Osteichthyes: Bregmacerotidae), from the eastern Mediterranean Sea. Zoology in the Middle East, 31(1), 111-112. https://doi.org/10.1080/09397140.2004.10638031

Zenetos, A., Gofas, S., Morri, C., Rosso, A., Violanti, D., García Raso, J.E., Çinar, M.E., *et al.* 2012. Alien species in the Mediterranean Sea by 2012. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. Mediterranean Marine Science, 13(2), 328-352. https://doi.org/10.12681/mms.327

Zenetos, A., Akel, E., Apostolidis, C., Bilecenoglu, M., Bitar, G., Buchet, V., Chalari, N., *et al.* 2015. New Mediterranean biodiversity records (April 2015). Mediterranean Marine Science, 16(1), 266-284. https://doi.org/10.12681/mms.1292