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BIOTSKA GLOBALIZACIJA

GLOBALIZZAZIONE BIOTICA

BIOTIC GLOBALIZATION

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THE FIRST MEDITERRANEAN RECORD OF RED-TOOTHED TRIGGERFISH *ODONUS NIGER* (BALISTIDAE) FROM THE SYRIAN COAST (EASTERN MEDITERRANEAN SEA)

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ABSTRACT

The present paper reports the first record of the red-toothed triggerfish, Odonus niger *(Rüppell, 1836), in the Mediterranean Sea. Two specimens were captured in Syrian marine waters (Eastern Mediterranean), measuring 250 mm and 225 mm in total length (TL) and weighing 209 g and 126 g, respectively. The species' original distribution is in the Indo-West Pacific, including the Red Sea, suggesting* O. niger *is a Lessepsian migrant introduced through the Suez Canal. However, other explanations for its presence in the Mediterranean Sea, such as introduction via ship ballast waters or release from aquariums cannot be totally excluded. This new record confirms that the number of alien species entering the Mediterranean is still increasing and highlights the need for further monitoring to determine the true status of this species in the study area.*

Key words: *Odonus niger*, Lessepsian migrant, aquarium, Eastern Levant, Mediterranean Sea

PRIMA SEGNALAZIONE MEDITERRANEA DI PESCE BALESTRA NERO *ODONUS NIGER* (BALISTIDAE) LUNGO LA COSTA SIRIANA (MEDITERRANEO ORIENTALE)

SINTESI

Il presente lavoro riporta la prima segnalazione del pesce balestra nero, Odonus niger *(Rüppell, 1836), nel Mediterraneo. Due esemplari sono stati catturati nelle acque marine siriane (Mediterraneo orientale), di 250 mm e 225 mm di lunghezza totale (TL) e 209 g e 126 g di peso, rispettivamente. La distribuzione originaria della specie è nel Pacifico indo-occidentale, compreso il Mar Rosso, il che suggerisce che* O. niger *sia un migratore lessepsiano introdotto attraverso il Canale di Suez. Tuttavia, non si possono escludere altre ipotesi per la sua presenza nel Mediterraneo, come l'introduzione attraverso le acque di zavorra delle navi o il rilascio dagli acquari. Questo nuovo dato conferma che il numero di specie aliene che entrano nel Mediterraneo è ancora in aumento e sottolinea la necessità di ulteriori monitoraggi per determinare il vero status di questa specie nell'area di studio.*

Parole chiave: *Odonus niger*, migratore lessepsiano, acquario, Levante orientale, Mediterraneo

INTRODUCTION

So far, according to Kovačić *et al.* (2021), the family Balistidae has been represented in the Mediterranean Sea by two species: the grey triggerfish, *Balistes capriscus* Gmelin, 1789, and the clown triggerfish, *Balistoides conspicillum* (Bloch & Schneider, 1801). *B. capriscus* was reported as *B. carolinensis* Gmelin, 1789, by Tortonese (1986), who noted that the species was common throughout the Mediterranean Sea and rare in the Black Sea. In Syrian marine waters, *B. capriscus* was first recorded by Gruvel (1931), and more recently by Ali (2018). The species feeds on molluscs and crustaceans, and deposits eggs in the summer in a cavity made by the female and guarded by the male (Tortonese, 1986).

Balistoides conspicillium was sighted in an underwater photograph by Weitzmann *et al.* (2015) off Sitges, a city in Costa Daurada, northern Spain. The species is solitary and its diet is similar to that of *B. capriscus*. It is widely distributed in the Indo-Pacific, from South Africa to Samoa, but is unknown in the Red Sea (Golani *et al.*, 2021).

Investigations conducted over the past two decades along the Syrian coast have provided the opportunity to collect two specimens of the red-toothed triggerfish *Odonus niger* (Rüppell, 1836). This species is widely distributed in the Indo-West Pacific, from East Africa to southern Japan, including the Red Sea, the Ogasawara Islands, the Great Barrier Reef and the Coral Sea (Randall *et al.*, 1990). It is also present in the Marquesas and Society islands (Golani & Fricke, 2018), around Madagascar and Sri Lanka (Fischer & Bianchi, 1984), as well as in Indonesia and the Marianas Islands (Heemstra *et al.*, 2022). It has been recorded at depths of up to 130 m off the southwest coast of India (Ramachandran & Philip, 2010). Previously, *O. niger* had not been confirmed in the Mediterranean Sea; therefore, both collected specimens, and the potential causes of these new findings are discussed here.

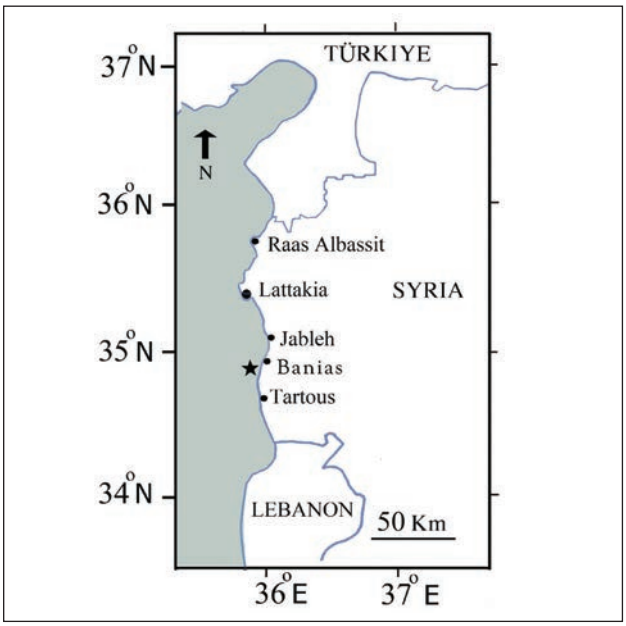

Fig. 1: Map of the Syrian coast with the black star indicating the capture site of the two specimens of *Odonus niger* ***(ref. 2332 and 2333 MSL).***
Sl. 1: Zemljevid sirske obale z označeno lokaliteto ulova (črna zvezdica) dveh primerkov vrste *Odonus niger* ***(ref. 2332 in 2333 MSL).***

MATERIAL AND METHODS

The study of both specimens follows the protocol of Bello *et al.* (2014), recommended for first records. The two specimens were caught on 13 September 2024, using a metal bottom cage, at a depth of 15 m on a rocky bottom. The captures occurred 1 km off the fishing port of Banias city at 35°11′ N and 35°55′ E (Fig. 1). The identification of the specimens was based on ichthyological notes and field guides. Morphometric measurements, recorded to the nearest millimetre are summarized in Table 1, along with meristic counts and total body weight to the nearest gram. The specimens were photographed, preserved in 10% buffered formaldehyde, and deposited in the Ichthyological Collection of the Marine Sciences Laboratory (MSL) at the Faculty of Agriculture, Tishreen University (Syria), under reference numbers 2332 MSL (Fig. 2) and 2333 MSL.

RESULTS AND DISCUSSION

The two specimens measured 250 mm and 225 mm in total length (including long caudal-fin lobes), and weighed 209 g and 126 g, respectively. They were classified as *O. niger* based on the combination of the following main morphological characters: body deep and laterally compressed, with large rectilinear scale plates forming regular rows on thick skin; a prominent groove in the skin extending anteriorly from front of eye equal to, or slightly longer than eye diameter; three prominent dorsal fin spines, with first capable of being locked erect by second; caudal fin rays greatly prolonged above and below; anterior rays of both soft dorsal and anal fins elevated, with margins prominently concave in profile; mouth slightly supraterminal, with lower jaw jutting forward, featuring distinctive red teeth, including two canine-like lateral teeth in upper jaw; enlarged bony scales present behind gill opening; deep groove before the eyes and below the nostrils; dorsal fins with 3 spines, 34 rays; anal fin with 28 rays; pectoral fins with 14 rays; pelvic fins reduced to a single rudiment; caudal fin extremely

Tab. 1: Morphometric measurements with percentages of total length (%TL), meristic counts, and total body weight of the** Odonus niger **captured 1 km off Banias city, Syrian coast (ref. 2332 MSL and 2333 MSL).
Tab. 1: Morfometrične meritve z deleži celotne dolžine (%TL), meristična štetja in celokupna teža primerkov vrste** Odonus niger**, ujetih v vodah, oddaljenih 1 km od mesta Banias, sirska obala (ref. 2332 MSL in 2333 MSL).

References	**MSL 2332**		**MSL 2333**	
Morphometric measurements	**mm**	**%TL**	**mm**	**%TL**
Total length	250	100	225	100
Standard length	161	64.4	144	64.0
Fork length	197	78.8	175	77.8
Body depth	84	33.6	76	33.8
Head length	55	22	45	20.0
Eye diameter	8	3.2	7	3.1
Snout length	38	15.2	35	15.6
Upper jaw length	8	3.2	6	2.7
Lower jaw length	7	2.8	5	2.2
Base of first dorsal fin length	23	9.2	21	9.3
Base of second dorsal fin length	102	40.8	92	40.9
Base of pectoral fin length	10	4.0	9	4.0
Base of anal fin length	59	23.6	53	23.6
Base pelvic fin length	25	10.0	23	10.2
Pre- first dorsal length	53	21.2	48	21.3
Pre- second dorsal length	93	37.2	84	37.3
Pre-pectoral length	50	20.0	46	20.4
Pre-pelvic length	65	26.0	58	25.8
Pre-anal length	104	41.6	88	39.1
Meristic counts				
First Dorsal fin rays	III		III	
Second Dorsal fin rays	34		34	
Pectoral fin rays	14		14	
Pelvic fin rays	XV		XVI	
Anal fin rays	28		28	
Total body weight (gram)	209		126	

lunate, with upper and lower lobes extended into filaments; head and body bluish black. Colour: ground colour of body and fins blackish-brown, with a darker stripe running from mouth to pectoral fin base; posterior margin of caudal fin featuring a lunar-shaped white bar.

All these characters are completely consistent with Fischer & Bianchi (1984), Randall *et al.* (1990), Heemstra & Randall (1993), and Heemstra *et al.* (2022). The findings constitute the first record of the species from the Syrian coast (Saad, 2005; Ali, 2018), as well as in the Mediterranean Sea, where this species had not been recorded previously (Golani *et al.*, 2021). However, these observations are not sufficient to suggest that a viable population of the species is successfully established in Syrian marine waters. Additional records are necessary to determine the true status of the species in the study area and the broader Mediterranean Sea.

O. niger is relatively abundant in the Red Sea (Golani & Bogorodsky, 2010; Golani & Fricke, 2018). It has also been recorded along the Egyptian coast of the Red Sea (El Sayed *et al.*, 2017), in the Jordanian Gulf of Aqaba (Khalaf, 2004), and in Somalia (Sommer *et al.*, 1996). *O. niger* is known to be a strong swimmer (Randall *et al.*, 1990), therefore, given its proximity to the Syrian coast, a migration from the Red Sea through the Suez Canal could be considered a plausible hypothesis. *O. niger* is a new Lessepsian migrant (*sensu* Por, 1971), contributing to the increasing number of alien fishes in

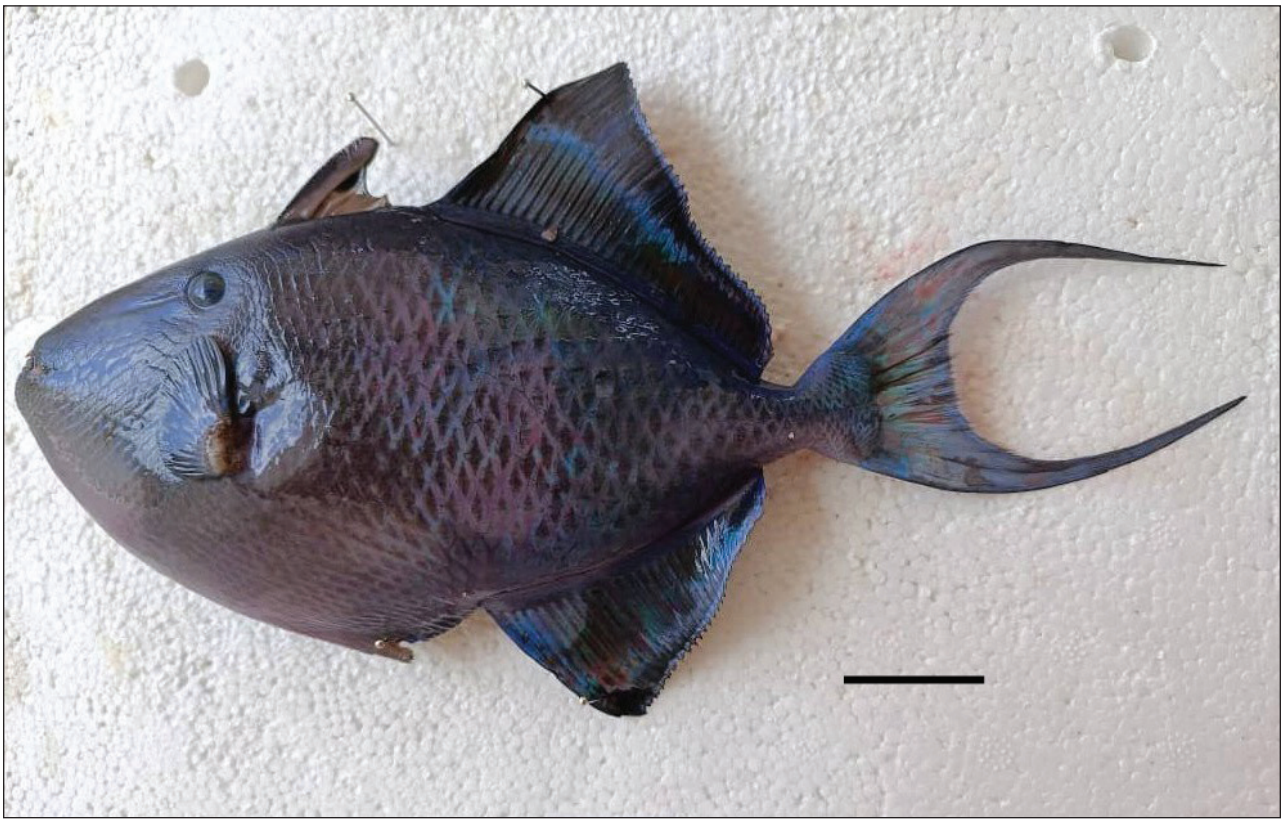

Fig. 2: *Odonus niger* ***(ref. 2332) captured 1 km off Banias city, Syrian coast. Scale bar = 30 mm.***
Sl. 2: Primerek vrste *Odonus niger* ***(ref. 2332), ujet v vodah, oddaljenih 1 km od mesta Banias, sirska obala. Merilo = 30 mm.***

the Mediterranean. According to Golani *et al.* (2021), 75% of the exotic species recorded in the Mediterranean Sea to date originate from the Indo-Pacific, primarily from the Red Sea. However, as suggested by Golani *et al.* (2021), other vectors may also be responsible for the introduction of many exotic species, including ship ballast waters and aquarium releases.

The latter cause should be particularly considered in relation to *O. niger*, as it was found to apply to *B. conspicillum* (Weitzmann *et al.*, 2015). Randall *et al.* (1990) noted that these balistid species are highly valued and very popular in aquariums, with many available for sale on various online platforms. Therefore, a management plan should be implemented in local fisheries, in cooperation with fishermen, to identify the causes of new arrivals, monitor their presence, and potentially contribute to the establishment of a viable population of *O. niger* in the study area and throughout the Mediterranean Sea.

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The authors wish to thank Mr. Ali Mousa for collecting and providing the specimens of the Red-toothed triggerfish *O. niger*. They are also grateful to two anonymous referees for their useful and helpful comments which considerably improved the scientific quality of the original manuscript.

PRVI ZAPIS O POJAVLJANJU RDEČEZOBE BALESTRE *ODONUS NIGER* (BALISTIDAE) IZ SIRSKE OBALE (VZHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o prvi najdbi rdečezobe balestre Odonus niger *(Rüppell, 1836) v Sredozemskem morju. Gre za dva primerka, ujeta v sirskih vodah (vzhodno Sredozemsko morje), ki sta merila 250 mm in 225 mm v dolžino in tehtala 209 g in 126 g. Vrsta domuje v Indo-zahodnem Pacifiku, vključno z Rdečim morjem, na podlagi česar avtorji sklepajo, da je* O. niger *lesepska selivka, ki je prišla v Sredozemsko morje skozi Sueški prekop. Vendar drugih razlag za njegovo pojavljanje v Sredozemskem morju, kot je prihod z balastnimi vodami ladij ali izpust iz akvarijev, ni mogoče popolnoma izključiti. Ta novi zapis o pojavljanju potrjuje, da število tujih vrst, ki vstopajo v Sredozemsko morje, še vedno narašča, in narekuje potrebo po nadaljnjem spremljanju te vrste na proučevanem območju, na podlagi katerega bo možno opredeliti pravi status.*

Ključne besede: *Odonus niger*, lesepska selivka, akvaristika, vzhodni Levant, Sredozemsko morje

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OCCURRENCE OF *PTEROIS MILES* (SCORPAENIDAE) IN THE MEDITERRANEAN SEA

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ABSTRACT

This paper presents an update of the Mediterranean distribution of Pterois miles*, based on a comprehensive list of geo-referenced occurrences up to July 2024, including a maximum size report. On 11 July 2024, a huge specimen of* P. miles *was captured by commercial trammel net at a depth of 40 m off Kadırga cove, Marmaris, Muğla. The specimen has a total length of 437 mm and a wet weight of 1268 g. Following the initial Mediterranean record of* P. miles *in Israel in 1991, the species has exhibited a relatively rapid dispersal rate, subsequently expanding to the northern Aegean Sea (Edremit Bay) and southern Aegean Sea (southern Crete) as well as the Libyan Sea between 2016 and 2018. Since then, the species expanded its distribution range to the northernmost limit of the Adriatic Sea, reaching as far as Southern Sicily and the Gulf of Tunis.*

Key words: Devil firefish, lionfish, maximum length, distribution, Aegean Sea

PRESENZA DI *PTEROIS MILES* (SCORPAENIDAE) NEL MAR MEDITERRANEO

SINTESI

Il presente lavoro presenta un aggiornamento della distribuzione mediterranea di Pterois miles*, basato su un elenco completo di presenze georeferenziate fino al luglio 2024, compreso un rapporto sulle dimensioni massime. L'11 luglio 2024, un enorme esemplare di* P. miles *è stato catturato con un tramaglio commerciale a 40 m di profondità al largo di Kadırga cove, Marmaris, Muğla. L'esemplare ha una lunghezza totale di 437 mm e un peso umido di 1268 g. Dopo il primo ritrovamento mediterraneo di* P. miles *in Israele nel 1991, la specie ha mostrato un tasso di dispersione relativamente rapido, espandendosi successivamente al Mar Egeo settentrionale (Baia di Edremit) e al Mar Egeo meridionale (Creta meridionale), nonché al Mar Libico tra il 2016 e il 2018. Da allora, la specie ha ampliato il suo areale di distribuzione fino al limite più settentrionale dell'Adriatico, raggiungendo anche la Sicilia meridionale e il Golfo di Tunisi.*

Parole chiave: pesce scorpione, lunghezza massima, distribuzione, Egeo

INTRODUCTION

The devil firefish, *Pterois miles* (Bennet, 1828) is a marine and reef-associated fish that inhabits shallow waters with rocky or sandy bottoms at a depth of 0 - 85 m (Froese & Pauly, 2024). *P. miles*, which reaches a length of 43 cm (Froese & Pauly, 2024), is an opportunistic predator that affects ecosystem dynamics through the consumption of large quantities of small-sized fish and crustaceans (Eddy *et al.,* 2016). It is distributed in a wide range, including the tropical waters of the Indian Ocean: the Persian Gulf (Wright, 1988); the Red Sea south to Port Alfred, South Africa and east to Sumatra, Indonesia (Fricke, 1999); and the Atlantic Ocean up to a depth of 60 meters (Sommer *et al.,* 1996). It has also been detected in the Mediterranean Sea (Golani & Sonin, 1992). *P. miles* is considered amongst the most successful invaders in the history of aquatic invasions (Bariche *et al.,* 2013). Their fin spines are highly venomous and can be fatal humans (Sommer *et al.,* 1996).

A recent genetic study revealed the origin of the lionfish invasion in the Mediterranean Sea (Bariche *et al.,* 2017). The authors determined that the most likely explanation for the Mediterranean invasion was the Lessepsian migration of lionfish from the Red Sea into the Mediterranean through the Suez Canal. *P. miles* first appeared in the eastern Mediterranean Sea in 1991 in Haifa Bay, Israel (Golani & Sonin, 1992). After a gap of two decades, it was reported on the Lebanon coast (Bariche *et al.,* 2013), in İskenderun Bay, Türkiye (Turan *et al.,* 2014) and at Rhodes, Greece (Crocetta *et al.,* 2015). Apparently, it has spread relatively quickly and has further expanded to the northern Aegean Sea (Edremit Bay) and southern Aegean Sea (southern Crete) as well as the Libyan Sea between 2016 and 2018 (Dailianis *et al.,* 2016; Al Mabruk & Rizgalla, 2019; Aydın *et al.,* 2022). Then, it expanded its distribution range to the northernmost limit of the Ionian Sea, close to the border with the Adriatic Sea (Di Martino & Stancanelli, 2021) to southern Sicily (Azzurro *et al.,* 2017) and to the Gulf of Tunis (Dailianis *et al.,* 2016). This might be considered as the westernmost limit of its current distribution for the time being.

In Turkish seas, since the first recording (Turan *et al.,* 2014), the species has been recorded in various studies (Bilge *et al.,* 2016; Yağlıoğlu & Ayaş, 2016; Özgür Özbek *et al.,* 2017; Dağhan & Demirhan, 2020; Tanrıverdi *et al.,* 2022). Sporadically, the fish has moved to the western part of Anatolia. Therefore, the first occurrence reports for the Aegean Sea

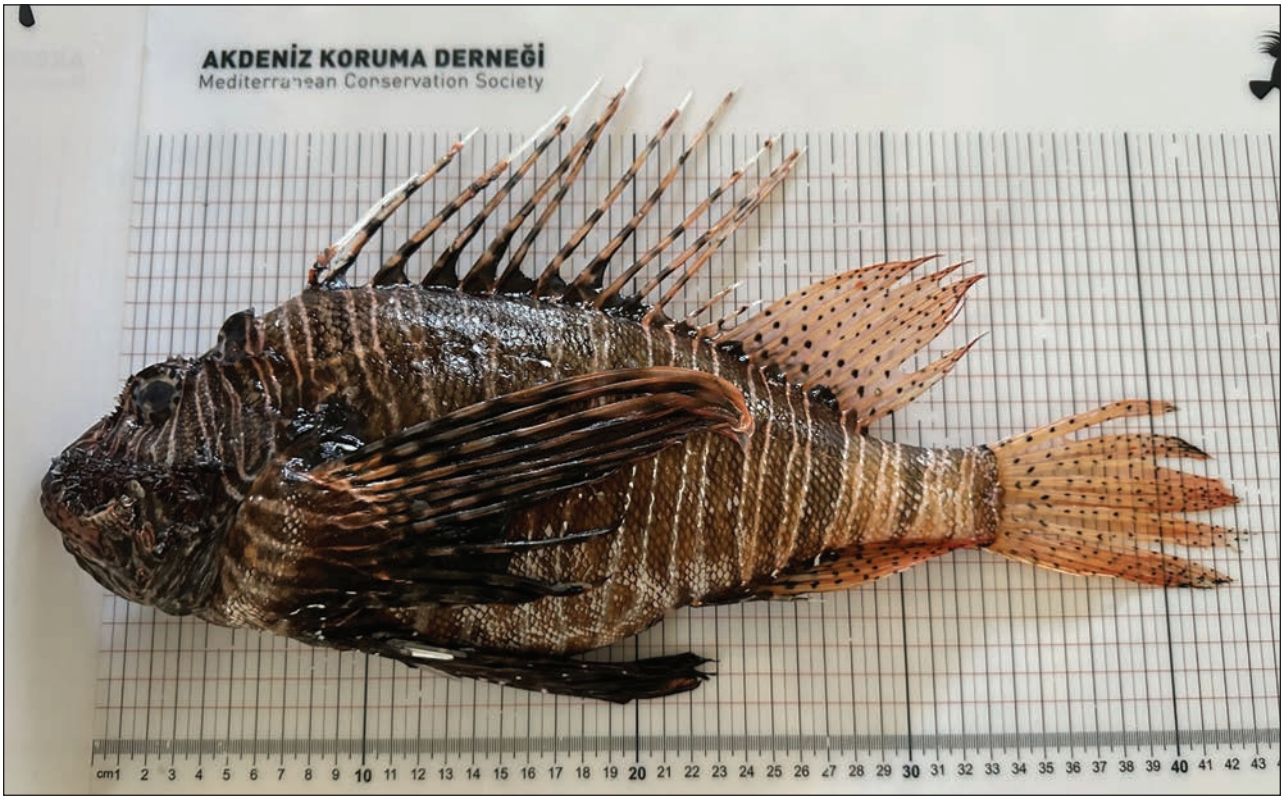

Fig. 1: A huge** Pterois miles**, 437 mm TL (1268 g), caught at Marmaris, southeastern Aegean Sea.
Sl. 1: Ogromen primerek vrste** Pterois miles**, 437 mm TL (1268 g), ujet v Marmarisu, jugovzhodno Egejsko morje.

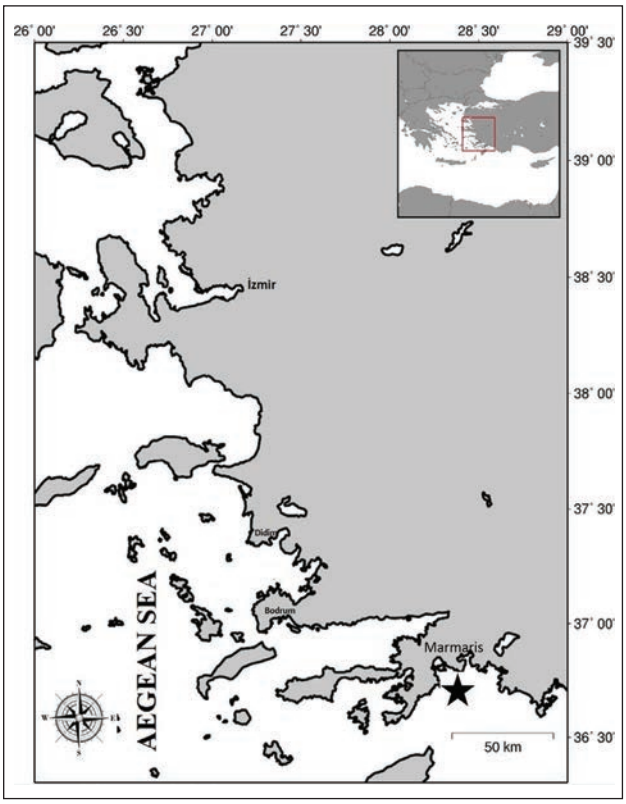

Fig. 2: Sampling site (black star) of** Pterois miles **captured at Marmaris, southeastern Aegean Sea.
Sl. 2: Mesto vzorčenja (črna zvezda) primerka vrste** Pterois miles**, ujetega v Marmarisu, jugovzhodno Egejsko morje.

Tab. 1: Morphometric measurements and percentages of total length (TL%) of the** Pterois miles**, captured at Marmaris, southeastern Aegean Sea.
Tab. 1: Morfometrične meritve in deleži celotne dolžine (TL%) primerka vrste** Pterois miles**, ujetega v Marmarisu, jugovzhodno Egejsko morje.

Morphometrics	**mm**	**%TL**
Total length	437	-
Standard length	340	77.8
Fork length	110	25.2
Body depth	21	4.8
Head length	35	8.0
Eye diameter	119	27.2
Snout length	88	20.1
Upper jaw length	234	53.5
Lower jaw length	102	23.3
Base of first dorsal fin length	27	6.2
Meristic counts		
Dorsal fin	XIII + 10	
Anal fin	III + 6	
Pectoral fin	14	
Ventral fin	I + 5	
Weight (g)	1268	

were from the Dalyan coast (Muğla) in 2015 (Turan & Öztürk, 2015). The distribution of the species along the Aegean Sea has expanded towards the northern latitudes of the Aegean Sea. The species has been observed in Kokar Bay, Izmir (Özgül, 2020), Karaburun, Izmir Bay (Oruç *et al.,* 2022) and Edremit Bay (Aydın *et al.,* 2022; Alkan *et al.,* 2023). In this study, we present updated records of *P. miles* in the Mediterranean, including a recent sighting of a large individual in the southern Aegean Sea.

MATERIAL AND METHODS

On 11 July 2024, a huge specimen of *Pterois miles* (Fig. 1) was captured by a commercial trammel net (mesh size 100 mm) targeting grouper and common dentex off Kadırga cove, Marmaris, Muğla (coordinates: 36°43′49′′N and 28°18′19′′E), at a depth of 40 m (Fig. 2). Morphometric measurements were recorded to the nearest millimetre and weighing in grams. The specimen was preserved in 6% formaldehyde solution and subsequently deposited in the Ichthyological Collection of the Fisheries Faculty, Ege University, under catalogue number ESFM-PIS/2024-03. To ascertain the distribution of *P. miles* throughout the Mediterranean Sea, we undertook a review of the literature, applying the criteria between 1 and 5 (i.e. verified presence in collection, publications on evidences from photo, morphological or genetic data, expert providing individual collecting data and exper performing broad study) for the confirmed presence of the fish species (see Kovačić *et al.,* 2020).

RESULTS AND DISCUSSION

The specimen was measured to the nearest millimetre. For species identification, we followed Bariche *et al.,* (2013), Turan *et al.,* (2014), Dağhan & Demirhan (2020) and Froese & Pauly (2024). Morphometric measurements and percentages of total length (TL%) of *Pterois miles* are provided in Tab. 1. This specimen is of considerable size (437 mm TL, 1268 g wet weight), exceeding the previously reported greatest length in unpublished data by Ulman *et al.,* (2022) (see FishBase). Moreover,

Tab. 2: Records of** Pterois miles **throughout the Mediterranean Sea (*BS: beach seine; CCS: communication with citizen scientists; GN: gillnet; LL: longline; OD: observation by diver; SG: speargun; T: trawl; TN: trammel net; WT: wire-trap). Tab. 2: Zapisi o pojavljanju vrste** Pterois miles **v Sredozemskem morju (*BS: obalna potegalka; CCS: komunikacija na podlagi občanske znanosti; GN: zabodna mreža; LL: parangal; OD: opazovanje potapljača; SG: podvodna puška; T: vlečna mreža; TN: trislojna mreža; WT: žična past).

Sampling locations	Depth (m)	Method of detection*	Date	N	Size range (TL, mm)	References
Herzliya, Israel	35	T	28 July 1991	1	328 SL	Golani & Sonin (1992)
Al Minie, Lebanon	?	WT	02 Oct. 2012	1	?	Bariche *et al.* (2013)
Al Minie, Lebanon	30	TN	12 Dec. 2012	1	209	Bariche *et al.* (2013)
Limassol, Cyprus	?	?	? Feb. 2013	1	?	Kletou *et al.* (2016)
Cypriot waters	2-35	CCS	2012-2015	79	50-300	Jimenez *et al.* (2016)
Lebanese coasts	12-37	CCS	Jun. 2013-Oct. 2015	47	?	Dailianis *et al.* (2016)
Iskenderun Bay, NE Medit.	25	?	13 Apr.2014	1	276	Turan *et al.* (2014)
Ormidia, Cyprus NE Medit.	10	GN	22 May 2014	1	170	Iglésias & Frotté (2015).
Limassol, Cyprus, NE Medit.	15	?	? Jan.2015	1	?	Kletou *et al.* (2016)
Karpas, N Cyprus, NE Medit.	40	GN	26 Feb.2015	1	373	Oray *et al.* (2015)
Larnaca, Cyprus, NE Medit.	40	?	? May 2015	1	?	Kletou *et al.* (2016)
Zembra Island, Tunisia	5	?	? Jun.2015	1	202	Ounifi Ben Amor & Ghanem (2016)
Ayios Theodoros, Cyprus, NE Med.	15	?	? July 2015	1	?	Kletou *et al.* (2016)
Kallithea, Rhodes, SE Aegean	7	OD	15 July 2015	1	?	Crocetta *et al.* (2015)
Plimmiri, Rhodes, SE Aegean	?	OD	02 Aug. 2015	1	?	Crocetta *et al.* (2015)
Dalyan, SE Aegean	11	OD	? Aug. 2015	1	?	Turan & Öztürk (2015)
Psaropoula, Rhodes, SE Aegean	2	OD	23 Sep. 2015	1	?	Crocetta *et al.* (2015)
Lattakia, Syrian coasts	1	T	28 Sep. 2015	1	211	Ali *et al.* (2016)
Cape Bon, Tunisia	?	OD	? Sep. 2015	1	?	Dailianis *et al.* (2016)
Off Kavo, Kriti, Greece	?	GN	? Nov. 2015	2	?	Dailianis *et al.* (2016)
Kouremenos Bay, Kriti, Greece	33	GN	? Nov. 2015	1	250	Dailianis *et al.* (2016)
Jableh, Syrian coasts	1	T	10 Dec. 2015	1	269	Ali *et al.* (2016)
Yeşilovacık Bay, NE Medit.	100	T	20 Dec. 2015	1	250	Yağlıoğlu & Ayas (2016)
Datça, SE Aegean	10	GN	19 Apr. 2016	1	200	Bilge *et al.* (2016)
SE Kriti, Greece	18-30	GN	24 Jul. 2016	1	100	Dailianis *et al.* (2016)
E Rhodes, SE Aegean	1-50	SG-BS-LL	May 2016-Nov. 2017	42	149-315	Zannaki *et al.* (2019)
Karpathos Island, Greece	9-17	OD	? Aug. 2016	3	100-200	Mytilineou *et al.* (2016)
S Sicily, Italy	3.5	OD	23 Sep. 2016	1	120	Azzurro *et al.* (2017)
Kemer, Antalya, NE Medit.	10-15	SG	20 Jan.-10 Feb. 2017	8	85-293	Özgür-Özbek *et al.* (2017)
Didim, SE Aegean	18	OD	05 Apr. 2017	1	?	Yapıcı (2018)
Lattakia, Syrian coasts	25	WT	29 May 2017	1	226	Ali *et al.* (2017)
S Cyprus, NE Medit.	5-40	SG	Sep. 2017-Aug. 2018	82	158-390	Mouchlianitis *et al.* (2022)
Iskenderun Bay, NE Medit.	?	SG-TN	Mar. 2018-Apr. 2019	179	145-355	Dağhan & Demirhan (2020)
Marsa Metruh, Egypt, SE Medit.	7-27	SG	17 Aug. 2018	2	200-400	Al Mabruk *et al.* (2020)
Gulf of Antalya, NE Medit.	8-22	SG	Oct. 2018-May 2019	35	131-352	Tanrıverdi *et al.* (2022)

Wadi Al-Klag, Libya	25-27	SG	01 Dec. 2018	1	?	Al Mabruk & Rizgalla (2019)
Karsa, Libya	8	LL	04 Dec. 2018	1	?	Al Mabruk & Rizgalla (2019)
Lecce, Italy, Adriatic	?	OD	20 July 2019	1	?	Di Martino & Stancanelli (2021)
Dhermi, Albania, Adriatic	?	OD	28 July 2019	1	?	Di Martino & Stancanelli (2021)
Kokar Bay, SE Aegean Sea	15	SG	26 Aug. 2019	1	144	Özgül (2020)
Brindisi, Italy, Adriatic	?	OD	09 Aug. 2020	1	?	Di Martino & Stancanelli (2021)
Edremit Bay, NE Aegean	70	T	07 Oct. 2020	1	224	Aydın *et al.* (2022)
Karaburun, Izmir, N Aegean	36	OD	18 Mar. 2021	1	309	Oruç *et al.* (2022)
Çökertme, Bodrum, SE Aegean	10	?	15 July 2021	1	340	Soykan & Ulaş (2022)
Vis Island, Croatia, Adriatic	15	OD	13 Aug. 2021	1	150	Dragičević *et al.* (2021)
E Rhodes, Greece, SE Aegean	8-35	GN-TN	Apr. 2021-Mar. 2022	363	160-380	Kondylatos *et al.* (2024)
Edremit Bay, NE Aegean	12	SG	11 June 2023	1	297	Alkan *et al.* (2023)
Marmaris, SE Aegean Sea	40	TN	11 July 2024	1	437	Present study

according to the records included in this study (see the size range column in Tab. 2), such a large specimen has never previously been caught. However, a local fisher claimed to have seen one larger than this (Coşkun Kılıç, *pers.comm*.).

Forty-eight distinct sightings of a total of 879 specimens of *P. miles* were made at about 43 different locations throughout the Mediterranean from 1991 to 11 July 2024 (see, Tab. 2). A considerable number of photographs of *P. miles* from a multitude of geographical locations are being uploaded to social media every day; thus, it is evident that the population of *P. miles* is more substantial than Tab. 2 suggests. To gain a more accurate understanding of the situation, we have considered reports published in scientific journals and have omitted reports of lionfish sightings on electronic social media, such as Facebook, along with photographs taken by local divers.

As a rapid invader, *P. miles* reached Tunisia, Italy, Albania and Libya and colonised the majority of the eastern Mediterranean over a three-decade period (Tab. 2). Indeed, the species has become well established over the past 12 years (as documented by Bariche *et al.,* 2013). A number of studies on invasive alien species have attributed this phenomenon to changes in seawater temperatures resulting from global warming (Bianchi & Morri, 2003; Azzurro *et al.,* 2019; Dimitriadis *et al.,* 2020; Turan, 2020; Ulman *et al.,* 2022). Dimitriadis *et al.* (2020) posited that the mean winter sea surface temperature (i.e. 15.3°C winter isotherm) represents the primary limiting factor governing the range expansion of the species. Consequently, *P. miles* could potentially expand further in the Mediterranean Sea, with the exception of the coolest northernmost regions. Turan (2020) supports this point based on a 'max-like' distribution mapping analysis that identifies appropriate habitats under the current climate condition, *P. miles* predominantly occurs in the eastern coastal areas of the Mediterranean, with no pattern of distribution in the Marmara and Black Seas.

In conclusion, *P. miles* is now a well-established species, especially in the eastern part of the Mediterranean and its population is increasing day by day. Although the continuing distribution of this species cannot be prevented, some efforts can be made to reduce its population. Kletou *et al*. (2016) believe that there is a strong motivation to aid removal efforts. The authors argue that the lionfish is safe to consume after the venomous dorsal, pelvic fin and anal fin spines are removed, and its edibility can be promoted; removal programs should also be combined with efforts to restore populations of potential predators of lionfish, such as the dusky grouper (Kletou *et al.,* 2016). The fact that lionfish are edible focuses the fight against this invasive species on a catch and consume approach. For example, the Mediterranean Conservation Society (MCS) purchased over four tonnes of lionfish for distribution from small-scale fishermen in the southern Aegean Sea during the last fishing season. As a result of promotional activities carried out by MCS, lionfish are now on the menus of some luxury restaurants and consumed by the public. This removal activity may be a factor limiting the increase of the species in the area.

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POJAVLJANJE NAVADNE PLAMENKE *PTEROIS MILES* (SCORPAENIDAE) V SREDOZEMSKEM MORJU

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POVZETEK

Avtorja poročata posodobljen seznam o razširjenosti navadne plamenke Pterois miles *v Sredozemskem morju, ki temelji na izčrpnem seznamu georeferenciranih dogodkov do julija 2024, vključno s poročilom o največji velikosti. Enajstega julija 2024 so s komercialno trislojno mrežo na globini 40 m pri zalivu Kadırga, Marmaris, Muğla ujeli ogromen primerek plamenke. Meril je 437 mm v dolžino in tehtal 1268 g. Po začetnem sredozemskem zapisu o pojavljanju vrste* P. miles *v Izraelu leta 1991 se je vrsta pričela hitro širiti in se postopno razširila v severno Egejsko morje (zaliv Edremit) in južno Egejsko morje (južna Kreta) ter Libijsko morje med 2016 in 2018. Odtlej je vrsta razširila svoje območje razširjenosti do severne meje razširjenosti v Jadranskem morju, vse do južne Sicilije in Tuniškega zaliva.*

Ključne besede: navadna plamenka, plamenke, največja dolžina, razširjenost, Egejsko morje

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NEW NON-NATIVE AND RARE MARINE INVERTEBRATES IN SYRIAN WATERS

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ABSTRACT

Recent biological surveys of the Syrian coast have documented the first occurrences of non-native species from various origins, as well as rare native species. This paper describes the first findings of Isognomon bicolor *(C. B. Adams, 1845),* Escharoides coccinea *(Abildgaard, 1806),* Tylodina perversa *(Gmelin, 1791),* Planocera graffi *Lang, 1879, and* Planocera pellucida *(Mertens, 1833) in Syrian waters, and provides further information on* Branchiomma luctuosum *(Grube, 1870). The impact of non-native species on native biodiversity is briefly discussed.*

Key words: non-native species, rare species, Eastern Mediterranean, Syria

NUOVE SPECIE DI INVERTEBRATI MARINI ALLOCTONI E RARI IN ACQUE SIRIANE

SINTESI

Recenti indagini biologiche lungo la costa siriana hanno documentato le prime presenze di specie alloctone di varia origine e di rare specie autoctone. Il presente lavoro descrive i primi ritrovamenti di Isognomon bicolor *(C. B. Adams, 1845),* Escharoides coccinea *(Abildgaard, 1806),* Tylodina perversa *(Gmelin, 1791),* Planocera graffi *Lang, 1879 e* Planocera pellucida *(Mertens, 1833) nelle acque siriane e fornisce ulteriori informazioni su* Branchiomma luctuosum *(Grube, 1870). L'impatto delle specie alloctone sulla biodiversità autoctona viene brevemente discusso.*

Parole chiave: specie alloctone, specie rare, Mediterraneo orientale, Siria

INTRODUCTION

The dispersal of non-native species far from their original distribution areas, along with the expansion of their geographical range and impact, is a significant concern in biology and ecology (Albano *et al.*, 2021a; MMC, 2024). The migration of these species occurs through various pathways, including biofouling (Ulman *et al.*, 2019), ballast water, waterways, and mariculture (Vidas & Kostelac, 2011). The presence of invasive species in shipyards and marine docks reinforces the belief that ports are the main transit gateway for these species via shipping (Tempesti *et al.*, 2020; Massé *et al.*, 2023; Serrano *et al.*, 2023). Inventories of non-native species have been compiled for various regions of the Mediterranean Sea, with 1006 non-native marine species documented as of 2020 (Galanidi *et al.*, 2023). An increase in the number of species of tropical Atlantic and Indo-Pacific origin has been reported throughout the Mediterranean Sea, with the largest number of them found in the Eastern Mediterranean and Italy (Tiralongo *et al.*, 2022; Zenetos *et al.*, 2022; Christidis *et al.*, 2024), This significant change in the species composition of Mediterranean bio-communities is attributed to the environment's readiness to be invaded by alien species due to the diversity of climatic conditions and circumstances across its regions, from temperate to subtropical (Vermeij, 2011; Pisano *et al.*, 2020). The climate warming in the eastern Mediterranean is accelerating the loss of native biodiversity and creating conditions suitable for the settlement and stability of tropical species (Albano *et al.*, 2021b; Digenis *et al.*, 2024).

However, continuing research and increased field efforts help track the presence of new and rare invertebrate species in the Mediterranean Sea and determine their biological and environmental characteristics. Reporting the occurrence of rare and endangered species and studying their geographical distribution is important for enhancing knowledge of biodiversity and managing these species. Many rare species in the Mediterranean have been discussed in collective articles (Santin *et al.*, 2021; Tsagarakis *et al.*, 2021), and many have been documented in specific habitats such as marine protected areas and caves (UNEP/MAP - SPA/RAC, 2022). The marine environment in Syria, part of the eastern Mediterranean, has seen a significant rise in the number of non-native species discovered in recent years, especially at port sites, which are hotspots for biological invasion. Their percentage exceeded 36% in the fishing port of Ras al-Basit (Alo, 2024) and 50% in the Al-Massab basin (Ammar, 2023a). Among them, several Atlantic tropical species have been documented, including the anemone *Teimatactis panamensis* (Verrill, 1869) (Arabia *et al.*, 2023), the yellow sponge *Aplysina insularis* (Duchassaing & Michelotti, 1864) (Ammar *et al.*, 2023a), and the red alga *Hypnea cornuta* (Kützing) J. Agardh, as well as some cephalopods and marine crabs (Ammar *et al.*, 2023b). Their presence can be attributed to maritime transport activities, which have greatly aided long-distance migration of warm-water species to environments experiencing increasing temperatures due to global warming, especially to the eastern Mediterranean (Costa *et al.*, 2019; Zittis *et al.*, 2022).

In this research, we highlight records of marine

Fig. 1: Study areas in the Syrian coast.
Sl. 1: Obravnavana območja sirske obale.

invertebrates new to Syrian waters, in particular non-native benthic species, but also rare native species. The continuous influx of non-native benthic species into the Syrian marine environment, and the increasing number of newly established species pose a significant threat to local marine biodiversity. This trend aligns with a potential scenario in which the entire Mediterranean Sea transforms into a tropical sea due to the invasion of species from the tropical Atlantic, as well as Indian and Pacific Oceans (Albano *et al*., 2024).

MATERIAL AND METHODS

The species were observed and collected through diving between 2020 and 2024 from rocky substrates at several locations in the tidal and subtidal zones of the southern and northern sectors of the Syrian coast (Fig. 1). Some species were observed and photographed on site, while specimens of others were collected, transported to the laboratory at the High Institute of Marine Research, and preserved in 5% formaldehyde. The samples were classified following the keys of Riedl (2011), Bariche (2012), and Zenetos *et al*. (2003), along with specialized references and databases (MolluscaBase, 2023), adopting the nomenclature from the World Register of Marine Species (WoRMS, 2024).

RESULTS AND DISCUSSION

***Planocera graffi* Lang, 1879**
***Planocera pellucida* (Mertens, 1833)**
(Platyhelminthes: Polycladida: Planoceridae)

These two species belong to the phylum Platyhelminthes, or flatworms. This is a very diverse phylum with more than 100,000 species known to date (Rawlinson, 2014). The genus *Planocera* Blainville, 1828 is widely distributed throughout the world's seas and is represented in the Mediterranean Sea by three species (Rawlinson, 2014): *Planocera folia* Grube, 1840, *Planocera graffi* Lang, 1879, and *Planocera ceratommata* (Palombi, 1936).

Five individuals belonging to the genus *Planocera* Blainville, 1828, were collected in 2021, 2022, and 2023 from four different sites. The samples were photographed, collected, and preserved in 5% formalin. Two individuals were collected in 2022, respectively, from the underside of beach stones near the High Institute of Marine Research (35.5922090°N, 35.742187°E) (Fig. 2a) and from the Al-Massab site north of Tartus (34.9684°N, 35.8750°E) (Fig. 2b). Both were classified as *Planocera graffi* Lang, 1879, identified according to relevant references (Lang, 1879, 1884; Faubel, 1983; Digenis *et al*., 2024). The length of the individuals did not exceed 12 mm and the width was approximately 9 mm. The body shape was broadly oval, almost round, with the edges slightly ruffled; the ground color was yellow-orange, with an accumulation of reddish network-like pigment granules along the midline of the body following the branches of the intestine. The terminal branches on the dorsal side and the edges of the body of this species can sometimes reflect the white color. The body appeared fleshy but very transparent and delicate. There were two conical tentacles near the brain, away from the edges, with numerous eyes at the base of each tentacle. There were many small cerebral eyes in front of and behind the tentacles, the latter more abundant than the former. The broad, frilled pharynx occupied the central region of the body.

A third specimen of *P. graffi* was collected on 1 September 2021 from the fishing port of Ras al-Basit (35.854361°N, 35.817528°E). It was characterized by its thickness, the white coloration of its ventral face, and different patterns on its upper surface (Fig. 2c). A similar individual (a fourth specimen) of the same species was collected from the Marine Research Area in the same year (Fig. 2d).

Planocera graffi was first described in the Gulf of Naples, Italy (Lang, 1879, 1884; Tyler *et al*., 2012). Its presence has since been recorded in Cape Verde, along the Catalan coast (Faubel & Noreña, 2001), and the Spanish coast (Marquina *et al*., 2014). While it has recently also appeared in marine caves in Greece (Digenis *et al*., 2024), this is the first time it has been reported from Syria and the eastern Mediterranean. It is unclear whether this delay in its discovery is due to the species' rarity in the region or its late, only recent arrival in the area.

A fifth *Planocera* specimen was collected on 22 September 2023 from the beach of Chalet Al-Basit (35.850389°N, 35.842139°E) at a depth of 3 m, and was identified as *P. pellucida* (Mertens, 1833) (Fig. 2e), a cosmopolitan species occurring in the Atlantic, North Sea, Pacific Ocean, and Red Sea (Faubel, 1984; Marquina *et al*., 2014; Digenis *et al*., 2024). Lang (1879, 1884) noted strong similarity between *P. pellucida* and *P. pelagica* (Moseley, 1877), which led Faubel to adopt the former name as a synonym of the latter (1983). Bock (1913) and Faubel (1983) also explained some morphological differences between *P. pellucida* and *P. graffi*. The former is typically oval and tapers towards the back, while the latter is round and sometimes wider than it is long. However, *P. pellucida* may exhibit both slightly elongated and rounded forms (Prudhoe, 1985), and this variation is the only difference between the two species. An anatomical study conducted on samples of the two species from the Atlantic Ocean and Mediterranean Sea showed no differences between them, leading to suggestion to synonymize

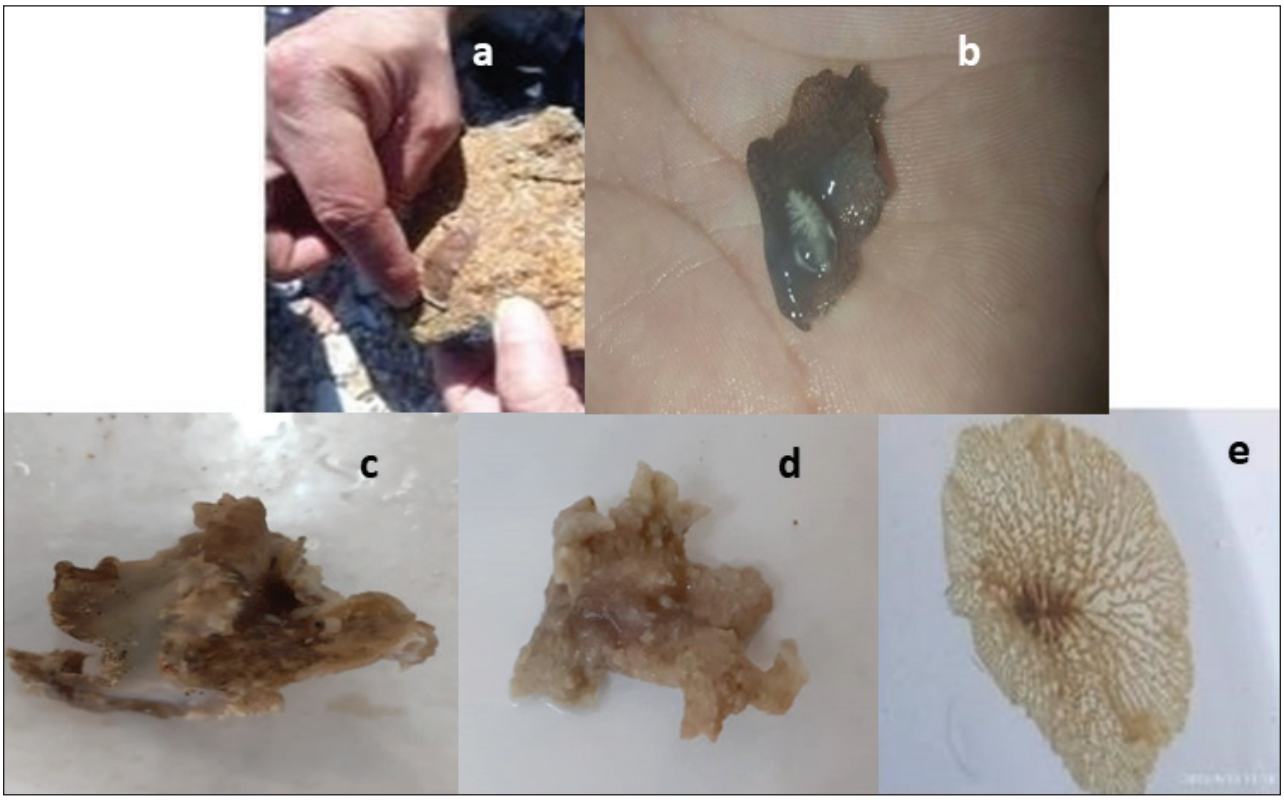

Fig. 2: Different specimens of Platyhelminthes *Planocera graffi* ***(a, b, c, d) and*** *Planocera pellucida* ***(e) from the Syrian coast.***
Sl. 2: Različni primerki vrtinčarjev *Planocera graffi* ***(a, b, c, d) in*** *Planocera pellucida* ***(e) iz sirske obale.***

P. graffi with *P. pellucida* (Marquina *et al*., 2014). Consequently, the distribution of *P. pellucida* now also includes the Mediterranean (Cuadrado *et al*., 2021). It is worth noting that the finding described in the present study is the first record of this species in Syrian coastal waters.

Tylodina perversa (Gmelin, 1791)
(Heterobranchia: Umbraculidae: Tylodinidae)

This species of mollusk is typically found in the North Atlantic Ocean and in the western and eastern Mediterranean (WoRMS, 2024), but it has also been recorded in the Aegean and Mediterranean Turkish waters (Öztürk *et al*., 2014) and reported from the Levantine Basin, specifically Cyprus (Öztürk *et al*., 2004). Recently, it has also appeared in the western and eastern Adriatic according to Zenetos *et al*. (2016) and, spotted at a depth of 12.3–31.4 m, on the Sicilian island of Pantelleria (Lombardo & Marletta, 2023). A single specimen, not exceeding 3 cm in length, was observed and photographed on 18 June 2024, on the Latakia coast opposite Sports City (35.572912°N, 35.732057°E), at a depth of 9–10 meters (Fig. 3). It was identified from photos following Riedl (2011).

Tylodina perversa is commonly found on yellow sponges of the genus *Aplysina*. In fact, the presence of two species from this genus, *A. insularis* (Duchassaing & Michelotti, 1864) and *A. aerophoba* Nardo, 1843, has been previously documented at this site and several others along the Syrian coast (Ammar *et al*., 2008; Ammar *et al*., 2023a). This is the first observation of *T. perversa* on the Syrian coast. The species was not included in the list by Ammar (2024) as it was discovered after the publication of that work.

Isognomon bicolor (C. B. Adams, 1845)
(Mollusca: Bivalvia: Ostreida: Isognomonidae)

The purse oyster *I. bicolor* is distributed in the South Atlantic Ocean, including the Caribbean Sea, Colombia, Cuba, the Gulf of Mexico, and Venezuela. The presence of the genus *Isognomon* was first recorded in the Mediterranean Sea in 2004 (Öztürk & Salman, 2004) and confirmed in Turkey and Greece in 2017 (Ovalis & Zenetos, 2017; Angelidis, 2017). It was also recorded in Libya, Cyprus, and the Aegean Sea but under different names, until molecular evidence confirmed that the species found in the Mediterranean was the Atlantic oyster *Isognomon bicolor*.

Fig. 3: *Tylodina perversa* ***from Latakia coast (Syria). Photograph by Nouh Abbas.***
Sl. 3: *Tylodina perversa* ***iz obale Latakie (Sirija). Fotografija: Nouh Abbas.***

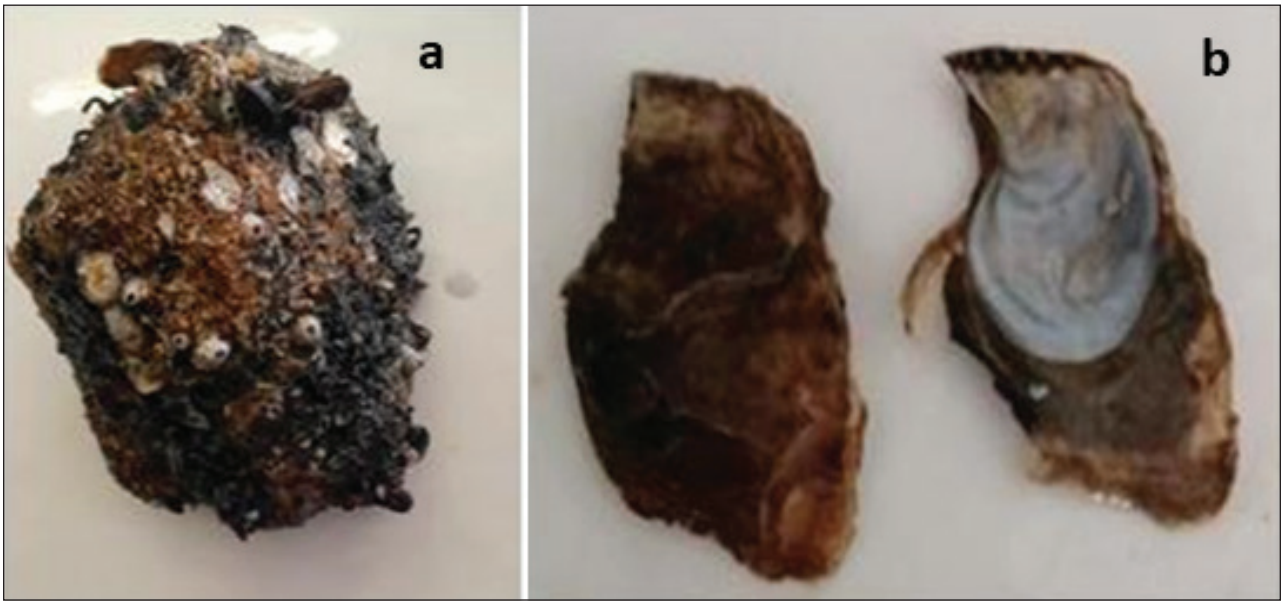

Fig. 4: *Isognomon bicolor* ***from the Al-Ahlam beach near Tartus (a) and from the Tartus seaport (b).***
Sl. 4: *Isognomon bicolor* ***s plaže Al-Ahlam beach blizu Tartusa (a) in iz pristanišča Tartus (b).***

Fig. 5: Underwater photographs of the bryozoan *Escharoides coccineaat* ***from the Ibn Hani MPA, north of Latakia (Syria). Photograph by Nouh Abbas.***
Sl. 5: Podvodne fotografije mahovnjaka vrste *Escharoides coccineaat* ***iz morskega zavarovanega območja Ibn Hani,MPA, severno od Latakie (Sirija). Fotografija: Nouh Abbas.***

This finding suggests that global climate change may have facilitated the species' introduction and rapid spread in the Mediterranean Sea (Garzia *et al*., 2022). In Syria, the species was observed, photographed, and collected for the first time on the intertidal rocky shore at Ahlam Beach (34.863154°N, 35.886355°E) near Tartus (Ammar, 2023b) on 31 May 2023 (Fig. 4a). The specimens were identified following Zenetos *et al*. (2003) and Garzia *et al*. (2022). Subsequently, many additional individuals were collected from Tartus seaport (34.87395°N, 35.880702°E) in June 2024 (Fig. 4b). Current field work reports an abundance of *I. bicolor* in the ports of Tartus and Arwad Island.

Escharoides coccinea **(Abildgaard, 1806)**
(Bryozoa: Gymnolaemata: Cheilostomatida: Exochellidae)

The bryozoan *Escharoides coccinea* forms orange-red, crust-like colonies composed of numerous square zooids with a convex surface. The upper surface of each zooid exhibits a wide orifice covered by a gill structure featuring a broad shelf along the outer edge and tooth-like projections along its inner edge. The individuals (zoophages) are separated from each other by deep furrows. The side of the opening that faces the colony edge bears an arch of 6 long tubular spines and is lined by large pores (source: Bryozoa of the British Isles https://britishbryozoans.myspecies.info/). The species was observed in March 2020, on the rocky bottom of the shallow coastal area of the Ibn Hani Marine Protected Area (MPA) at a depth of 5 m (Fig. 5) and identified from photos following Richards (2008) and the Checklist dataset of Bryozoa of the British Isles. The species is found in the North Atlantic (Davoult *et al*., 1993) and the Mediterranean Sea (Gerovasileiou & Rosso, 2016; Achilleos *et al*., 2020). This bryozoan has not been recorded in Syria before.

Branchiomma luctuosum **(Dalyell, 1853)**
(Annelida: Polychaeta: Sabellida: Sabellidae)

The polychaete B. luctuosum is an invasive non-native species from the Red Sea (Fernández-Romero *et al*., 2021; Galanidi et al., 2023). It is one of the most frequently recorded non-native species in the Mediterranean, from the western to the eastern basin (Çinar, 2009; Tempesti et al., 2020), and is currently spreading along the Mediterranean coasts of Morocco (Mabrouki & Taybi, 2024). Several individuals of this invasive species were observed in October 2021 in the subtidal zone of the Al-Massab basin north of Tartus (Ammar, 2023a), where the bottom is rocky and covered by a thin layer of sand (Fig. 6a, b, c). Identification was carried out following El Haddad *et al*. (2008) and Licciano *et al*. (2012). A clear decline in the native species Sabella spallanzanii (Gmelin, 1791) on the Syrian coast may have been brought on by the presence of *B. luctuosum* (personal observations), as competition between these two species is also believed to exist in Mediterranean ports and coastal ponds (Flagella & Abdulla, 2005). Large

Fig. 6: The polychaete *Branchiomma luctuosum* ***from Tartus (Syria). Photograph by Mahmoud Halhal.***
Sl. 6: Mnogoščetinec vrste *Branchiomma luctuosum* ***iz Tartusa (Sirija). Fotografija: Mahmoud Halhal.***

numbers of *B. luctuosum* were collected recently, in June 2024, as part of biofouling removal in Tartus seaport (Fig. 6d).

Unpublished data from an ongoing study limited to the fishing ports of Tartus and Arwad Island indicate a high proportion of non-native bivalves, echinoderms, ascidians, and polychaetes, with some species even becoming dominant (Ammar, 2023a; Alo, 2024). Studies examining the spread of non-native species in Syrian ports, particularly the two largest commercial terminals in Tartus and Latakia, and the oil port of Banias, but also the main fishing ports in Banias, Jableh, and Latakia, will no doubt contribute to the early detection of these species, help explain the mechanisms of their migration and arrival in the region, and fill related knowledge gaps. Furthermore, these data could be integrated into monitoring and assessment programs for the Mediterranean Sea.

The occurrence of Atlantic species reported in the present study (*O. patagonica* and *I. bicolor*) and others previously documented in Syria and the Levantine Sea, along with their increasing numbers over time, confirms the rapid trend of these species passing through the Strait of Gibraltar and the western Mediterranean to settle in the region (Bianchi *et al.*, 2012). The Syrian coast evidently provides a favorable environment for these newcomers, which could significantly impact native biodiversity in the eastern Mediterranean if they succeed in establishing themselves.

NOVI PRIMERI O POJAVLJANJU TUJERODNIH IN REDKIH MORSKIH NEVRETENČARJEV V SIRSKIH VODAH

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POVZETEK

Nedavne biološke raziskave sirske obale so obelodanile prve pojave nekaterih tujerodnih vrst iz različnih okolij, pa tudi nekatere redke domorodne vrste. Avtor opisuje prvi primer najdbe vrst Isognomon bicolor *(C. B. Adams, 1845),* Escharoides coccinea *(Abildgaard, 1806),* Tylodina perversa *(Gmelin, 1791),* Planocera graffi *Lang, 1879, in* Planocera pellucida *(Mertens, 1833) v sirskih vodah ter podaja dodatne podatke o vrsti* Branchiomma luctuosum *(Grube, 1870). Nadalje avtor razpravlja o vplivu tujerodnih vrst na domorodno biodiverziteto.*

Ključne besede: tujerodne vrste, redke vrste, vzhodno Sredozemsko morje, Sirija

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A NEW LOCALITY RECORD FOR THE RANGE EXPANDING FISH *SERIOLA FASCIATA* IN THE MEDITERRANEAN

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ABSTRACT

We present the first record of the lesser amberjack, Seriola fasciata *(Bloch, 1793), for Pantelleria Island (Strait of Sicily) based on a specimen fished and photographed by a tourist. It is a range expanding Atlantic fish species in the Mediterranean about which very little information is available. The importance of involving citizens in reporting sightings of rare or previously unseen species in an area is also discussed.*

Key words: lesser amberjack, Pantelleria, range expanding species, new record, Strait of Sicily

NUOVA LOCALITÀ PER LA RICCIOLA FASCIATA, *SERIOLA FASCIATA* (BLOCH, 1793), IN MEDITERRANEO

SINTESI

Gli autori presentano il primo ritrovamento di Seriola fasciata *(Bloch, 1793) nell'isola di Pantelleria (Stretto di Sicilia) sulla base di un esemplare pescato e fotografato da un turista. È un pesce atlantico in espansione di areale di cui si hanno scarsissime informazioni. Viene anche discussa l'importanza di coinvolgere i cittadini nel riportare le segnalazioni di specie rare o mai segnalate in un'area.*

Parole chiave: ricciola fasciata, Pantelleria, specie in espansione, nuovo record, Canale di Sicilia

INTRODUCTION

The lesser amberjack *Seriola fasciata* (Bloch, 1793) is one the several range expanding species that entered the Mediterranean Sea through the Strait of Gibraltar (Ben Rais Lasram *et al.*, 2008). This carangid species is typically found in the western Atlantic Ocean, including the Gulf of Mexico and the Caribbean Sea (Smith-Vaniz, 2002), less commonly encountered in the eastern Atlantic, extending from Galician waters (Spain) in the north to the Island of St. Helena in the south (Bañón & Mucientes, 2009). Its first appearance in the Mediterranean Sea took place in the Balearic Islands in 1989 (Massutí & Stefanescu, 1993), the species then expanded eastwards until reaching the coasts of Lebanon (Levant Basin) where it was first recorded in 2005 (Crocetta & Bariche, 2015). The biology and ecology of lesser amberjack are poorly known: juveniles are pelagic and are usually observed under floating objects as well as under fish aggregating devices (FADs) for the catch of dolphinfish, *Coryphaena hippurus* Linnaeus, 1758, while adults are very rarely caught or misidentified with congeneric species (Andaloro *et al.*, 2005; Galbraith *et al.*, 2022; Cillari *et al.*, 2024). We here present the first record of *S. fasciata* for Pantelleria Island (Strait of Sicily), a volcanic island of huge ecological relevance for the high biodiversity of its marine life (Alongi *et al.*, 2004).

MATERIAL AND METHODS

In mid-September 2024, one individual of *Seriola fasciata* was caught with a trolling line by a tourist on the south-west coast of the island of Pantelleria (approximate coordinates 36.7628 °N, 11.9684 °E, Fig. 1). The specimen was photographed and then released into the sea, so unfortunately there are no measurements available. The photo (Fig. 2) was shown to a local fisherman who contacted ISPRA researchers for identification, claiming he had never seen this fish before.

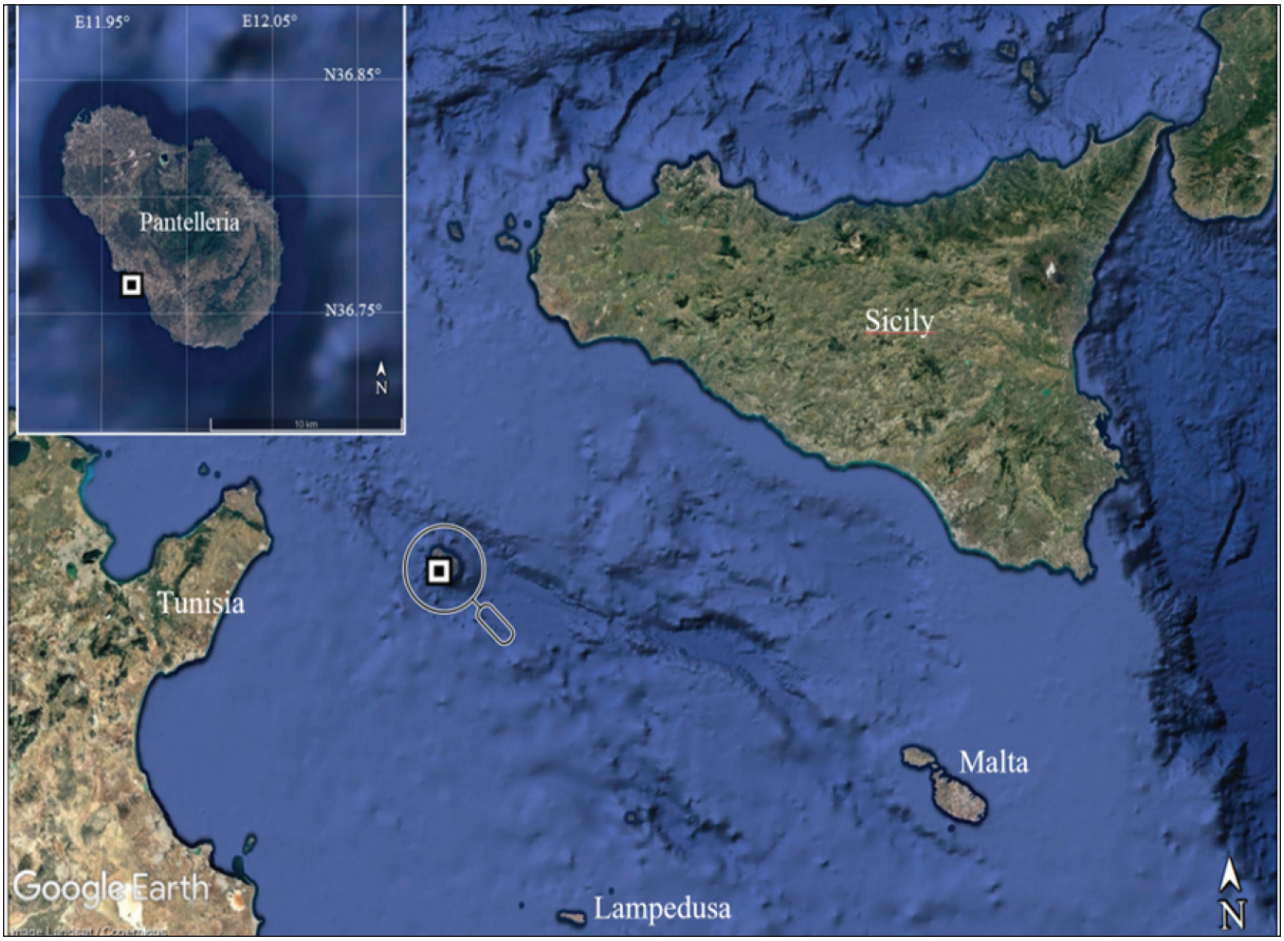

Fig. 1: Location (square) off the south-western coast of Pantelleria Island, where the specimen of *Seriola fasciata* ***was fished.***
Sl. 1: Lokaliteta (kvadrat) ob jugozahodni obali otoka Pantellerie, kjer so ulovili primerek vrste *Seriola fasciata.*

Fig. 2: *Seriola fasciata* ***caught at Pantelleria Island.***
Sl. 2: Primerek vrste *Seriola fasciata****, ujetega v vodah otoka Pantellerie.***

RESULTS AND DISCUSSION

The island of Pantelleria is located in the Pantelleria Rift, between Africa and Sicily, on the European continental shelf, with a minimum distance of about 38 nautical miles from the Tunisian coast, 54 from Sicily and 111 from Malta. The seabeds, especially in the first few metres, are steep and rocky, then they degrade more slowly to a depth of around 35-50 m, on sandy or gravelly bottoms interspersed with large boulders. The island mainly bases its economy on agriculture and is a destination for thousands of tourists every year, especially sea lovers, swimmers, divers and anglers. Regarding professional fishing, a very small number of vessels carry out artisanal activities. Although *Seriola fasciata* has already been reported in the Strait of Sicily (Bradai *et al*., 2004; Andaloro *et al*., 2005), it had never been reported on this island.

The species belonging to the *Seriola* genus are not easy to identify, particularly at their adult stage when they lose some phenotypic characters typical of juveniles. According to Smith-Vaniz (2016) as well as to the more recent revision of Galbraith *et al*. (2022), the specimen caught in Pantelleria Island is attributed to *S. fasciata* for bearing a narrow supramaxilla and seven vertical dark body bands plus a well visible nuchal stripe and a further band on the caudal peduncle. Such a pattern is an indication that the caught specimen is a juvenile. The lesser amberjack is a little-known subtropical species with a very dispersed distribution in the Mediterranean where it is mainly reported in the juvenile stage (Cillari *et al*., 2024). Its presence is mainly correlated with the presence of FADs (Cillari *et al*., 2024), which might represent the key factor for the success of this species. Indeed, as already observed for other FADs associated species (Andaloro *et al*., 2003), juvenile *S. fasciata* caught as bycatch of dolphinfish fishery, are discarded and thrown back into seawater alive since they are non-marketable. The increasing use of FADs in certain areas might therefore have contributed to the population increase of

this species as well as to its spread elsewhere. Its current distribution in the Mediterranean is mainly concentrated in the southern sectors (Cillari *et al*., 2024), which suggests that the presence of this species could also be linked to the higher temperatures recorded in those areas compared to the northern sectors. This agrees with the results of the MaxEnt model applied to this species where sea floor temperature was among primary factors driving species distribution (Cillari *et al*., 2024). Pantelleria island, besides, is located in an area between Tunisia, Sicily and Malta, where the use of FADs is widespread. In agreement, spatial-temporal analyses made on *S. fasciata* distribution in the Mediterranean had already identified this area as a presumed expansion area (Cillari *et al*., 2024), so its appearance in the island of Pantelleria was predictable. The capture of a single individual, however, does not allow us to advance hypotheses on the stage of settlement of this species on this island, but adds a missing piece to the distribution of the species in the Strait of Sicily. What is not yet known mainly concerns the adult stage of lesser amberjack whose ecology is still poorly understood, and which instead could help to define the potential of this species as a fishing resource. In this regard, the arrival and establishment of *S. fasciata* in the Levant Sea led some authors to consider it as a promising fishery resource, so much so as to suggest the implementation of a management plan to protect it and prevent its decline (Jawad *et al*., 2015; Ali *et al*., 2024). However, it needs to be considered that the arrival of new species in an area where they were not yet present involves the establishment of interactions with marine local communities, in some cases with consequent impacts. It is therefore essential to collect information and data on new species to understand their ecology in order to preserve native biodiversity. From this perspective, it is important not only to collect the first records of the new species, but above all the subsequent ones as they identify their establishment and help to trace their spread. Most records of lesser amberjack in the Strait of Sicily documented in literature come from Lampedusa Island and Malta (Andaloro *et al*., 2005; Deidun *et al*., 2021; Ragkousis *et al*., 2023), over 75 nautical miles southeast to Pantelleria Island, and date back no later than 2020. The closest record is a single juvenile specimen caught about 45 nautical miles in the southern coast of Sicily, and dates back to 2016 (Geraci *et al*., 2020). The present record adds a new locality for the lesser amberjack in a marine area of the Straits of Sicily considered of great naturalistic interest and suggests further investigations, also with the support of citizens, in order to acquire more information on its population in this area. Only recently has the use of social media made information on rare or poorly known species more widely available, allowing for more consistent population estimates. In order to fill the knowledge gaps on the historically overlooked lesser amberjack, it would be fruitful to promote citizen science activities, involving the main stakeholders such as fishers and divers, aimed at collecting any type of information in the event of specimens being caught and to preserve them for subsequent biological analyses by researchers.

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NOVA LOKALITETA POJAVLJANJA VRSTE *SERIOLA FASCIATA*, KI ŠIRI AREAL V SREDOZEMSKEM MORJU

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POVZETEK

Avtorji predstavljajo prvi zapis o pojavljanju malega gofa Seriola fasciata *(Bloch, 1793) za otok Pantelleria (Sicilijanska ožina) na podlagi primerka, ki ga je ulovil in fotografiral turist. Gre za atlantsko ribjo vrsto, ki se širi v Sredozemlje in o kateri je na voljo zelo malo podatkov. Avtorji razpravljajo tudi o pomenu vključevanja državljanov v poročanje o opažanjih redkih ali prej neopaženih vrst na območju.*

Ključne besede: mali gof, Pantelleria, vrsta, ki razširja areal, novi zapis o pojavljanju, Sicilijanska ožina

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FIRST RECORD OF THE *ABUDEFDUF* CF. *SAXATILIS/VAIGIENSIS/TROSCHELII* SPECIES COMPLEX (PISCES: POMACENTRIDAE) IN THE BLACK SEA

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ABSTRACT

On 28 September 2024, an individual of the pomacentrid genus Abudefduf *Forsskål, 1775, was recorded on video in the southwestern Black Sea, off the coast of Turkey. This is the first record of the* A. *cf.* saxatilis/vaigiensis/troschelii *species complex in the Black Sea. The paper provides information on the colouration and some morphological characteristics of the individual. However, to accurately determine which species from this complex is present in the Black Sea, the specimen should have been collected for detailed morphometric and genetic analyses.*

Key words: *Abudefduf*, Pomacentridae, Black Sea, invasion

PRIMA TESTIMONIANZA DI *ABUDEFDUF* CF. *SAXATILIS/VAIGIENSIS/TROSCHELII* COMPLESSO DI SPECIE (PISCES: POMACENTRIDAE) NEL MAR NERO

SINTESI

Il 28 settembre 2024, un individuo del genere Abudefduf *Forsskål, 1775 (Pomacentridae), è stato avvistato in un video girato nel Mar Nero sudoccidentale, al largo delle coste della Turchia. Si tratta della prima registrazione del complesso di specie* A. *cf.* saxatilis/vaigiensis/troschelii *nel Mar Nero. Il documento fornisce informazioni sulla colorazione e su alcune caratteristiche morfologiche dell'individuo. Tuttavia, per determinare con precisione quale specie di questo complesso sia presente nel Mar Nero, sarebbe stato necessario catturare l'esemplare per condurre analisi morfometriche e genetiche dettagliate.*

Parole chiave: *Abudefduf*, Pomacentridae, Mar Nero, invasione

INTRODUCTION

The pomacentrid damselfishes (Perciformes: Labroidei: Pomacentridae) are represented by 30 genera and 424 species distributed worldwide, with one of the best-known genera in the family being *Abudefduf* (Froese & Pauly, 2024). Pomacentrids are small fishes, typically reaching less than 15 cm in total length (TL), with a maximum TL of 35 cm. The mouth is small in most species with moderately to highly protrusible jaws, and a single pair of nostrils is found in Atlantic species (Edwards, 2016). According to Kovačić *et al*. (2021) four species of *Abudefduf* have been reported from Mediterranean waters over the last few decades. The chronological order of the publications that reported the first records of *Abudefduf* spp. from the Mediterranean Sea, lists these species as follows: *A. vaigensis* (Quoy & Gaimard, 1825) (Tardent, 1959), *A. saxatilis* (Linnaeus, 1758) (Azzurro *et al*., 2013; Deidun & Castriota, 2014), *A. hoefleri* (Steindachner, 1881) (Vella *et al*., 2016) and *A. sexfasciatus* (Lacepède, 1801) (Giovos *et al*., 2018). Of these, only *A. saxatilis* has been reported from Turkish waters (Bilecenoğlu, 2016); however, the most recent ichthyological checklist of Turkish seas by Bilecenoğlu (2024) includes the *A.* cf. *saxatilis/vaigiensis/troschelii* species complex rather than solely mentioning the occurrence of *A. saxatilis* in the region. Fishes of the genus *Abudefduf* are increasingly being recorded in Mediterranean waters and, as emphasised by Dragičević *et al*. (2021), most of these occurrences are based merely on underwater photographs or video footage. This article reports the first record of an individual of the *A. cf. saxatilis/vaigiensis/troschelii* species complex from the Black Sea based on underwater footages recorded by a recreational spearfisherman.

MATERIAL AND METHODS

The present specimen of the *A.* cf. *saxatilis/vaigiensis/troschelii* species complex was recorded in the southwestern part of the Black Sea, which is defined as geographical subarea (GSA) 29 of the Mediterranean (GFCM, 2018; Fig. 1). As it is visible from the photo (Fig. 2), the rocky substratum is covered by dense vegetation of brown and green algae, *Cystoseira* spp. and *Ulva* spp., both well-known components of the Black Sea marine flora. Given the nature of the sampling (opportunistic photographic record), this study is a typical example of opportunistic examination of marine fauna, rather than a direct result of a scientific field survey (Hiddink *et al*., 2023). Species identification follows Edwards (2016) and Dragičević *et al*. (2021), taxonomic nomenclature is based on Froese and Pauly (2024). The examined video footage and the captured frame of the specimen of the *A.* cf. *saxatilis/vaigiensis/troschelii* species complex are available from the first author upon request for further inspection.

RESULTS AND DISCUSSION

On 28 September 2024, a specimen of what seems to be a sergeant major damsel fish (Fig. 2) was captured on video by a recreational spearfisherman off the coast of Eşek Island, Riva (41°13′56.10'' N; 29°13′4.36'' E; southwestern Black Sea) over a rocky bottom, at a depth ranging between 5 and 7 m. Upon inspection of the footage the following characters were observed: body deep and laterally compressed; five prominent black

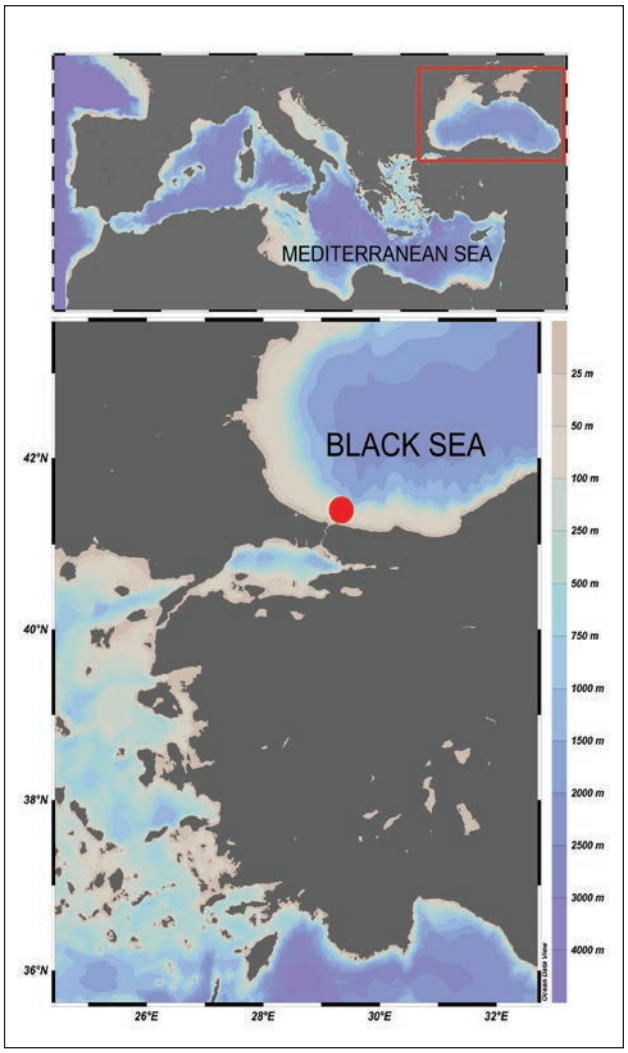

Fig. 1: Red rectangle on the map (upper panel) depicts the Black Sea in the Mediterranean Basin. The solid red circle (lower panel) indicates the locality where the present specimen of *A.* ***cf.*** *saxatilis/vaigiensis/trochelii* ***was filmed as estimated by the recreational spearfisherman.***
Sl. 1: Rdeči pravokotnik na zemljevidu (zgornja plošča) prikazuje Črno morje v Sredozemskem bazenu. Rdeč krogec (spodnja plošča) označuje lokacijo, kjer je bil posnet primerek vrste iz kompleksa *A.* ***cf.*** *saxatilis/vaigiensis/trochelii* ***po oceni rekreativnega podvodnega ribiča.***

bars on the sides, narrowing towards belly, a faint sixth bar on upper caudal peduncle; colour of abdomen silvery white, with a black spot at the base of pectoral fins, the fifth black bar continuing on the dorsal fin, two black dots at the base of caudal fin (characteristic of this species), back yellowish green. The descriptive characters were consistent with those described for *A.* cf. *saxatilis/vaigiensis/troschelii* by Azzurro *et al*. (2013), Deidun and Castriota (2014), Tsadok *et al*. (2014), Vella *et al*. (2016) and Edwards (2016).

In recent years, many fish species of tropical origin have been reported from different regions of the Mediterranean Sea. The majority were Lessepsian immigrants (Golani *et al*., 2021), entering the Mediterranean Sea through the Suez Canal. However, species migrations to the Mediterranean are not limited to the Suez Canal; several Atlantic species also enter through the Strait of Gibraltar (Azzurro *et al*., 2022). One of these is *A. saxatilis* (Dragičević *et al*., 2021). According to Froese and Pauly (2024), *A. saxatilis* is a strictly Atlantic species, with its distribution range extending in the tropical and subtropical Atlantic from 43°N to 35°S latitudes (Edwards, 2016). Although the introduction vectors for a given occurrence are difficult to establish and may vary depending on the species, as emphasised by Bitar (2021) and Kampouris and Sujariya (2023), the most likely are canal connections (in Lessepsian migration), ballast water from ships, and aquarium releases. In recent years, several Mediterranean (thermophilic) and/or Red Sea (tropical) fish species have been reported in the Sea of Marmara (Karakulak *et al*., 2020) and the Black Sea (Yağlıoğlu & Turan, 2021; Uzer *et al*., 2024). Although the range extension of tropical fish species into the Mediterranean Sea and further north may occur naturally (Occhipinti *et al*., 2011) as a result of global warming (Bianchi, 2007), the available evidence is unable to confirm this for the *A.* cf. *saxatilis/vaigiensis/troschelii* species complex in the Black Sea. The current specimen may instead have escaped or been released from an aquarium.

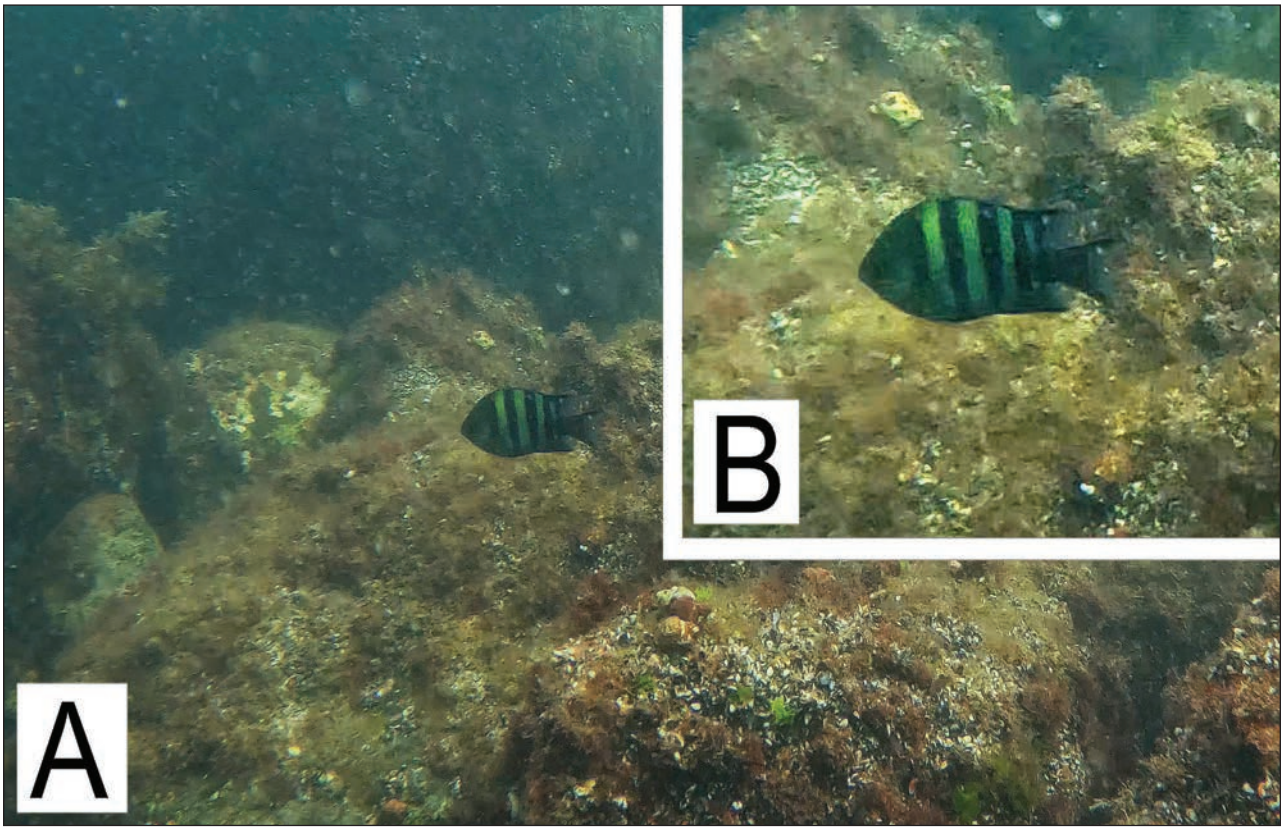

Fig. 2: (A) Captured frame from the video footage of the studied individual of the** A. **cf.** saxatilis/vaigiensis/troschelii **species complex recorded on 28 September 2024 at a depth between 5 and 7 m off the coast of Riva in the southwestern Black Sea, showing the surrounding substratum and vegetation; and (B) close-up of the specimen seen in panel A. (Photo: İsa Şentürk).
Sl. 2: (A) Zajet okvir iz videoposnetka primerka iz kompleksa vrst** A. **cf.** saxatilis/vaigiensis/troschelii**, posnetega 28. septembra 2024 na globini med 5 in 7 m ob obali Rive v jugozahodnem Črnem morju, ki prikazuje okoliški substrat in vegetacijo; in (B) primerek od blizu na plošči A. (Foto: İsa Şentürk).

The first record of *A. saxatilis* in the Mediterranean, reported by Azzurro *et al*. (2013), was soon followed by other records from several different regions of the Mediterranean (Deidun & Castriota, 2014, Tsadok *et al*., 2014; Bilecenoğlu, 2016; Vella *et al*., 2016). Froese and Pauly (2024) emphasised that *A. saxatilis* was being replaced in the Indo-Pacific region by the closely related *A. vaigiensis*. However, as noted in several recent studies, species identification of *Abudefduf* spp. based solely on external colouration has certain limitations. In a recent study, Bitar (2021) focused on the dark vertical bars seen on the bodies of *Abudefduf* spp. and provided a detailed morphological description of the appearance of the fifth vertical bar (continuous or discontinuous), which was accepted as an identifying morphological character for *A. saxatilis* according to Mediterranean literature until the end of 2020. Comparing numerous underwater photographs of *Abudefduf* spp. from Lebanese waters, Bitar (2021) concluded that relying solely on the appearance of the fifth vertical bar for species identification is flawed, as the feature can be observed in both *A. saxatilis, A. vaigiensis* and even *A. troschelii*. This means that observation and analyses of photographs are insufficient for an accurate identification of *Abudefduf* (Bitar 2021; in Kampouris & Sujariya, 2023) and may cause confusion and misidentification, as does relying on videographic material alone. Recent studies by Vella *et al*. (2016) and Dragičević *et al*. (2021) addressed this issue, emphasising that while documenting *Abudefduf* spp. occurrences through underwater photos and videos is valuable, only molecular analysis combined with detailed morphological descriptions can confirm a specimen as a determinate *Abudefduf* species. In the absence of morphological and genetic evidence it is recommended that presumed specimens of one of the *Abudefduf* species be referred to in the Mediterranean as *A.* cf. *saxatilis/vaigiensis/troschelii,* as already practiced by Kampouris and Sujariya (2023) and Bilecenoğlu (2024). It is therefore more accurate to report the current specimen from the Black Sea as *A.* cf. *saxatilis/vaigiensis/trochelii* until another is collected in the region and confirmed as either of the four species through morphological and molecular analysis.

ACKNOWLEDGEMENTS

We thank to spearfisherman Mr. İsa Şentürk for sending us the video footage of *A.* cf. *saxatilis/vaigiensis/trochelii*. Special thanks go to two anonymous referees for their valuable comments and contributions which improve the content and quality of the article.

PRVI ZAPIS O POJAVLJANJU PRIMERKA VRSTE IZ KOMPLEKSA *ABUDEFDUF* CF. *SAXATILIS/VAIGIENSIS/TROSCHELII* (PISCES: POMACENTRIDAE) IZ ČRNEGA MORJA

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POVZETEK

Osemindvajsetega septembra 2024 so s kamero posneli primerek vrste iz rodu Abudefduf *Forsskål, 1775 v jugozahodnem Črnem morju, ob obali Turčije. Gre za prvi zapis o pojavljanju primerka iz kompleksa vrst* A. *cf.* saxatilis/vaigiensis/troschelii *v Črnem morju. Avtorji v prispevku navajajo podatke o obarvanosti in nekaterih morfoloških značilnostih primerka. Da bi natančno določili, katera vrsta iz tega kompleksa je prisotna v Črnem morju, bi morali odvzeti vzorec za podrobne morfometrične in genetske analize.*

Ključne besedes: *Abudefduf*, Pomacentridae, Črno morje, invazija

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SREDOZEMSKE HRUSTANČNICE

SQUALI E RAZZE MEDITERRANEE

MEDITERRANEAN SHARKS AND RAYS

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OCCURRENCE OF THE RARE BLONDE RAY, *RAJA BRACHYURA* (RAJIDAE), OFF THE ALGERIAN COAST (SOUTHWESTERN MEDITERRANEAN SEA)

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ABSTRACT

The paper describes captures of large specimens of blonde ray, Raja brachyura *Lafont 1873, off the Algerian coast. The presence of large egg-producing females in the catch and cases of already laid eggs suggest that a population of* R. brachyura *is successfully established in the area. The Algerian coast is likely a starting point for migrations of the species towards northern regions, such as the coast of Sardinia, where several specimens have recently been found.*

Key words: *Raja brachyura*, egg case, migration, distribution, western Mediterranean basin

PRESENZA DELLA RARA RAZZA A CODA CORTA, *RAJA BRACHYURA* (RAJIDAE), AL LARGO DELLA COSTA ALGERINA (MEDITERRANEO SUD-OCCIDENTALE)

SINTESI

L'articolo riporta la cattura di grandi esemplari della razza a coda corta, Raja brachyura *Lafont 1873, al largo della costa algerina. La presenza nelle catture di grandi femmine produttrici di uova e di casi di uova già deposte suggeriscono che una popolazione di* R. brachyura *si è stabilita con successo nell'area. La costa algerina è probabilmente un punto di partenza per le migrazioni della specie verso le regioni settentrionali, come le coste della Sardegna, dove sono stati recentemente rinvenuti diversi esemplari.*

Parole chiave: *Raja brachyura*, uova, migrazione, distribuzione, Mediterraneo occidentale

INTRODUCTION

The blonde ray, *Raja brachyura* Lafont, 1873, occurs in the eastern Atlantic from the Shetlands and the English Channel to the western part of the North Sea (Stehmann & Bürkel, 1986). Further south, the species is found in the Bay of Biscay, off the northern coast of Spain, and along the coast of Portugal (Quéro *et al*., 2003). South of the Strait of Gibraltar, *R. brachyura* has been recorded off the Moroccan coast (Aloncle, 1966), around the Madeira Islands (Wirtz *et al*., 2008). In addition, the species is present around the Azores Archipelago (Santos *et al*., 2020).

Stehmann & Bürkel (1986) noted that *R. brachyura* is only known in the western Mediterranean basin, while in the eastern basin, the species is rare with a single and doubtful record from the Aegean Sea. *R. brachyura* used to be rare off the Spanish coast (Lozano Rey, 1928) and around the Balearic Islands (Massutí & Moranta, 2003). With regard to the Mediterranean coast of France, the first record of a single specimen was made by Euzet (1960), while Quignard (1965) noted that the species was very rare in the area. The last recorded specimen in France was captured by trawl on 14 April 1992, between Sète and Palavas (Capapé *et al*., 2006). Another specimen was photographed in a fish shop in Montpellier on 8 September 2021, but no information was available on its origin (see Association Ailerons, 2021).

Tortonese (1956) studied a single specimen caught in the Ligurian Sea, and more recently, Bottaro *et al*. (2009) reported the capture of two specimens, noting that the species was very rare in Italian waters. Conversely, Catalano *et al*. (2007) and Porcu *et al*. (2015) documented the capture of several specimens around Asinara Island, located off northwestern Sardinia, providing studies on the diet and feeding habits of the species, along with descriptions of certain aspects of its reproductive biology. It appears that *R. brachyura* is regularly caught in the area and holds economic significance for local fisheries. Soldo & Lipej (2022) noted that while *R. brachyura* is present in the Adriatic Sea, it is very rare; in fact, it is absent from the Croatian coast (Balaka *et al*., 2023) and the coast of Montenegro (Ćetković *et al*., 2024).

In the central Mediterranean, *R. brachyura* is a rarely occurring species found in the waters around the Maltese Islands (Borg *et al*., 2026). A single specimen was captured on 16 March 1972, off Tabarka on the northern Tunisian coast. It was a female, measuring 920 mm in total length (TL), 620 mm in disc width (DW), and weighing 6.5 kg (Quignard & Capapé, 1972). No new specimens have been recorded in the area since (Rafrafi-Nouira, 2016; Enajjar *et al*., 2022).

R. brachyura has been reported from the Aegean Sea (Papaconstantinou, 2014), more specifically from Turkish marine waters (Turan *et al*., 2024) and off Cyprus (Giovos *et al*., 2021; O'Keefe *et al*., 2023). This appears to be the easternmost range of the species in the Mediterranean Sea, as *R. brachyura* is unknown in the southern Levant Basin (Golani, 2005; Ali, 2018; Bariche & Fricke, 2020). In the south, the species is recorded neither on the Libyan coast (Shakman *et al*., 2023) nor the Mediterranean coast of Egypt (El Sayed *et al*., 2017).

Dieuzeide *et al*. (1953) reported the capture of a large female specimen off the Algerian coast, measuring 1150 mm TL, 620 mm DW, and weighing 6.5 kg TBW. The capture occurred on 2 February 1950, off Bou-Ismail (formerly Castiglione) in central Algeria, at a depth of 30 m. Dieuzeide *et al*. (1953) provided no further details apart from noting that the species is locally caught by trawl and longline. Observations consistently conducted over two decades (2000–2020) along the Algerian coast, at fish landings and markets,

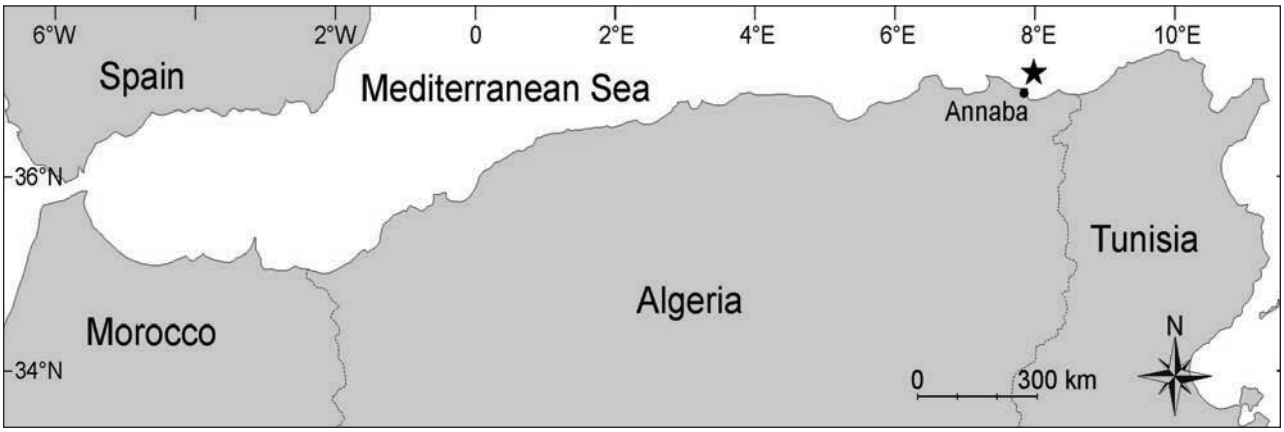

Fig. 1: Map of the Algerian coast with the black star indicating the capture site of *Raja brachyura* ***specimens, off Annaba.***
Sl. 1: Zemljevid alžirske obale s črno zvezdico, ki označuje mesto ulova primerkov vrste *Raja brachyura* ***v vodah blizu Annabe.***

Fig. 2: Numerous** Raja brachyura **captured off Annaba, with arrow 1 indicating a rough ray,** R. radula **(Photo by F. Hemida).
Sl. 2: Številni primerki vrste** Raja brachyura**, ujeti v vodah pri Annabi, s puščico 1, ki označuje hrapavo ražo,** R. radula **(Foto by F. Hemida).

show that *R. brachyura* is caught in relative abundance. This paper describes some specimens captured in Algerian marine waters and offers a few comments on the species' distribution in the local area and the broader Mediterranean Sea.

MATERIAL AND METHODS

The specimens of *R. brachyura* presented herein were observed at the main fish market of Algiers, where catches made along the entire Algerian coast, from the Moroccan to the Tunisian border, are landed. On 29 October 2018, several specimens were captured off Annaba, in the eastern region, at 35°42''35″ N and 1°22'17″ W (Fig. 1). They were caught by trawler at a depth of 50 m, on sandy-muddy bottoms, together with a rough ray, *R. radula* Delaroche, 1809 (Fig. 2). The specimens were carefully examined and identified using field guides and ichthyological fauna references (see *infra*). They were photographed and, when possible, measured. Obtaining morphometric measurements was generally difficult, as the specimens were rapidly sold, mainly in large quantities, for local consumption.

RESULTS AND DISCUSSION

Based on our observations of the landings of *R. brachyura* in the area, the species has been caught in relatively abundance in Algerian marine waters. All specimens were identified based on the combination of the following main morphological characters: body medium-sized, about 1200 mm in total length, rhomboid disc slightly wider than long, with sinuous anterior margins, rostrum short and slightly rounded at its distal end, pectoral fins with clear rounded angles on the lateral side, upper surface entirely prickly (except in juveniles), ventral surface only prickly along front margins of disc, separate orbital thorns, tail short and thick, dorsal surface ochre, covered entirely with small dark spots and several light blotches surrounded by dark spots, belly white.

These features are in complete agreement with previous descriptions of the species (Clark, 1926; Dieuzeide *et al.*, 1953; Tortonese, 1956; Stehmann & Bürkel, 1984; Serena, 2005; Ebert & Stehmann, 2013 and Last *et al.*, 2016). The specimens herein presented were large; the six that were measured had DW ranging between 530 and 630 mm, and TL between 605 and 942 mm. No information on their total body

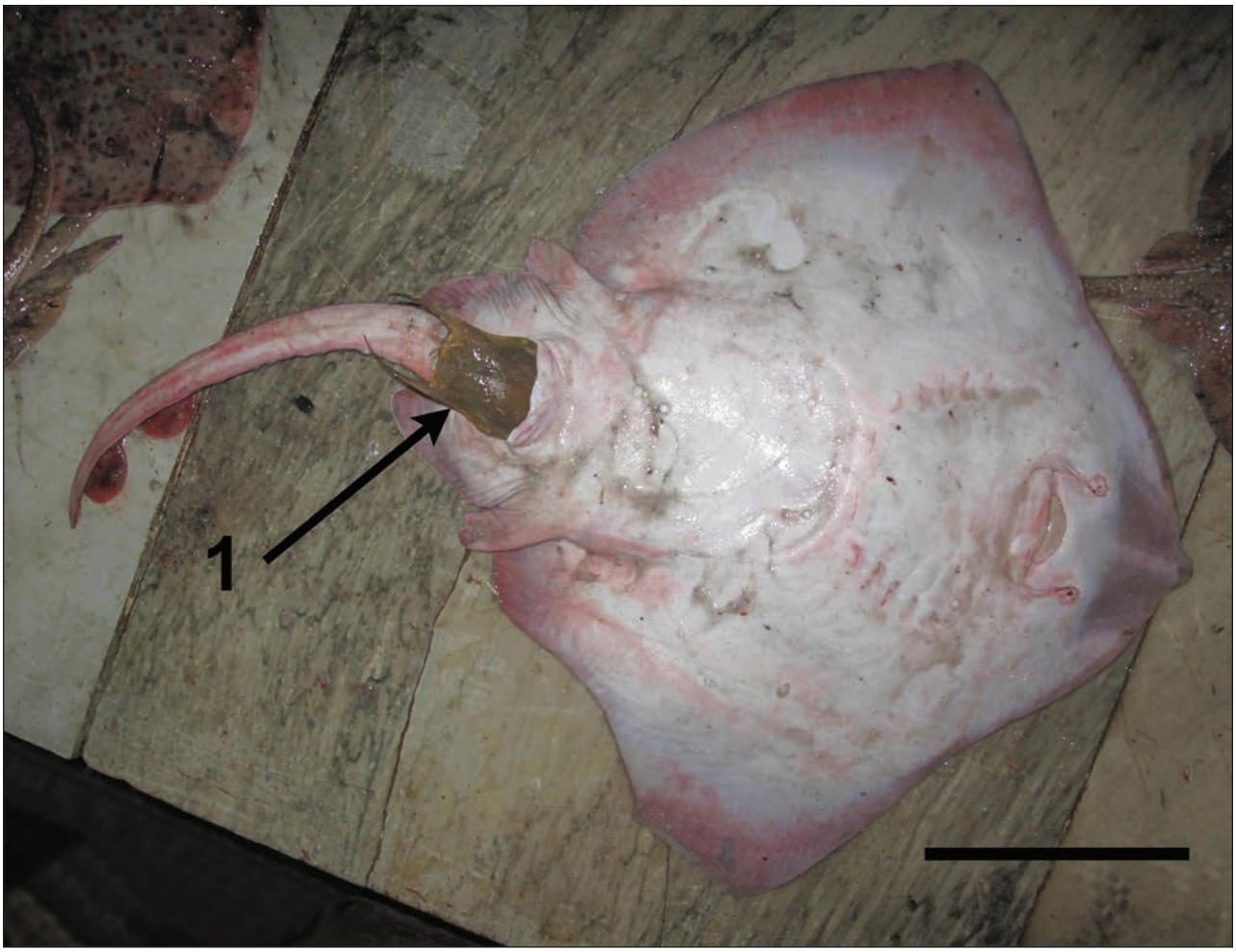

Fig. 3: Adult female of** Raja brachyura **expelling an egg case (arrow 1) (Photo by F. Hemida).
Sl. 3: Odrasla samica vrste** Raja brachyura**, ki je izvrgla jajčno kapsulo (puščica 1) (Foto: F. Hemida).

weight was provided, but their large size, along with previous data on the species (see Capapé *et al*., 2006), suggests that they likely weighed around 6 kg. Among the captured blonde rays, a large female was observed expelling an egg case (Fig. 3), and a fully expelled egg case was found next to a large male (Fig. 4). This egg case measured 112 mm in length (excluding the horns) and 83 mm in width, which are values similar to those typically observed for this species (Stehmann & Bürkel, 1984). Its general morphology also confirmed the description by Porcu *et al*. (2017).

Common captures of *R. brachyura* along the Algerian coast, along with with females producing egg cases suggest that a viable population is successfully established in the area. The species is quite abundant and regularly landed in the eastern Atlantic according to Stehmann & Bürkel (1984) and Ebert & Stehmann (2013). It can therefore be assumed that by migrating to the Mediterranean Sea through the Strait of Gibraltar, the species reached the Algerian coast, where it found sufficient resources to develop and reproduce. The same assumption has also been suggested for other skate species found in Algerian marine waters, such as the cuckoo ray *Leucoraja naevus* (Müller and Henle, 1841) (see Capapé *et al*., 2023) and the undulate ray *Raja undulata* Lacépède, 1802 (see Hemida *et al*., 2024), which could thus be considered Herculean migrants (cf. Quignard & Tomasini, 2000).

In addition, the Algerian coast likely constitutes a hotspot for *R. brachyura* in the western Mediterranean basin. Migrations toward northern areas could explain its abundance off southern Sardinia (Catalano *et al*., 2007; Porcu *et al*., 2015), the sporadic captures reported in the Ligurian Sea (Bottaro *et al*., 2006), off southern Corsica (MSRG-Corsica, 2013), possibly off the coast of Languedoc (Association Ailerons, 2021), and its range extension in the eastern Mediterranean basin (Giovos *et al*., 2021; Turan *et al*., 2024).

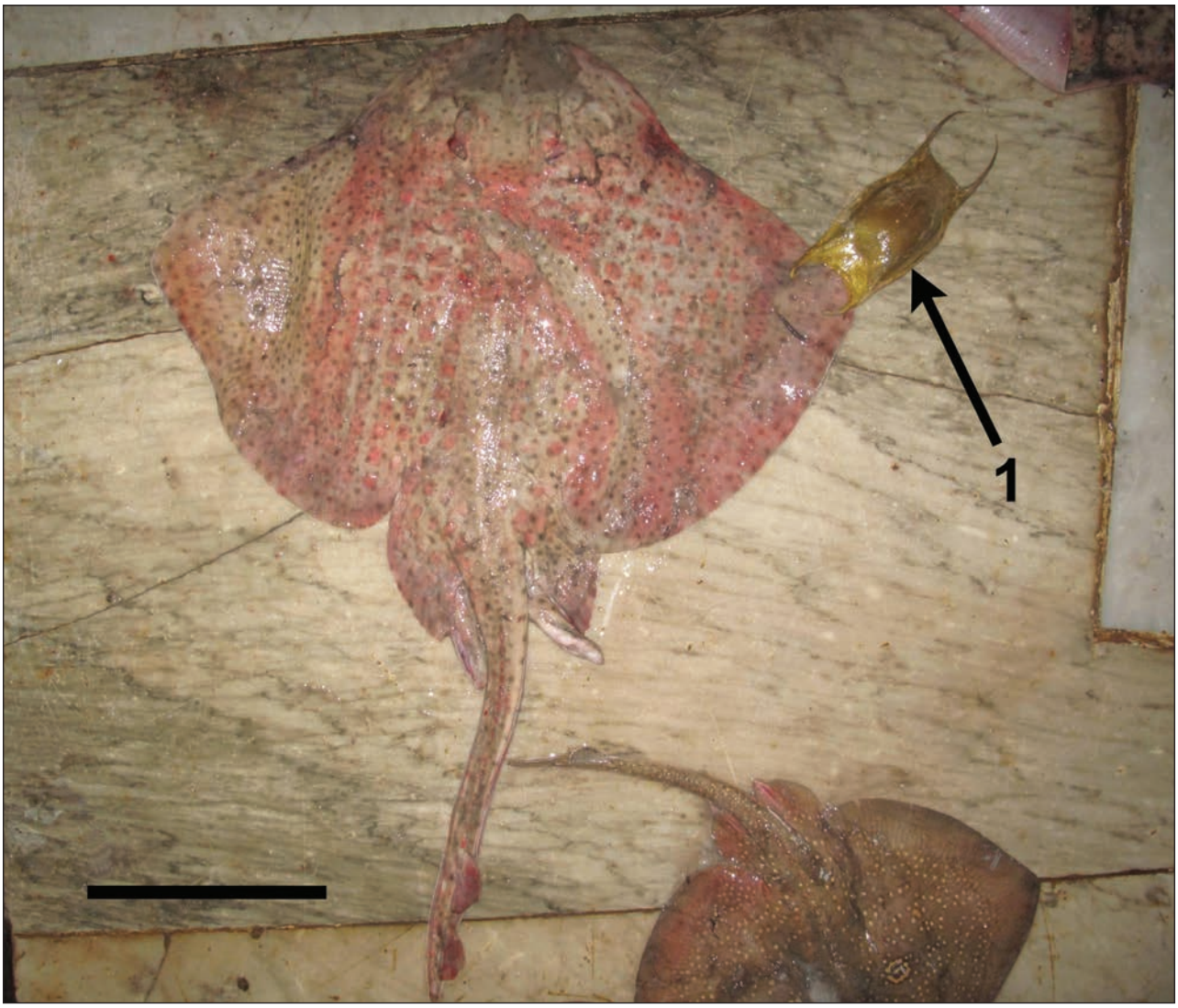

Fig. 4: Egg case of** Raja brachyura **found near an adult male (arrow 1) (Photo by F. Hemida).
Sl. 4: Jajčna kapsula vrste** Raja brachyura**, najdena blizu odraslega samca (puščica 1) (Foto: F. Hemida).

R. brachyura is known to be caught in the temperate waters off the eastern Atlantic coast (Stehmann & Bürkel, 1984; Ebert & Stehmann, 2013). According to Golani *et al.* (2021), the waters of the eastern Mediterranean basin are warmer than those of the western basin, which could explain the successful establishment of alien species from the Red Sea and the Indian Ocean in the eastern basin, as well as the scarcity of species such as *R. brachyura* farther from the Strait of Gibraltar.

Ebert & Stehmann (2013) consider the conservation status of *R. brachyura* to be least concern globally, but near threatened in the Mediterranean Sea, despite the fact that some viable populations still exist in its western basin. The warming of the Mediterranean Sea (Francour *et al.*, 1994) due to global climate change, along with its particular morphology (flattened shape), *K*-selected reproductive characteristics, and over-exploitation, makes this skate species vulnerable (Silva *et al.*, 2012). Therefore, a management plan should be implemented across Mediterranean fisheries to protect *R. brachyura* and prevent its decline, as is the case for all elasmobranch species.

POJAVLJANJE REDKE OKRASTE RAŽE, *RAJA BRACHYURA* (RAJIDAE), OB ALŽIRSKI OBALI (JUGOZAHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o ulovu velikih primerkov okraste raže, Raja brachyura *Lafont 1873, ob alžirski obali. Na podlagi ulovljenih velikih samic, ki nosijo jajca, in primerov že odloženih jajc, kaže, da je populacija vrste* R. brachyura *na tem območju uspešno vzpostavljena. Domnevajo, da je alžirska obala najverjetneje izhodišče za selitev vrste proti severnim regijam, kot je na primer obala Sardinije, kjer so pred kratkim našli nekaj primerkov.*

Ključne besede: *Raja brachyura*, jajčna kapsula, selitev, razširjenost, zahodni sredozemski bazen

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OCCURRENCE OF LONGNOSED SKATE, *DIPTURUS OXYRINCHUS*, IN THE SEA OF MARMARA

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ABSTRACT

On 3 September 2024, a longnosed skate, Dipturus oxyrinchus *(Linnaeus, 1758), was incidentally caught in a trammel-net fishery in the northern Sea of Marmara at a depth of 100 m. It was a male with a TL of ca. 100 cm and a TW of ca. 3000 g. Surveys conducted in the late 1990s to assess the status of demersal fishery resources in the Sea of Marmara indicated that* D. oxyrinchus *once had a considerable stock in the region, in stark contrast to its current rarity. Despite the confirmation of the current presence of* D. oxyrinchus *in the Sea of Marmara, it would be ecologically challenging for it to persist in a sea faced with overfishing and environmental degradation.*

Key words: *Dipturus*, batoids, reoccurrence, shelf, rarity, Sea of Marmara

PRESENZA DI RAZZA MONACA, *DIPTURUS OXYRINCHUS*, NEL MARE DI MARMARA

SINTESI

Il 3 settembre 2024, una razza monaca, Dipturus oxyrinchus *(Linnaeus, 1758), è stata accidentalmente catturata in un tramaglio nel nord del Mar di Marmara ad una profondità di 100 m. Si trattava di un maschio, con lunghezza totale di circa 100 cm e peso totale di circa 3000 g. Le indagini condotte alla fine degli anni '90 per valutare lo stato delle risorse della pesca demersale nel Mar di Marmara, hanno indicato che* D. oxyrinchus *aveva al tempo uno stock considerevole nella regione, in netto contrasto con la sua attuale rarità. Nonostante la conferma dell'attuale presenza di* D. oxyrinchus *nel Mar di Marmara, la sua persistenza in un mare sottoposto alla pesca eccessiva e al degrado ambientale sarebbe ecologicamente impegnativa.*

Parole chiave: *Dipturus*, batoidi, ricorrenza, piattaforma, rarità, Mar di Marmara

INTRODUCTION

In the Mediterranean Sea, the family Rajidae includes 4 genera (*Dipturus, Leucoraja, Raja,* and *Rostroraja*) and 16 species, one of which is the longnosed skate, *Dipturus oxyrinchus* (Linnaeus, 1758) (Rajiformes: Rajidae) (Barone *et al.*, 2022). The distribution range of *D. oxyrinchus* extends across a wide area in the eastern Atlantic Ocean, from central Norway to Senegal, and into the Mediterranean Sea (Froese & Pauly, 2024). Inhabiting sandy and sandy-rocky bottoms of deeper slope waters, *D. oxyrinchus* is mainly found in the deeper parts of the continental shelf and upper slope waters at depths between 200 and 500 m (Froese & Pauly, 2024; Deval & Mutlu, 2024).

The presence of *D. oxyrinchus* in Turkish seas has been observed since the first quarter of the 20th century (Ninni, 1923) and its current occurrence in the region has been confirmed in several ichthyological (e.g., Mater & Meriç, 1996; Bilecenoğlu *et al.*, 2014) and chondrichthyan-specific (e.g., Kabasakal, 2002; Deval & Mutlu, 2024) studies. This skate species has long been considered rare in the Sea of Marmara (GSA 28), with only a few scientific reports from the late 20th century documenting its presence (Japan International Cooperation Agency – JICA, 1993; Uysal *et al.*, 1996). In fact, its inclusion in recent chondrichthyan inventories of the Sea of Marmara (Artüz & Friecke, 2024) relies not on original studies of *D. oxyrinchus* but rather on secondary references to its occurrence in the region. Furthermore, the absence of *D. oxyrinchus* in the species lists of recent surveys of demersal fishes (Torcu Koç *et al.*, 2012; Karakulak *et al.*, 2017; ÇŞİDB-TUBİTAK-MAM, 2021; Daban *et al.*, 2021) or chondrichthyans (Karadurmuş & Sari, 2024) in the Sea of Marmara suggests that the longnosed skate has likely been extirpated from the region. In this article, we report a recent incidental capture of *D. oxyrinchus* in the Sea of Marmara and discuss the factors that may influence the future presence of the species in the area.

MATERIAL AND METHODS

The specimen of the *D. oxyrinchus* presented was accidentally captured in a commercial fishery, using a trammel net with a knot-to-knot mesh opening of 120 mm when stretched. The fisherman photographed the individual, releasing it alive and emailing its images for taxon identification. While the species was identified based on the descriptions by Ebert and Stehmann (2013) and Barone *et al.* (2022), the taxonomic nomenclature follows Froese and Pauly (2024). Information on the total length (TL), weight (TW), depth of capture, and specifications regarding the fishing gear used was obtained from the fisherman. The angle of the snout preceding the line that connects the anterior edges of the spiracles in the individual shown in Fig. 1, a key descriptive characteristic used to differentiate rajids (Ebert & Stehmann, 2013), was measured using a freeware digital protractor tool, "Angle Meter 360," available for download from the Google Play Store. The ratio of preorbital length to interorbital distance is another key descriptive trait in *D. oxyrinchus* (Ebert & Stehmann, 2013). The interorbital distance and preorbital length were measured using the ruler function in Photoshop 7.0. Preorbital length is the distance from the tip of the snout to the front margin of an eyeball, while interorbital distance is the narrowest width between the inner margins of the eyes (Hubbs & Ishiyama, 1968). Photographs of the individual are kept in the personal archives of the first author.

RESULTS AND DISCUSSION

On 3 September 2024, a longnosed skate (Fig. 1) was accidentally caught in a trammel-net fishery off the coast of Silivri (40º57.494′ N, 28º19.190′ E) in the northern Sea of Marmara (Fig. 2) at a depth of 100 m. It was a male with a TL of ca. 100 cm and a TW of ca. 3000 g. Its claspers extended well beyond the posterior edge of the pelvic fin, thus, based on the MEDITS maturity scale for oviparous elasmobranchs, it was identified as a mature (adult) male (Follesa & Carbonara, 2019). The following is a description of the characters shown in Fig. 1: disc broadly rhombic, with outer corners acutely pointed and anterior margins deeply concave, falling well short of the imaginary line between the tip of the snout and the outer wing tip; snout extremely long and acutely pointed, forming a 52º angle; preorbital length 5.14 times the interorbital distance. No buckler thorns on dorsal surface, but alar patches present near the tips of pectoral fins. Due to the framing of the specimen's dorsal view, only the anterior part of the tail is visible in the photograph, showing 5 thorns along the central line. Upper surface of skate dusky brown, featuring widely spaced creamy whitish spots on disc; two eye spots – light-coloured central spots surrounded by dark brown halos – observed on wings closer to midline of body, and a few dark patches on posterior parts of pectoral fins. Ground colour of ventral surface bluish grey, with a prominent dark brownish area on head and wing tips; mucous and sensory pores visible on the central surface as black dots. Ventral side of disc without the thick coating of dark mucus (Fig. 1). This description is consistent with those provided by Ebert and Stehmann (2013) and Barone *et al.* (2022), identifying the individual as *Dipturus oxyrinchus* (Linnaeus, 1758). The preorbital length to interorbital distance ratio in the examined individual differed slightly from the 5.5 to 7.0 ratio reported by Ebert and Stehmann (2013), but

Fig. 1: A male longnosed skate, *D. oxyrinchus****, accidentally captured in the Sea of Marmara by a commercial trammel-netter and released alive. The arrows indicate the patches of alar thorns. Scale bar = 25 cm. Photo credit: Mr. Barış Köksalan.***
Sl. 1: Samec koničaste raže, *D. oxyrinchus****, ki se je v Marmarskem morju slučajno ujel v komercialno trislojno mrežo in so ga ribiči živega izpustili. Puščice označujejo lise trnov na disku. Merilo = 25 cm. Avtor fotografije: g. Barış Köksalan.***

this variation is admissible and may be attributed to either the angle of the image, which hindered precise measurements, or to allopatry.

According to Barone *et al*. (2022), the genus *Dipturus* is represented by three species: *D.* cf. *batis* (Linnaeus, 1758), *D. nidarosiensis* (Storm, 1881), and *D. oxyrinchus* (Linnaeus, 1758). In *D.* cf. *batis*, preorbital length is 2.5 to 4 (so less than 5.5) times the interorbital distance, in *D. oxyrinchus*, it is 5.5 to 7 (Ebert & Stehmann, 2013; Barone *et al.*, 2022). In *D. nidarosiensis*, the dorsal and ventral sides of the disc are uniformly dark and the abdomen covered with dark mucus (Barone *et al.*, 2022), the preorbital length is less than 5 times the interorbital length, and only a median row of 40 to 50 small thorns is featured along the tail up to first dorsal fin (Ebert & Stehmann, 2013). In the present specimen, the preorbital length was 5.14 times the interorbital distance (the possible reasons for this explained above), the dorsal and ventral sides of the body were not uniformly dark, the abdomen was not covered by a dark mucus layer, and only 5 thorns were observed along the central line. The descriptive characteristics of *D.* cf. *batis* and *D. nidarosiensis* differ from those of the present specimen, confirming the latter was a *D. oxyrinchus*.

A critical reading of the literature on the presence of longnosed skate in the Sea of Marmara revealed uncertainty regarding the date of the first *D. oxyrinchus* record from this region. According to the evidence-based criteria for confirmed ichthyological records proposed by Kovačić *et al*. (2020), the records of *D. oxyrinchus* in JICA (1993) and Uysal *et al*. (1996) are classified as "criteria 1", indicating collected and preserved specimens with verified records. On the other hand, data on the occurrence of *D. oxyrinchus* in the Sea of Marmara, provided in several ichthyological reviews published in this century (e.g., Kabasakal, 2002; Eryılmaz & Meriç, 2005; Bilecenoğlu *et al.*, 2014; Artüz & Friecke, 2024), are based solely on earlier reports from the 1990s. Even the source cited by Artüz and Friecke (2024) for the date of the first record of *D. oxyrinchus* in the Sea of Marmara,

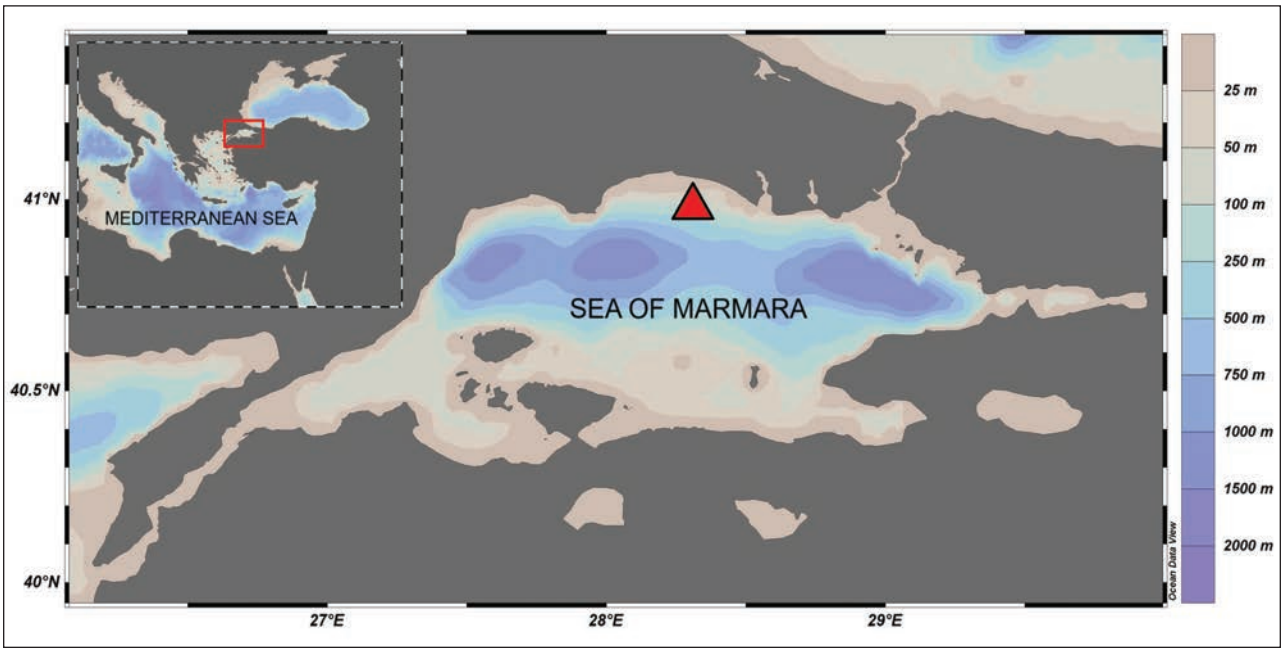

Fig. 2: Map showing the approximate locality (red triangle) of the capture of the longnosed skate. The red rectangle in the small map indicates the geographical position of the Sea of Marmara in the Mediterranean ecosystem.
Sl. 2: Zemljevid s približno lokacijo (rdeči trikotnik) ulova koničaste raže. Rdeči pravokotnik na manjšem zemljevidu označuje geografsko lego Marmarskega morja v sredozemskem ekosistemu.

Ninni (1923), is debatable. In his ichthyological inventory study, Ninni (1923) stated, "I saw this species once in the market of Istanbul," adding that "several specimens were also caught by the Royal Thalassographic Ship Tremiti in the Dardanelles, specifically in the vicinity of Cianac." (Ninni, 1923; p. 20) Therefore, although Emilio Ninni did see a specimen of *D. oxyrinchus* (referring to it as *Raja oxyrhynchus*; in Ninni, 1923; p. 20) in the market of Istanbul, as inferred from his annotation, he examined the species based on specimens brought into the city from other areas, such as the nearby Strait of the Dardanelles, not from the Sea of Marmara. Also, the species is not included in one of the earliest and detailed ichthyological inventories of the Sea of Marmara (Rhasis Erazi, 1942). Therefore, it would be more appropriate to consider JICA (1993) and Uysal *et al.* (1996) as the first references for records of *D. oxyrinchus* in the Sea of Marmara, rather than Ninni (1923).

In MEDITS surveys evaluating the spatial distribution of demersal cartilaginous fishes in the northern Mediterranean, the frequency of occurrence of *D. oxyrinchus* in the eastern Mediterranean at depths of 200–800 m was reported to be 50% (Follesa *et al.*, 2019). Conversely, the frequency of occurrence of *D. oxyrinchus* as bycatch in recent bottom trawl surveys conducted in Turkish seas is below 25% (Keskin & Karakulak, 2006; Yağlıoğlu *et al.*, 2015), classifying the species as rare. In a recent study conducted in the Aegean Sea, Filiz *et al.* (2018) reported that *D. oxyrinchus* was rarely encountered in waters deeper than 100 m in the central Aegean. Also, according to Damalas and Vassilopoulo (2011), there has been a significant decrease in the catch rate of *D. oxyrinchus* in bottom trawl fishery in the central Aegean Sea in recent years (from 1.11 kg/h in 1995 to 0.41 kg/h in 2006). Contrary to these findings, a previous study showed that *D. oxyrinchus* had a considerable stock in the Sea of Marmara in the past (JICA, 1993). Its abundance ranged from 47.9 kg/km^2 (in autumn) to 67.4 kg/km^2 (in winter) at depths of 101–200 m, and from 9.1 kg/km^2 (in spring) to 37.6 kg/km^2 (in winter) at depths of 201–500 m (JICA, 1993). This is consistent with Deval and Mutlu (2024), who stated that *D. oxyrinchus* is a chondrichthyan species mainly found in upper slope waters at depths ≤ 500 m.

In the Sea of Marmara, batoids have faced significant mortality in recent years as a result of environmental degradation, especially severe hypoxia (Karadurmuş & Sarı, 2022; Mantıkçı *et al.*, 2022). As a result, cartilaginous fishes inhabiting the bathyal zone and the deep continental shelf have become more common in the upper areas of the continental shelf (Kabasakal *et al.*, 2023, 2024). The main threat to *D. oxyrinchus* in Turkish seas is fishing, particularly as bycatch in bottom trawls (Yağlıoğlu *et al.*, 2015; Filiz *et al.*, 2018). However, like other cartilaginous fish that are forced into shallow continental shelf waters due to deoxygenation in deeper

areas, *D. oxyrinchus* may also become a target of year-round small-scale fishing in this region.

In conclusion, the absence of *D. oxyrinchus* in recent trawl surveys of deeper areas in the Sea of Marmara (Torcu Koç *et al.*, 2012; Karakulak *et al.*, 2017; ÇŞİDB-TUBİTAK-MAM, 2021; Daban *et al.*, 2021; Karadurmuş & Sarı, 2024), along with the capture of this individual by small-scale fishermen at a depth where the species has not previously been encountered (JICA, 1993), supports this assumption. According to Ellis *et al.* (2016), the population of *D. oxyrinchus* in the Mediterranean Sea has declined by around 30% over three generations (30 years). While the current record confirms the species' presence in the Sea of Marmara, it would be ecologically challenging for it to persist in a sea faced with overfishing and environmental degradation.

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POJAVLJANJE KONIČASTE RAŽE, *DIPTURUS OXYRINCHUS*, V MARMARSKEM MORJU

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POVZETEK

Tretjega septembra 2024 so v trislojno mrežo naključno ujeli primerek koničaste raže, Dipturus oxyrinchus *(Linnaeus, 1758) v severnem delu Marmarskega morja na globini 100 m. Bil je samec, ki je meril približno 100 cm v dolžino in tehtal približno 3000 g. Raziskave, opravljene v poznih devetdesetih letih prejšnjega stoletja za oceno statusa pridnenih ribolovnih virov v Marmarskem morju, so pokazale, da je imela koničasta raža (*D. oxyrinchus*) nekoč velik stalež v regiji, kar je v popolnem nasprotju s trenutno redkostjo. Kljub potrditvi trenutne prisotnosti* D. oxyrinchus *v Marmarskem morju bi bilo ekološko zahtevno, da bi koničasta raža še naprej vztrajala v morju, ki se sooča s prekomernim ribolovom in degradacijo okolja.*

Ključne besede: *Dipturus*, skati, ponovni pojav, šelf, redkost, Marmarsko morje

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CAPTURE OF A JUVENILE SHARPNOSE SEVENGILL SHARK, *HEPTRANCHIAS PERLO* (BONNATERRE, 1788), FROM THE TURKISH COAST (EASTERN MEDITERRANEAN SEA) WITH UPDATED RECORDS FROM MEDITERRANEAN WATERS

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ABSTRACT

In June 2024, an immature male specimen of Heptranchias perlo *(Bonnaterre, 1788) was caught by a commercial trawl boat off Tasucu (Silifke, Turkey) at a depth of 520 m. This represents a new juvenile record of the species in Turkish waters (eastern Mediterranean). This record is important for monitoring the sharpnose sevengill shark in Turkey and may contribute to improving regional sustainable fisheries policies, such as establishing a Shark Conservation Management Plan for the area. Furthermore, it enhances our understanding of shark species distribution and may help identify potential nursery areas in the region. The study also provides detailed historical and current records of newborn and juvenile sharpnose sevengill sharks in the region and the broader Mediterranean.*

Key words: juvenile shark, Hexanchidae, Tasucu coast, Turkey, Levantine Sea

CATTURA DI UN GIOVANE SQUALO MANZO, *HEPTRANCHIAS PERLO* (BONNATERRE, 1788), LUNGO LA COSTA TURCA (MEDITERRANEO ORIENTALE) CON SEGNALAZIONI AGGIORNATE PER IL MEDITERRANEO

SINTESI

Nel giugno 2024, un esemplare maschio immaturo di Heptranchias perlo *(Bonnaterre, 1788) è stato catturato da una barca commerciale a strascico al largo di Tasucu (Silifke, Turchia) a una profondità di 520 m. Questo rappresenta un nuovo dato per un giovanile della specie nelle acque turche (Mediterraneo orientale). Questa cattura è importante per il monitoraggio dello squalo manzo in Turchia e può contribuire a migliorare le politiche regionali di pesca sostenibile, come l'istituzione di un piano di gestione della conservazione degli squali nell'area. Inoltre, migliora la nostra comprensione della distribuzione delle specie di squali e può aiutare a identificare potenziali aree di riproduzione nella regione. Lo studio fornisce anche una dettagliata documentazione storica e attuale dei neonati e degli stadi giovanili di squalo manzo nella regione e nel Mediterraneo in generale.*

Parole chiave: giovane squalo, Hexanchidae, Costa di Tasucu, Turchia, Mar Levantino

INTRODUCTION

In the Mediterranean, the genus *Heptranchias* is represented by a single species, the sharpnose sevengill shark *Heptranchias perlo* (Bonnaterre, 1788), a small deep-water shark belonging to the family Hexanchidae (IUCN, 2024).

Sharpnose sevengill sharks are a circumglobal species found in tropical and temperate oceans, excluding the northeastern Pacific (Compagno & Niem, 1998). Their distribution extends from the western and eastern Atlantic, including the Mediterranean, to the Indian Ocean and western Pacific (Ebert *et al.*, 2013). In the Mediterranean waters of Turkey, they are considered to be rare (Ergüden & Bayhan, 2015).

The sharpnose sevengill shark, *H. perlo*, is a bathydemersal species typically found on the outer continental and insular shelves and upper slopes at depths of 100 to 400 m, though it occasionally ventures into shallower inshore waters or descends to depths of up to 1000 m (Compagno & Niem, 1998; Last & Stevens, 1994; Froese & Pauly, 2024), but mostly found at 27-720 m (Ebert *et al.*, 2013; Weigmann, 2016). It feeds on small sharks and rays, small bony fish, shrimps, crabs, lobsters, squid, and cuttlefish (Capapé, 1980; Compagno *et al.*, 1989; Henderson & Williams, 2001; Barnett *et al.*, 2012).

In the Mediterranean, *H. perlo* has been recorded at various depths and in different regions (Capapé, 1980; Boeseman, 1984; Serena; 2005), including the Adriatic Sea (Lipej & Dulčić, 2010; Dragičević & Isajlović, 2020 Lipej & Mavrič, 2022a, 2022b), Sicilian waters (central Mediterranean) (De Maddalena *et al.*, 2002), the Balearic Sea (western Mediterranean) (Guallart *et al.*, 2019a,b), Algerian waters (Ordines *et al.*, 2011), Tunisian waters (El Kamel-Moutalibi *et al.*, 2014; Rafrafi-Nouira *et al.*, 2015; Capapé *et al.*, 2018), waters off Sardinia (Marongiu *et al.*, 2017; Mulas *et al.*, 2021), Strait of Sicily (De Maddalena *et al.*, 2002; Scacco *et al.*, 2010), Gulf of Gabès (Bradai *et al.*, 2002), Maltese waters (Schembri *et al.*, 2003), eastern Mediterranean (Golani 2005), off Cyprus (Guallart *et al.*, 2019a), the Ionian Sea (Mytilineou *et al.*, 2005), Greek waters (Damalas & Megalofonou, 2012; Papaconstantinou, 2014; Karachle *et al.*, 2020), Turkish waters (Akşıray, 1987; Filiz & Mater, 2002; Öziç & Yilmaz, 2006; İşmen *et al.*, 2007, 2009; Kabasakal & Ince, 2008; Güven *et al.*, 2012; Eronat & Özaydın 2014; Ergüden & Bayhan, 2015; Başusta, 2016), and Syrian waters (Alkusairy & Saad, 2018).

In Turkey, *H. perlo* was first recorded in Mediterranean waters (Akyüz, 1957). While its range has evidently expanded since, as the species has been documented in the Turkish waters of both the Aegean

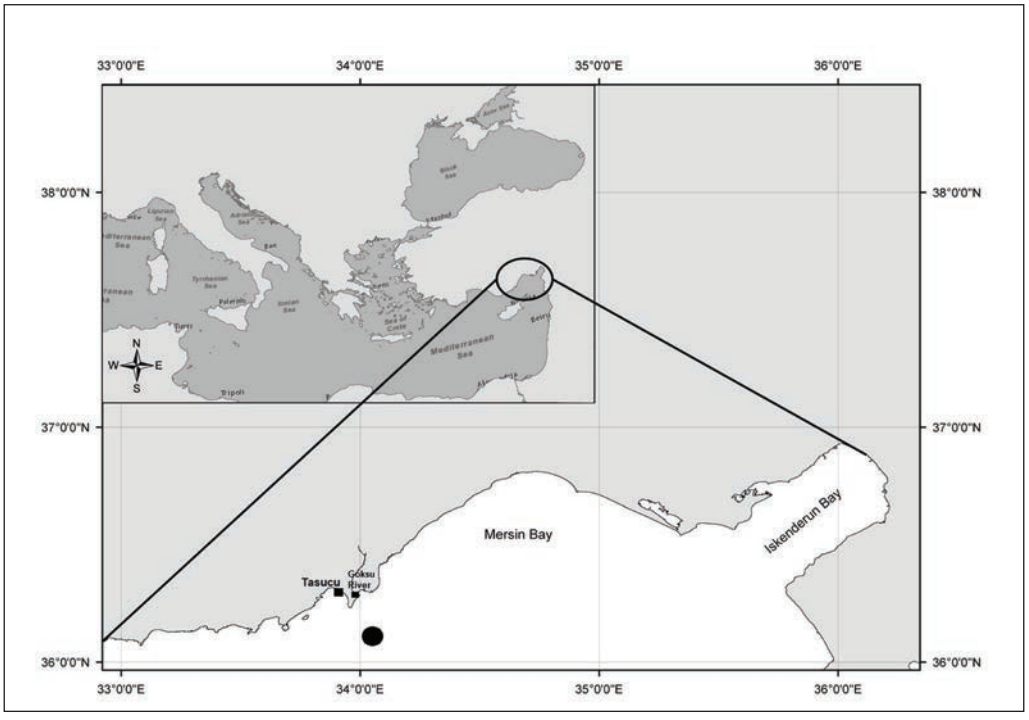

Fig. 1: Map showing the capture site (•) of the sharpnose sevengill shark, *Heptranchias perlo* ***(Bonnaterre, 1788), in the eastern Mediterranean.***
Sl. 1: Zemljevid obravnavanega območja z označeno lokaliteto ulova (•) morskega psa sedmeroškrgarja, *Heptranchias perlo* ***(Bonnaterre, 1788), v vzhodnem Sredozemskem morju.***

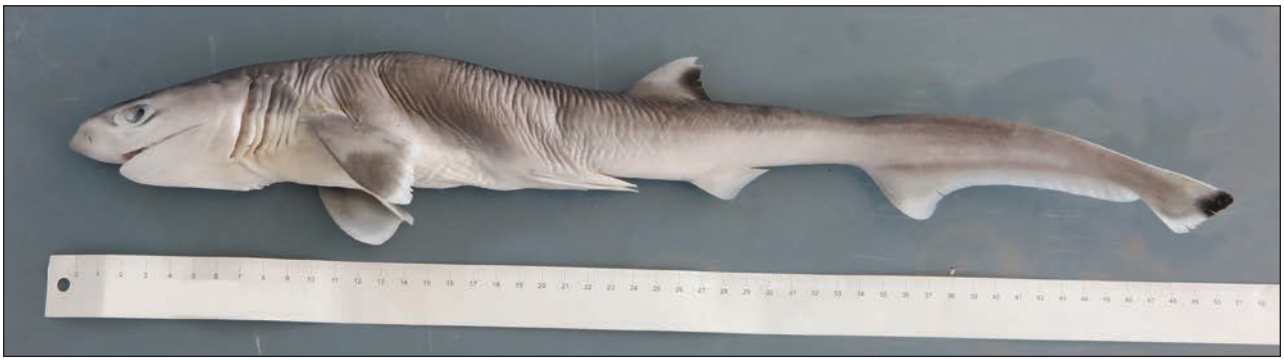

Fig. 2: General view of the male** Heptranchias perlo **from the Tasucu coast.
Sl. 2: Splošni pogled na samca vrste** Heptranchias perlo **z obale Tasucu.

Tab 1: Morphometric measurements of the juvenile specimen of** H. perlo **collected from the Tasucu coast, Turkey, compared with previous records of neonate and juvenile specimens from the Mediterranean Sea.
Tab 1: Morfometrične meritve juvenilnega osebka vrste** H. perlo**, ujetega na obali Tasucu v Turčiji, v primerjavi s prejšnjimi zapisi o pojavljanju novoskotenih ih in nedoraslih osebkov iz Sredozemskega morja.

Reference	**This study**	**Başusta (2006)**	**El Kamel-Moutalibi** *et al.* **(2014)**	**Capape** *et al.* **(2018)**	**Gullard** *et al.* **(2019a)**	**Gullard** *et al.* **(2019b)**
Locality	Tasucu coast, Türkiye	International waters of the North-eastern Mediterranean	Tunisian waters	Tunisian waters (off Bizerte)	Balearic Sea, western Mediterranean Sea, Spain	Ibiza Channel, western Mediterranean Sea, Spain
Morphometric measurements	**Value (cm)**					
Sex	**Male**	**-**	**Female-Male**	**Male-Female**	**Female**	**Female**
Specimen (N)	1	2	2	2	1	1
Total length	50.2	32.5-32.3	79.0-70.0	72.0-70.0	79.6	64.3
Fork length	37.5	25.5-25.3	61.0-55.4	55.0-55.0	-	-
Head length	10.1	6.8-6.7	16.8-14.7	14.5-14.2	15.2	12.9
Eye weight	1.9	1.5-1.5	2.6-2.5	3.1-3.0	2.8	2.3
Eye height	0.9	0.7-0.7	1.5-1.3	1.8-1.8	-	-
Pre-nasal length	1.5	-	2.2-1.6	2.0-2.0	-	1.3
Interorbital space	2.7	-	-	-	-	-
Internarial space	1.9	-	-	2.0-2.0	-	1.9
Clasper length	1.0	-	-	-	2.5	-
Pre-narial length	2.2	-	-	-	1.5	1.3
Pre-orbital length	2.8	1.7-1.6	-	-	4.3	3.5
Pre-branchial length	6.4	5.6-5.5	13.0-11.5	3.6-3.5	10.5	9.9
Pre-dorsal length	23.4	15.4-.15.3	38.0-35.4	35.6-35.0	39.0	31.3
Pre-pelvic length	10.0	-	32.0-28.5	29.4-29.4	32.5	25.9
Pre-pectoral length	19.3	-	17.0-14.7	14.9-14.5	14.6	12.8
Pre-anal length	26.4	13.3-13.0	42.5-38.8	38.4-38.0	43.1	35.0
Pre-caudal length	33.8	22.0-21.0	55.0-49.2	49.5-49.0	54.7	44.1
Weight (g)	328.3	106.9-101.7	1280-1000	1130-1092	1590	-

Tab. 2: Confirmed records of neonate and juvenile specimens of** H. perlo **from the Mediterranean Sea covering the period 1980–2024. N: Number of samples.
Tab. 2: Potrjeni podatki o novoskotenih in mladostnih primerkih vrste** H. perlo **iz Sredozemskega morja za obdobje 1980–2024. N: Število vzorcev.

References	Record Date	N	Sex	Location	Sampling Gear	Depth (m)	Length, TL (cm)	Weight (g)
Capapé (1980)	1980	68	Male	Tunisian waters	Trawl	36-32	118.0-30.0	-
		52	Female			40-12	139.0	-
Bradai *et al.* (2002)	4 February 1991 19 February 2001	1 2	Male Female	Gulf of Gabes, Tunisia	-	Surface 80	39.0 98.0-69.5	138 4000-688
	1-2/2001 1-2/2001 1 March 2002	2 3 2	Male Female Female	Gulf of Gabes, Tunisia	-	-	75.0-75.0 98.0-69.5 100.0-94.0	1259-1252 4000-828 2300
De Maddalena *et al.* (2002)	26 July 2000 June 2000 21 December 1989	1 5 1	Male - -	Ganzirri, Mesina Strait, Italy Linosa and Porto Empedocle Catania, Italy	- - -	70 200 -	85.0 80.0-70.0 95.0	1610 - 4000
Megalofonou *et al.* (2005)	1998-2001	1	-	Greek Seas	Longline		104.0	-
İşmen *et al.* (2007)	February 2005- April 2006	14	-	Saroz Bay (NE Aegean Sea, Türkiye)	Trawl	28-370	105.0-68.6	3388-920
İşmen *et al.* (2009)	March 2005-June 2008	5 13	Female Male	Saroz Bay (NE Aegean Sea, Türkiye)	Trawl	5-500	84-68.6 105.0-69.2	1960-920 3388-1170
Kabasakal & Ince (2008)	15 September 2008	1	Female	Kömür Cape, Saroz Bay (NE Aegean Sea, Türkiye)	Stranded individual	-	85.0	1700
Damalas & Megalofonou (2012)	1998-2001	1	-	Antikithyra strait, Greece	-	382	104.0	-
Güven *et al.* (2012)	October 2009-December 2010	11	-	Antalya Bay, Türkiye	Trawl	200-800	105.3-31.1	3560-80.2
Eronat & Özaydın (2014)	2008-2009	1	Female	Izmir Bay and Sığacık Bay (Central Mediterranean), Türkiye	Trawl	-	99.6	4382
El Kamel-Moutalibi *et al.* (2014)	21 May 2014	1 1	Male Female	Eskerkis Bank, off the northern Tunisian coast, Tunisia	Trawl	150-300	70.0 79.0	1000 1280
	01 April 2007-15 July 2007	1 1	Male Female	Tunisian waters, Tunisia	-	-	81.0 110.0	3000 5000
Lteif (2015)	01-08/2013	1	-	South Lebanese coasts, Lebanon	Trawl	0-300	115.0	6000
Rafrafi-Nouira *et al.* (2015)	25 September 2009	1	Female	Cani Rocks, Tunisia	Trawl	56	99.0	-
Başusta (2016)	4 May 2015	1 1	Male Female	NE Mediterranean, Türkiye	Trawl	360-400	32.5 32.3	101.8 106.9
Capapé *et al.* (2018)	24 November 2015	2	Female	Island of Zembra, (NE Gulf of Tunis)	Trawl	150	112.0-72.0	2255-1150
		2	Male			150	84.0-74.0	1735-1300
Capapé *et al.* (2018)	02 August 2018	1 1	Male Female	Tunisian waters, off Bizerte, (NW Gulf of Tunis)	Longline	130-140	72.0 70.0	1130 1092
Ergüden & Bayhan (2018)	27 June 2014	1	Male	off Erdemli (Mersin Bay), Türkiye	Trawl	601	105.0	3600
Alkusairy & Saad (2018)	November 2014-October 2016	2 2	Male Female	Syrian coasts (Eastern Mediterranean), Syria	Trawl	-	117-27 124-20	- -
Gullard *et al.* (2019a)	24 February 2018	1	Female	Balearic Sea, western Mediterranean Sea, Spain	Trawl	650	79.6	1590
Gullard *et al.* (2019b)	26 June 2019	1	Female	Ibiza Channel, western Mediterranean Sea, Spain	Trawl	-	64.3	-
Lipej & Mavrič (2022b)	21 December 2021	1	Female	Gulf of Trieste	Trammel net	20	72.8	1010
This study	28 June 2024	1	Male	Tasucu coast Eastern Mediterranean, Türkiye	Trawl	520	50.2	328.3

and Mediterranean Seas (Akşıray, 1987; Bilecenoglu *et al*., 2014), it should be noted that the species is only rarely observed by local fishermen along the Tasucu coast (Silifke, Turkey) when incidentally caught in fishing nets during trawl or bottom long-line operations. This paper presents a record of this species on the Levantine coast reporting the capture of a male juvenile.

MATERIAL AND METHODS

On 26 June 2024, a male specimen of sharpnose sevengill shark, *H. perlo*, was incidentally caught in a bottom trawl net at a depth of 520 m, off Tasucu, Silifke (36°12′435′′ N, 34°18′246′′ E) (Fig. 1). The specimen was photographed and taken to the laboratory for identification. All measurements, counts, morphological descriptions, and colors conform to species descriptions provided by Compagno (1984) and Golani *et al*. (2006). The morphometric measurements of the specimen recorded to the nearest 0.1 mm were taken using a caliper (Fig. 2 and Fig. 3). The specimen is deposited in the Museum of the Faculty of Fisheries, Çukurova University, under catalog number CSFM-PIS/24-37.

RESULTS AND DISCUSSION

The juvenile sharpnose sevengill shark, a male, measured 50.2 cm total length (TL) and weighed 328.3 g. Its morphometric measurements are presented in Table 1 and compared with previous Mediterranean records of the species (Başusta, 2006). *H. perlo* has a slender body with a long caudal peduncle. The head is pointed and narrowed, with large eyes (Fig. 3). It has seven pairs of long gill slits and a single dorsal fin, which is small and originates above the inner margins of the pelvic fins. The anal fin is also small, its height about half that of the dorsal fin. The pectoral fins are moderately small and broad, with narrowly rounded tips and a slightly concave hind margin. The caudal fin is heterocercal, featuring a long

Fig. 3: Head, eyes, jaw teeth, and seven gill slits of *Heptranchias perlo*.
Sl. 3: Glava, oči, zobje v čeljusti in sedem škržnih rež primerka vrste *Heptranchias perlo*.

upper lobe with a distinct sub-terminal notch and a short lower lobe (Compagno, 1984). The upper jaw teeth feature narrow oblique cusp and small lateral cusplets. Lower jaw teeth are comb-like (Last & Stevens, 1994). The body is brownish to grey above and paler below, the tips of the dorsal and anal fins dark in juvenile specimens. The large eyes are fluorescent green in live specimens (Bass *et al*., 1998; Last & Stevens, 1994).

The maximum total length of *H. perlo* recorded to date is 137 cm in males and 140 cm in females (Compagno, 1984), but the species commonly reaches 100 cm in total length (Sanches, 1991). Males mature at 75 to 85 cm TL, females at 90 to 105 cm TL. Reproduction is aplacental ovoviviparous (Breder & Rosen, 1966), with females producing litters of 6–20 individuals (Compagno, 1994). According to Ebert *et al*. (2013), the size at birth is estimated to be 26–30 cm TL. Capapé (1980) reported that in Tunisian waters the size at birth is 30 cm TL and the approximate weight 60 g.

Başusta (2016) suggested that some shark species may utilize the northeastern Mediterranean region as mating, breeding, and nursery grounds. Castro (1993) noted that the designation of an area as a breeding and nursery ground for a particular elasmobranch species is based on the presence of neonates, small juveniles, and gravid females in the respective area. Thus, the capture of this juvenile individual appears to support Başusta's findings. Additionally, fishermen interviewed for this study reported occasionally encountering adult individuals of this shark species, as well as egg casings, in the region (personal observation).

As mentioned above, the immature male specimen in this study measured 50.2 cm total length and weighed 328.3 g. Başusta (2016) reported two neonate *H. perlo* specimens, measuring 32.5 and 32.3 cm TL, respectively, from northeastern Mediterranean waters of Turkey. Our specimen was captured well outside the location reported by Başusta (2016) and was larger and heavier. This is the third case of a small juvenile sharpnose sevengill shark recorded in Turkish eastern Mediterranean waters, occurring approximately eight years after the second. However, our specimen is still smaller than the individuals previously documented by other authors (De Maddalena *et al*., 2002; İşmen *et al*. (2007; 2009; Kabasakal & Ince, 2008; Damalas & Megalofonou, 2012; Eronat & Özaydın, 2014; El Kamel-Moutalibi *et al*., 2014; Lteif, 2015; Rafrafi-Nouira *et al*., 2015; Capapé *et al*., 2018; Gullard *et al*., 2019a; Gullard *et al*., 2019b) as shown in Table 2, where the other Mediterranean Sea records of newborn and small juveniles *H. perlo* are compared with the results of the present study.

The juvenile male sharpnose sevengill shark reported in this study was observed in deep water (>500 m) during a trawl survey and accidentally caught at 520 m, which is consistent with the depth ranges stated in previous literature (Ebert et al., 2013; Weigmann, 2016) and previous reports (Tab. 2).

Although *H. perlo* has no commercial importance and is not specifically targeted, it can be caught as bycatch in deep-water fisheries throughout its range. It is, albeit infrequently, reported as incidental catch in commercial demersal trawl, longline, and gillnet fisheries (IUCN, 2024).

In 2019, the sharpnose sevengill shark was globally assigned a status of near threatened (NT) under criteria A2bd of the IUCN Red List (Finucci *et al*., 2020), in the Mediterranean, however, it is considered a data deficient (DD) species (Dulvy *et al*., 2016, Otero *et al*., 2019).

Currently, there are no species-specific conservation measures in place for the sharpnose sevengill shark in the Mediterranean, as more information is needed regarding its population size and habitat status. Therefore, further research on rare shark species and their distribution in the eastern Mediterranean should be encouraged and supported.

CONCLUSIONS

This record of a juvenile *H. perlo* can serve as an important tool for monitoring shark species. Furthermore, our findings could contribute to improving regional fisheries policies, such as establishing a Shark Conservation Management Plan for the area. They will also enhance our understanding of shark diversity and the identification of potential nursery grounds.

ULOV MLADOSTNEGA PRIMERKA MORSKEGA PSA SEDMEROŠKRGARJA, *HEPTRANCHIAS PERLO* (BONNATERRE, 1788), IZ TURŠKIH VODA (VZHODNO SREDOZEMSKO MORJE) Z POSODOBLJENIM SEZNAMOM ZAPISOV O POJAVLJANJU V SREDOZEMSKEM MORJU

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POVZETEK

Junija 2024 so s komercialno vlečno mrežo pri Tasucuju (Silifke, Turčija) na globini 520 m ujeli nezrelega samca morskega psa sedmeroškrgarja Heptranchias perlo (Bonnaterre, 1788). Gre za nov primer o pojavljanju mladostnega primerka vrste v turških vodah (vzhodno Sredozemsko morje). Ta zapis o pojavljanju je pomemben za spremljanje morskega psa sedmeroškrgarja v Turčiji in lahko prispeva k izboljšanju regionalnih trajnostnih ribiških politik, kot je vzpostavitev načrta upravljanja za ohranitev morskih psov za to območje. Poleg tega izboljšuje naše razumevanje o razširjenosti vrst morskih psov in lahko pomaga prepoznati potencialne jaslice v regiji. Študija ponuja tudi podrobne zgodovinske in trenutne zapise o pojavljanju novoskotenih in mladih primerkov morskih psov sedmeroškrgarjev v regiji in širšem Sredozemlju.

Ključne besede: mladostni primerek morskega psa, Hexanchidae, obala Tasucu, Turčija, Levantsko morje

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ADDITIONAL HISTORICAL RECORDS OF GREAT WHITE SHARKS, *CARCHARODON CARCHARIAS*, CAUGHT IN THE GULF OF LION, NORTHWESTERN MEDITERRANEAN SEA, BETWEEN THE 1920s AND 1950s

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ABSTRACT

Extensive archival investigations have led to the discovery of unpublished records of three specimens of the great white shark, Carcharodon carcharias *(Linnaeus, 1758), captured in the Gulf of Lion (NW Mediterranean Sea, GSA07). The materials examined consisted of archival photographs and a newspaper report (specimens Nos. 1 and 3), as well as a complete set of upper and lower jaws (specimen No. 2). These unpublished records pertain to specimens caught in an artisanal trammel-net fishery by fishermen from Brusc Port, Toulon (France), on 31 July 1926, in 1930, and in 1954, respectively. The total lengths (TL) of these adult specimens were estimated to be between 400 and 480 cm.*

Key words: Lamnidae, *Carcharodon*, GSA07, historical, jaws, conservation

ULTERIORI DATI STORICI DI GRANDI SQUALI BIANCHI, *CARCHARODON CARCHARIAS*, CATTURATI NEL GOLFO DEL LEONE, MAR MEDITERRANEO NORD-OCCIDENTALE, TRA GLI ANNI '20 E '50

SINTESI

Un'ampia ricerca d'archivio ha portato alla scoperta di documenti inediti relativi a tre esemplari di squalo bianco, Carcharodon carcharias *(Linnaeus, 1758), catturati nel Golfo del Leone (Mediterraneo occidentale, GSA07). I materiali esaminati consistevano in fotografie d'archivio e in un resoconto giornalistico (esemplari n. 1 e 3), oltre a un set completo di mascelle superiori e inferiori (esemplare n. 2). Questi documenti inediti si riferiscono a esemplari catturati da pesca artigianale con tramaglio da pescatori del porto di Brusc, Tolone (Francia), rispettivamente il 31 luglio 1926, nel 1930 e nel 1954. Le lunghezze totali (TL) di questi esemplari adulti sono state stimate tra i 400 e i 480 cm.*

Parole chiave: Lamnidae, *Carcharodon,* GSA07, dati storici, mascelle, conservazione

INTRODUCTION

The great white shark, *Carcharodon carcharias* (Linnaeus, 1758) (Lamniformes: Lamnidae), is one of the largest species of coastal and oceanic macro-predatory sharks (Compagno, 2001; De Maddalena & Heim, 2012; Ebert & Dando, 2020; Ebert *et al*., 2021; Rigby *et al*., 2022). Six genetically distinct and geographically isolated philopatric populations have been identified worldwide: Australian, South African, Northwest Atlantic, Northeast Pacific, Japanese, and Mediterranean (Villafaña *et al*., 2020; Ebert *et al*., 2021). The Mediterranean population is identified as genetically distinct (Gubili *et al*., 2012; Ebert & Dando, 2020).

C. carcharias preys on large pelagic bony fishes such as bluefin tuna (*Thunnus thynnus*) and swordfish (*Xiphias gladius*), along with other elasmobranchs, pinnipeds, and cetaceans (Fergusson, 1996; De Maddalena & Heim, 2012; Boldrocchi *et al*., 2017; Kabasakal *et al*., 2022). It is also one of the most necrophagous species among large macrophagous sharks, with numerous cases of scavenging on large cetacean carcasses recorded to date (De Maddalena & Heim, 2012). *C. carcharias* is mainly solitary, exhibiting migration patterns tied to environmental conditions, reproduction, and prey movements (Milankovic *et al*., 2021). Data on the global population size of the great white shark are insufficient, and only approximate estimates are available (Rigby *et al*., 2022). The historical census of the species indicates that 789 records of its presence have been documented across the Mediterranean to date (Kabasakal *et al*., 2022; Soldo & Bakiu, 2024).

The Mediterranean basin, stretching from the Strait of Gibraltar to the Sea of Marmara, has been the site of small but regular annual sightings of the great white shark, particularly its central and western parts (Barrull, 1993; Barrull & Mate, 2001; De Maddalena & Heim, 2012; Kabasakal, 2014; Moro *et al*., 2020). Moreover, as regards the sea's primary production, it is described as oligotrophic in the western region and ultra-oligotrophic in the central part (Stambler, 2013). However, the coastal and upwelling zones of the western Mediterranean, specifically the Gulf of Lion, are localised areas of high productivity and abundance of diverse marine species, including large predatory fish and apex predators (*Parc Naturel Régional de Camargue*, 2012; Roos, 2012; Bănaru *et al*., 2013; Fromentin & Lopuszanski, 2014; Di-Méglio *et al*., 2015; Poisson *et al*., 2015; Strady *et al*., 2015; Rouyer *et al*., 2021). The highest productivity occurs from spring to early autumn (Monaco *et al*., 2009; Carpaye & Maurel, 2023).

C. carcharias has been categorised as vulnerable in the Mediterranean since 1996 and is currently classified as critically endangered (CR, IUCN) (Ferretti *et al*., 2008; Otero *et al*., 2019; Rigby *et al*., 2018, 2022). Historically, it has been affected by overfishing for its prized teeth and fins. Although less frequent, accidental catches still occur, and increasing urbanisation continues to deteriorate its coastal habitat. Research and enhanced management are crucial for its conservation in the Mediterranean (Ferretti *et al*., 2010; Boldrocchi *et al*., 2017; Jenrette *et al*., 2023; Micarelli *et al*., 2023). Moreover, De Maddalena & Heim (2012) and Moro *et al*. (2020) reported a marked decline in the *C. carcharias* population in this region since the mid-20th century. Consequently, conservation measures have been implemented, including the listing of this species in Appendices I and II of the Commission on Migratory Species (CMS) in 2002 and in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2004. More recently, in 2012, the General Fisheries Commission for the Mediterranean (GFCM) banned the retention of great white sharks and mandated their release in the event of capture (Rigby *et al*., 2022). Since 2018, the GFCM has intensified efforts to protect the species throughout the Mediterranean Basin (Bradai *et al*., 2018).

Historically, the species has been recorded only sporadically in the Gulf of Lion since the 16th century, with a total of 40 specimens documented (De Maddalena & Zuffa, 2009; De Maddalena & Heim, 2012) and the records based solely on an inventory of dried jaws and teeth, a small sample of accidentally caught dead animals, and a limited number of reports from sea users, who often lack precision in their descriptions and data. *C. carcharias* remains largely unknown in terms of its ecology in this part of the Mediterranean. The very rare current sightings in the area involve an extremely small number of individuals, likely remnants of the original Mediterranean population, now nearing extinction. While it is well-documented that *C. carcharias* uses the central Mediterranean as a parturition and nursery area (De Maddalena & Heim, 2012; Boldrocchi *et al*., 2017; Bradai *et al*., 2018; Kabasakal *et al*., 2022), and despite its historical abundance in the region, the life history of the great white shark in the western Mediterranean remains unknown, with most sightings concentrated in the northwest (Morey *et al*., 2003; De Maddalena & Heim, 2012; Maliet *et al*., 2013; Boldrocchi *et al*., 2017).

MATERIAL AND METHODS

The Groupe Phocéen d'Étude des Requins (GPER) is a French research NGO founded in 2015 in Marseille. Since its inception, GPER has rigorously updated and expanded the records of *C. carcharias* in French waters, drawing on both historical archives

and contemporary data. This article, which is part of this ongoing systematic research, exemplifies the strategic use of historical data to enhance current studies and increase knowledge and protection of the species in the Mediterranean.

The localities where the three great white shark specimens examined in this study were captured were plotted on a map, all geographically located in the Gulf of Lion (France, NW Mediterranean Sea, Fig. 1). Relevant information about the captures was obtained from a news report published on 4 September 1926, in the daily newspaper *L'Illustration* (for specimen No. 1), and from interviews with relatives of the fishers who captured the other two individuals (specimen No. 2 and No. 3).

Species identification follows Barone *et al.* (2022). The total length (TL) for specimen No. 1 is that reported in the newspaper (*L'Illustration*, 1926), the estimated TL of specimen No. 3 was provided by the local fisher who took the archival photo during the landing in 1954, while the estimate for specimen No. 2 is based on morphometric measurements of the examined jaws conducted by the GPER, following the methods of Shimada (2002, 2019).

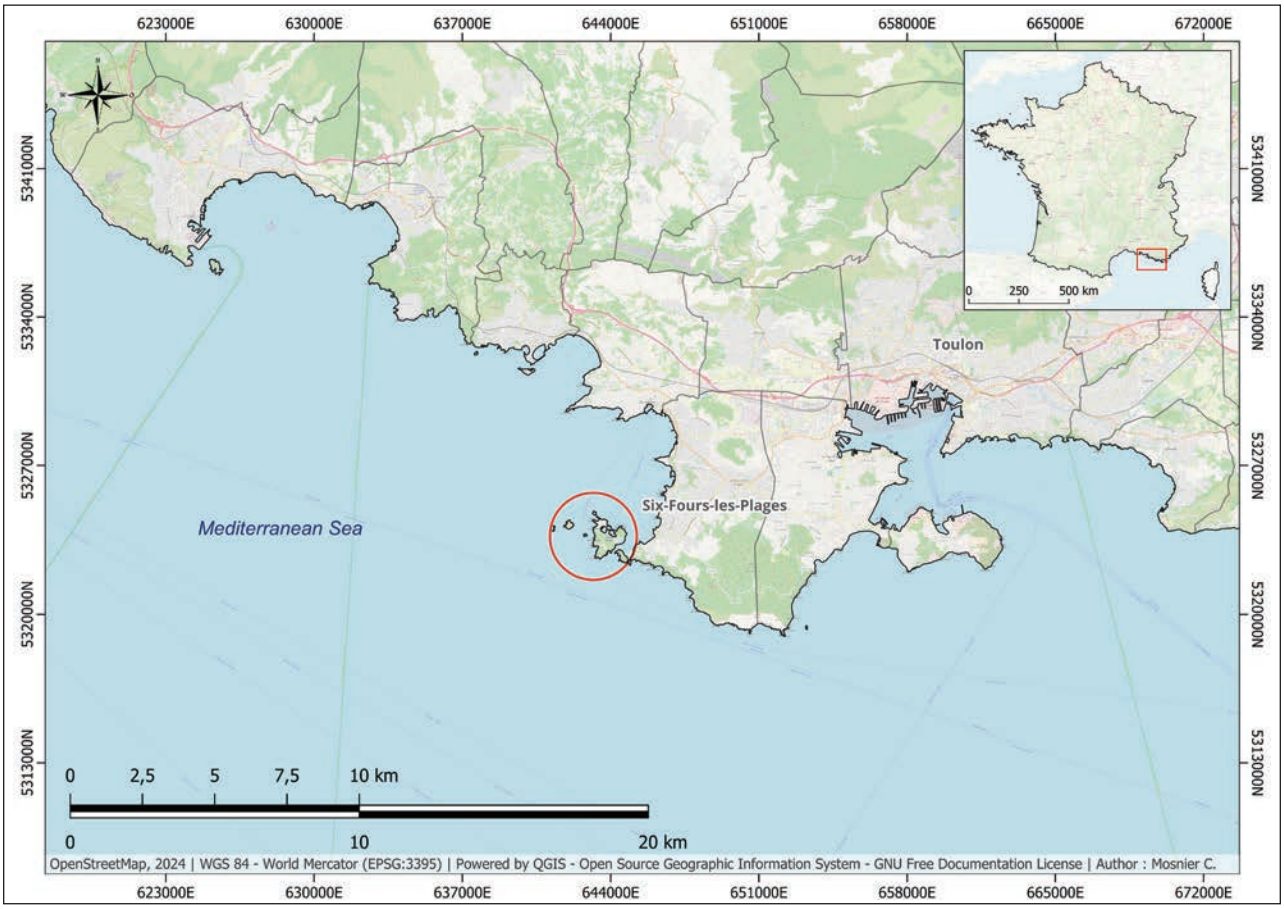

Fig. 1: The map in the upper panel shows the general location of the investigated area within the Gulf of Lion (northwestern Mediterranean). In the lower panel, the red frame indicates the approximate location where the three examined white shark specimens were caught in the Brusc Port area (Six-Fours-les-Plages, France). Since exact coordinates are unavailable, the capture locations of the three great white sharks cannot be indicated individually on the lower map. (OpenStreetMap, 2024; QGIS - Free and Open Source Geographic Information System, 2024).

Sl. 1: Zemljevid na zgornji plošči prikazuje lokacijo raziskanega območja znotraj Lionskega zaliva (severozahodno Sredozemsko morje). Na spodnji plošči rdeči okvir označuje približno lokacijo, kjer so bili ujeti trije pregledani primerki belega morskega volka na območju pristanišča Brusc (Six-Fours-les-Plages, Francija). Ker točne koordinate niso na voljo, lokacij ulova treh belih morskih volkov ni mogoče prikazati posamezno na spodnjem zemljevidu. (OpenStreetMap, 2024; QGIS – brezplačen in odprtokodni geografski informacijski sistem, 2024).

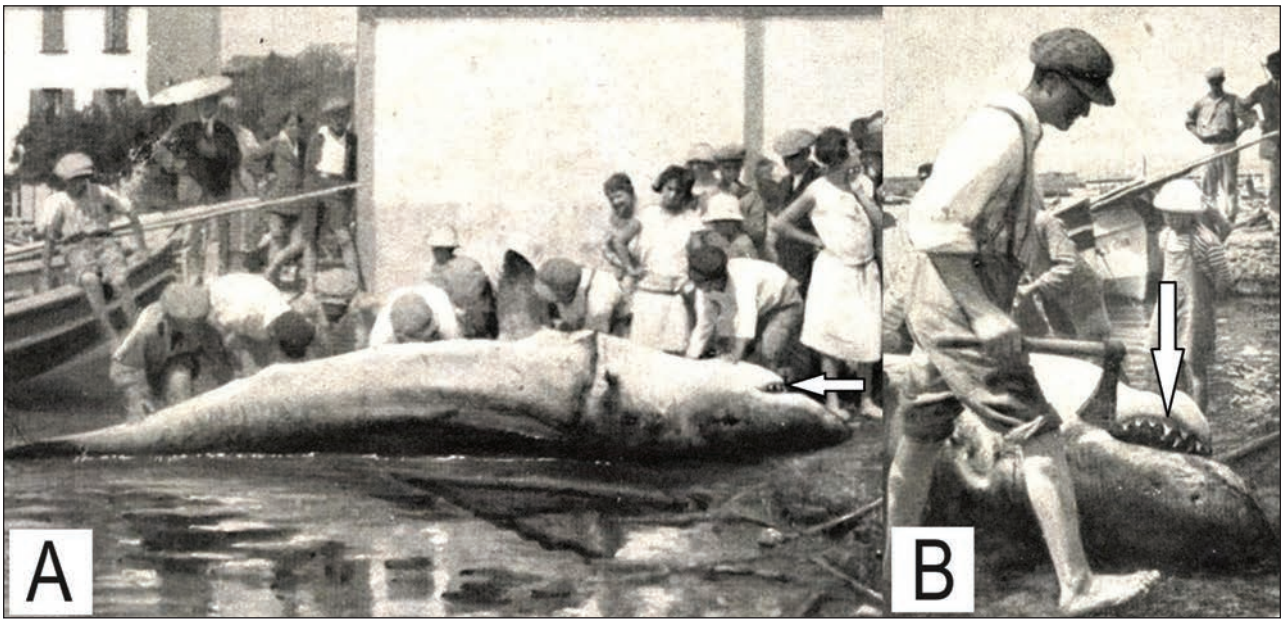

Fig. 2: (a) Lateral view and (b) head and buccal view of specimen No. 1. The arrows indicate the triangular teeth, the main identifying feature of *C. carcharias*. ***(Photo credit: L'Illustration, 1926).***
Sl. 2: (a) Pogled s strani in (b) pogled na glavo in ustno votlino primerka št. 1. Puščice označujejo trikotne zobe, ki je glavna prepoznavna značilnost vrste *C. carcharias*. ***(Avtor fotografije: L'Illustration, 1926).***

RESULTS

Specimen No. 1

According to the news article published in *L'Illustration* on 4 September 1926, a great white shark with a reported TL ≥ 450 cm was caught by a trammel-net fisherman from the small port of Le Brusc, near Toulon, on 31 July 1926 (Fig. 1). The main identifying feature of *C. carcharias* is its large, triangular tooth morphology (Barone *et al.*, 2022), and the dental characteristics of specimen No. 1 are consistent with this description of the species (Fig. 2). The article reports that "the fisherman 'drowned' the great white shark, but not before the animal had damaged the equipment" of the fishing fleet targeting it. When it was exhausted and trapped in the net, the fishermen were able to approach it by boat, and "one of them harpooned it." The great white shark was then brought to the beach, where it was eviscerated in front of a crowd of onlookers fascinated by this unexpected catch. The shark measured over 450 cm, with the liver alone measuring 200 cm. The second photograph shows the specimen's head with its mouth open, revealing the large triangular teeth of the jaws. The next day, the shark's flesh was sold at the Toulon market at three francs per pound under the name "white tuna," a common name used for *Thunnus alalunga* (Bonnaterre, 1788). Based on its reported TL, specimen No. 1 is identified as an adult, but its sex remains undetermined (Ebert et *al.*, 2021).

Specimen No. 2

In 1930, a specimen of *C. carcharias* was caught by an artisanal trammel-net fisherman, also from the fishing port of Le Brusc in the Gulf of Lion (Fig. 1). The jaws of specimen No. 2 were dissected by the fisherman, and today they are preserved and displayed in his grandson's café in Le Brusc (Fig. 3). Morphometric measurements of the teeth arranged in the functional rows of the upper and lower jaws are presented in Tables 1, 2, and 3. The dried upper jaw perimeter (DUJP) and dried lower jaw perimeter (DLJP) of the examined jaws are 98.6 cm and 87.2 cm, respectively (Tab. 2).

The TL of specimen No. 2 was estimated using Shimada's (2002, 2019) method, applying linear regression equations to the upper anterior teeth: TL = 11.788·CH + 2.143; r^2 = 0.983, and lower anterior teeth TL = 14.060·CH - 3.914; r^2 = 0.930. These equations are based on crown height (CH) measurements, labelled E2. The E2 values were taken from the left side of the jaw, as it was considered the most complete after excluding missing and damaged teeth.

The crown height measurements (E2) used for the estimation were taken from the largest and most robust teeth, identified as $E2_{Ua1}$ and $E2_{Ua2}$ for the upper anterior jaw, and $E2_{La1}$ and $E2_{La2}$ for the lower anterior jaw. The estimates based on the upper anterior teeth exhibited high consistency (R^2 = 0.983), with a TL estimated between 464.2 cm and 480.7

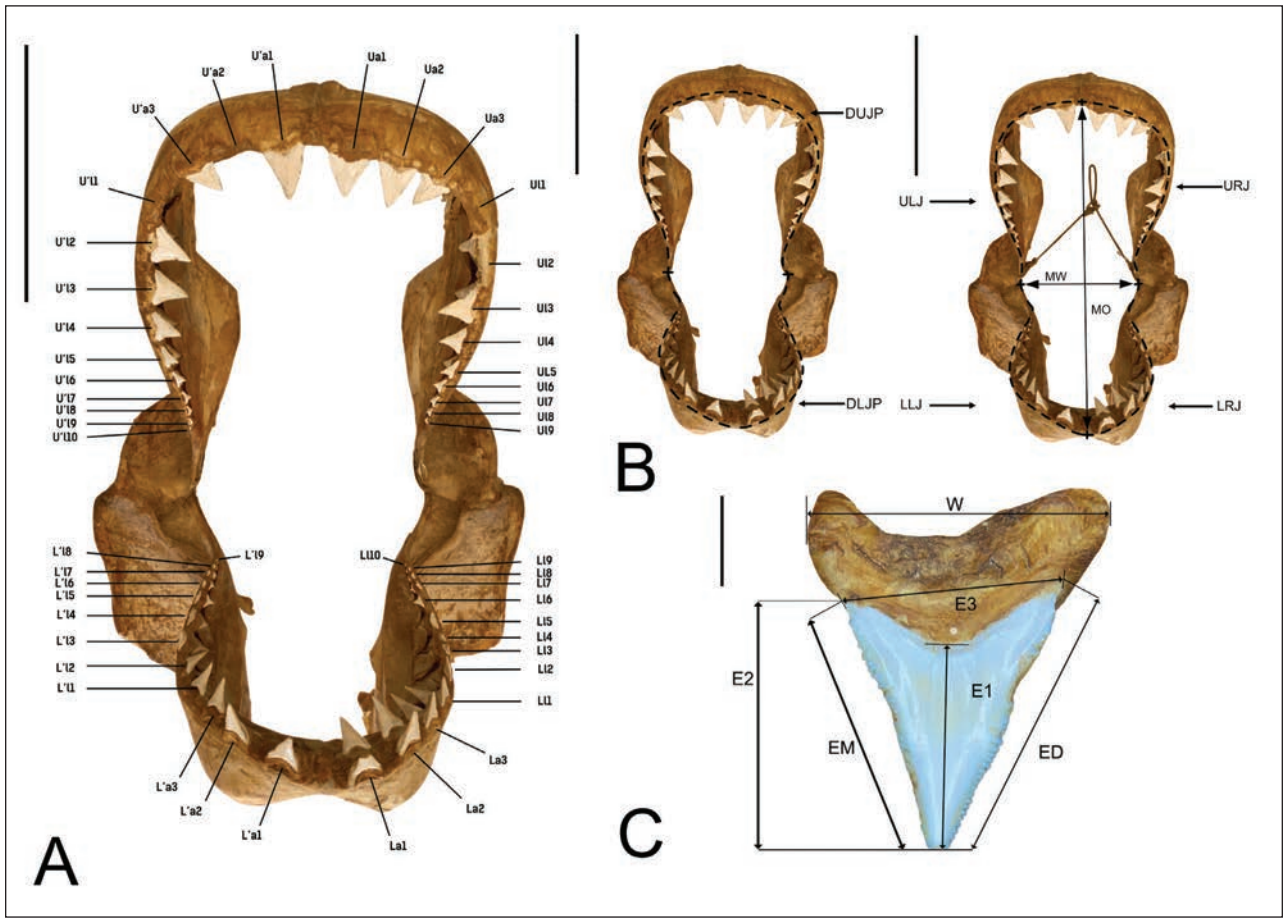

Fig. 3: (a) Upper and lower jaws of specimen No. 2 with teeth ID codes. Scale bar = 300 mm. (b) DUJP: Dried Upper Jaw Perimeter, DLJP: Dried Lower Jaw Perimeter, ULJ: Upper Left Jaw, LLJ: Lower Left Jaw, URJ: Upper Right Jaw, LRJ: Lower Right Jaw. Scale bars = 300 mm. (c) Detailed view of upper anterior tooth 1 (UA1). W: Tooth length including root, E1: Length from root tip to tooth tip, E2: Length from the line creating the root tip to the tip of the tooth, E3: Length of the visible part, EM: Length of the left side from the root tip, ED: Length of the right side from the root tip, RD: Tooth width. Scale bar = 10 mm. Measurements of upper and lower jaws: DUJP = 98.6 cm, MW = 26.8 cm, DLJP = 87.2 cm, MO = 69 cm, ULJ = 49.4 cm, URJ = 47.8 cm, LLJ = 42.4 cm, and LRJ = 44.0 cm. (Photo credit: GPER).
Sl. 3: (a) Zgornja in spodnja čeljust primerka št. 2 z ID kodami zob. Merilo = 300 mm. (b) DUJP: posušen obod zgornje čeljusti, DLJP: posušen obod spodnje čeljusti, ULJ: zgornja leva čeljust, LLJ: spodnja leva čeljust, URJ: zgornja desna čeljust, LRJ: spodnja desna čeljust. Merilo = 300 mm. (c) Podroben pogled na zgornji sprednji zob 1 (UA1). W: dolžina zoba vključno s korenino, E1: dolžina od konice korena do konice zoba, E2: dolžina od črte, ki tvori konico korena, do konice zoba, E3: dolžina vidnega dela, EM: dolžina leve strani od koreninske konice, ED: dolžina desne strani od koreninske konice, RD: širina zoba. Merilo = 10 mm. Mere zgornje in spodnje čeljusti: DUJP = 98,6 cm, MW = 26,8 cm, DLJP = 87,2 cm, MO = 69 cm, ULJ = 49,4 cm, URJ = 47,8 cm, LLJ = 42,4 cm in LRJ = 44,0 cm. (Avtorstvo fotografije: GPER).

cm. In contrast, estimates using the lower anterior teeth showed greater variability (R^2 = 0.930), with a TL estimated between 434.7 cm and 588.0 cm. Following Shimada's (2002, 2019) recommendations, it was advisable to use the upper anterior teeth for more precise estimates. The TL of specimen No. 2 is therefore more reliably estimated between 4.64 m and 4.80 m. Like specimen No. 1, specimen No. 2 is an adult individual of undetermined sex.

Specimen No. 3

In 1954, a great white shark with an estimated TL of 400 cm was caught in the same area, again using artisanal trammel nets. Several distinctive morphological features, including a massive body, large conical snout, relatively small eyes, long gill slits, a large first dorsal fin, and a wide caudal keel identified the shark as a *C. carcharias* individual

Tab. 1: Measurements (in cm) of teeth on the functional rows of jaws in specimen No. 2. The dental codes in the "Teeth ID" column are the same as those seen in Figure 4. *: missing tooth, **: broken tooth, ***: in small teeth, E1 = E2, EM and ED measurements not available, *: malformed teeth, ': broken tooth tip, NA: Not available, W: Tooth length including root, E1: Length from root tip to tooth tip, E2: Length from the line creating the root tip to the tip of the tooth, E3: Length of the visible part, EM: Length of left side from the root tip, ED: Length of the right side from the root tip, RD: Tooth width. Each measurement refers to Fig. 3.***

Tab. 1: Mere (v cm) zob na funkcionalnih vrstah čeljusti primerka št. 2. Kode zob v stolpcu »ID zob« so enake kot na sliki 4. *: manjka zob, **: zlomljen zob, ***: pri majhnih zobeh, E1 = E2, meritve EM in ED niso na voljo, *: nepravilno oblikovani zobje, ': zlomljena konica zoba, NA: ni na voljo, W: dolžina zoba vključno s koreninо, E1: dolžina od konice korena do konice zoba, E2: dolžina od črte, ki tvori konico korenine, do konice zoba, E3: dolžina vidnega dela, EM: dolžina leve strani od koreninske konice, ED: dolžina desne strani od koreninske konice, RD: širina zoba. Vsaka meritev se nanaša na sliko 3.***

Teeth ID	W	E1	E2	E3	EM	ED	RD	Teeth ID	W	E1	E2	E3	EM	ED	RD
Ua1	4.00	3.61	4.06	3.35	4.58	4.11	1.05	U'a1	4.00	3.56	3.56	3.28	4.01	4.56	1.16
Ua2	3.67	3.34	3,92	3.41	4.37	4.05	1.14	U'a2	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Ua3'	3.14	2.65	3.12	3.02	2.90	3.40	0.87	U'a3	3.22	2.65	2.81	3.13	3.52	3.28	0.94
Ul1	NA*	NA*	NA*	NA*	NA*	NA*	NA*	U'l1	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Ul2	NA*	NA*	NA*	NA*	NA*	NA*	NA*	U'l2	4.01	3.22	3.52	3.71	3.53	4.00	0.97
Ul3	3.88	2.91	3.26	3.59	3.91	3.40	0.86	U'l3	3.71	3.07	3.39	3.51	3.27	3.99	0.84
Ul4	3.16	2.22	2.33	3.00	2.95	2.45	0.91	U'l4	3.12	2.47	2.68	3.08	2.57	3.31	0.82
Ul5	2.39	1.52	1.69	2.21	2.18	1.64	0.72	U'l5	2.38	1.61	1.78	2.30	1.73	2.38	0.77
Ul6	1.87	0.98	1.18	1.73	1.48	1.20	0.53	U'l6	1.84	1.06	1.21	1.74	1.26	1.62	0.62
Ul7	1.39	0.60	0.81	1.31	1.06	0.79	0.58	U'l7	1.34	0.70	0.90	1.40	1.12	0.88	0.56
Ul8	1.09	0.50	NA***	1.00	0.73	0.67	0.54	U'l8	0.98	0.36	NA***	0.96	0.66	0.67	0.34
Ul9	0.80	0.30	NA***	0.77	0.46	0.50	0.40	U'l9	0.82	0.29	NA***	0.68	0.45	0.46	0.27
								U'l10	0.39	0.10	NA***	0.38	NA***	NA***	0.28
La1'	3.39	1.49	3.12	2.43	2.12	2.05	1.30	L'a1'	3.42	2.56	3.14	2.56	3.28	3.38	1.33
La2'	3.83	2.69	4.21	2.85	3.26	3.42	1.13	L'a2'	3.61	2.79	3.01	2.86	3.55	3.41	1.17
La3	3.29	2.42	4.11	2.53	3.01	3.00	0.77	L'a3	2.92	2.45	2.80	2.36	2.89	2.83	1.03
Ll1'	3.02	2.01	3.50	2.48	2.65	2.56	0.72	L'l1	3.14	2.43	2.54	2.46	3.05	2.87	0.96
Ll2'	2.80	2.11	2.40	2.21	2.57	2.54	0.88	L'l2	2.62	2.22	2.47	2.19	2.61	2.51	0.97
Ll3****'	1.13	1.05	NA	1.15	0.61	1.15	0.79	L'l3'	2.30	1.83	2.17	2.40	2.26	2.28	0.98
Ll4****	1.06	1.09	NA	0.92	0.89	0.55	0.84	L'l4	2.00	1.42	1.48	1.79	1.85	1.95	0.77
Ll5	1.90	NA**	NA**	1.72	NA**	NA**	0.69	L'l5	1.54	0.85	0.95	1.42	1.29	1.21	0.64
Ll6	1.53	0.93	1.04	1.41	1.1	1.13	0.49	L'l6	1.15	0.57	NA***	0.99	0.77	0.74	0.43
Ll7	1.09	0.51	NA***	1.02	0.55	0.64	0.43	L'l7	0.74	0.34	NA***	0.73	0.51	0.51	0.33
Ll8	0.72	0.45	NA***	0.78	0.48	0.52	0.32	L'l8	0.62	0.21	NA***	0.56	0.33	0.32	0.27
Ll9	0.52	0.24	NA***	0.47	0.37	0.32	0.23	L'l9	0.16	0.13	NA***	0.29	NA	NA	0.29
Ll10	NA	0.11	NA***	0.33	NA***	NA***	0.22								

Tab. 2: Measurements (in cm) of jaws of specimen No. 2. Each measurement refers to Fig. 3.
Tab. 2: Meritve (v cm) čeljusti primerka št. 2. Vsaka meritev se nanaša na sliko 3.

DUJP	98.6	**MW**	26.8
DLJP	87.2	**MO**	69.0
ULJ	49.4	**URJ**	47.8
LLJ	42.4	**LRJ**	44.0

Tab. 3: Glossary of measurements. Each measurement refers to Fig. 3.
Tab. 3: Slovar meritev. Vsaka meritev se nanaša na sliko 3.

W	Tooth length of tooth with root
E1	Tooth length from root tip to tooth tip
E2	Tooth length from the line creating the root tip to the tip of the tooth
E3	Tooth length according to the visible part
EM	Enamoile M.: length of left side of tooth from root tip
ED	Enamoile D.: length of right side of tooth from root tip
RD	Tooth width
DUJP	Diameter Upper Jaw Perimeter
DLJP	Diameter Lower Jaw Perimeter
ULJ	Upper Left Jaw
LLJ	Lower Left Jaw
URJ	Upper Right Jaw
LRJ	Lower Right Jaw

(Fig. 4). Additionally, the image of the captured animal clearly shows the irregular white marks on the anterior portion of the caudal fin's lower lobe, a typical trait of *C. carcharias* and one commonly used for photo-identification purposes (De Maddalena & Heim, 2012). The picture also reveals the presence of claspers, indicating that the shark was male. According to Ebert *et al.* (2021), males of *C. carcharias* attain sexual maturity between 310 and 410 cm. The size of the claspers, along with the reported total length of the shark, suggests that specimen No. 3 was sexually mature.

DISCUSSION AND CONCLUSIONS

Despite uncertainty about how accurately the current distribution of the species correlates with historical observations – given significant anthropogenic influences (Carpaye & Maurel, 2023) –, studies on the abundance and distribution of the great white shark in the Mediterranean indicate a decline of 60 to 90 percent in the population compared to the Middle Ages (Moro *et al.*, 2020; Soldo & Bakiu, 2024). From this perspective, the Gulf of Lion is one of the sub-regions in the Mediterranean where the decline of the species is most pronounced (Moro *et al.*, 2020).

While each discovery of historical material adds a new record to the great white shark's past, ongoing threats jeopardise the addition of young individuals to the population of this apex predator in the Mediterranean. Combining the results of all studies carried out to date (De Maddalena & Heim, 2012; Boldrocchi *et al.*, 2017; Moro *et al.*, 2020; Zaouali *et al.*, 2020; Jambura *et al.*, 2021; Kabasakal *et al.*, 2022; Soldo & Bakiu, 2024) with those of the present article, it is estimated that the total number of great white sharks recorded in the Mediterranean since the 1600s is 793. The Red List assessment of *C. carcharias* in the Mediterranean Sea, which is based on anecdotal records and limited fisheries data, suggests that the great white shark population has declined by at least 80 percent over 69 years, from 1947–2016 (Soldo *et al.*, 2016). As a result, the species is classified as critically endangered in the region, with the number of mature individuals estimated to be fewer than 250 (Soldo *et al.*, 2016). Today, hotspots (e.g., nursery grounds) for the species in the Mediterranean are attracting attention as potential research opportunities that could yield valuable insights (Jenrette *et al.*, 2023). However, the main priority in the Mediterranean remains reducing threats to species conservation (Jenrette *et al.*, 2023; Soldo & Bakiu, 2024). Although *C. carcharias* is still considered to have a continuous worldwide distribution, interchange between some regions appears to be quite limited (Gubili *et al.*, 2012; Rigby *et al.*, 2018). Protecting the genetically isolated Mediterranean population is crucial (Gubili *et al.*, 2012; Ebert *et al.*, 2021), as it has been decreasing since the Middle Ages (circa 1600) (Moro *et al.*, 2020; Soldo & Bakiu, 2024), with little to no contemporary immigration from the Atlantic suggesting that it is extraordinarily vulnerable (Gubili *et al.*, 2012; Ebert & Dando, 2020). If current trends continue, future Mediterranean societies may only recognise *C. carcharias* from materials displayed in museums or hidden in archives. Undocumented records from the Gulf of Lion are believed to be

Fig. 4: Lateral view of specimen No. 3. The white arrows, left to right: (↓) large conical snout, (←) relatively small eye, (↓) long gill slits, (→) large first dorsal fin, (←) wide caudal keel, (↓) irregular white marks on the anterior portion of the caudal fin's lower lobe, typical of *C. carcharias* ***(photo credit: GPER Archive).***
Sl. 4: Pogled s strani na primerek št. 3. Bele puščice, od leve proti desni: (↓) velik stožčast gobec, (←) razmeroma majhno oko, (↓) dolge škržne reže, (→) velika prva hrbtna plavut, (←) široka greben na repu, (↓) nepravilne bele lise na sprednjem delu spodnjega režnja repne plavuti, značilne za *C. carcharias* ***(fotografija: arhiv GPER).***

frequent, but this general observation may be biased by the common confusion of the species with another large lamnid shark, *Isurus oxyrinchus,* as seen in other parts of the Mediterranean (Soldo & Bakiu, 2024). The most significant sighting in the Gulf of Lion in decades was of a live adult individual on 12 September 2022 in the waters of the Parc Naturel Régional de Camargue (N. Ziani, *personal communication*).

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DODATNI ZGODOVINSKI ZAPISI O BELIH MORSKIH VOLKIH, *CARCHARODON CARCHARIAS*, UJETIH V ZALIVU LYON (SEVEROZAHODNO SREDOZEMSKO MORJE) V DVAJSETIH IN PETDESETIH LETIH

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POVZETEK

Obsežne arhivske preiskave so privedle do odkritja neobjavljenih zapisov o treh primerkih belega morskega volka, Carcharodon carcharias *(Linnaeus, 1758), ujetih v zalivu Lyon (SZ Sredozemsko morje, GSA07). Avtorji so preiskali gradivo kot so arhivske fotografije in časopisno poročilo (primerka št. 1 in 3) ter celoten komplet zgornje in spodnje čeljusti (primerek št. 2). Ti neobjavljeni zapisi se nanašajo na primerke, ki so jih ribiči iz pristanišča Brusc v Toulonu (Francija) ulovili pri ribolovu s trislojno mrežo 31. julija 1926, leta 1930 in 1954. Primerki so bili odrasli morski volkovi, ki so merili med 400 in 480 cm.*

Ključne besede: Lamnidae, *Carcharodon*, GSA07, čeljusti, ohranjanje

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CAPTURE OF A JUVENILE BASKING SHARK, *CETORHINUS MAXIMUS* (CETORHINIDAE), OFF THE SYRIAN COAST, WITH COMMENTS ON THE OCCURRENCE OF THE SPECIES IN THE LEVANT BASIN (EASTERN MEDITERRANEAN SEA)

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ABSTRACT

The authors report the capture of a young basking shark, Cetorhinus maximus*, in the Levant Basin, measuring 259 cm in total length and weighing 63 kg. According to the fisherman who captured it, the shark was part of a shoal of 40 other young specimens. Additionally, a brief report is presented listing several juvenile basking sharks among* C. maximus *captures in the Levant Basin, along with the capture of a large pregnant female years ago. This suggests that a viable population of the species may be established in the region. However, a management plan should be implemented to protect* C. maximus *and prevent the total disappearance of the species in the area.*

Key words: *Cetorhinus maximus*, shoal, population, distribution, Syrian coast, Levant Basin

CATTURA DI UN GIOVANE SQUALO ELEFANTE, *CETORHINUS MAXIMUS* (CETORHINIDAE), AL LARGO DELLA COSTA SIRIANA, CON OSSERVAZIONI SULLA PRESENZA DELLA SPECIE NEL BACINO DEL LEVANTE (MARE MEDITERRANEO ORIENTALE)

SINTESI

Gli autori riportano la cattura nel bacino del Levante di un giovane squalo elefante, Cetorhinus maximus*, con una lunghezza totale di 259 cm e un peso di 63 kg. Secondo il pescatore che lo ha catturato, lo squalo faceva parte di un banco di altri 40 esemplari giovani. Nell'articolo viene inoltre presentato un breve rapporto che elenca diversi giovani squali elefante tra le catture di* C. maximus *nel bacino del Levante, insieme alla cattura di una grande femmina gravida anni fa. Ciò suggerisce che una popolazione vitale della specie potrebbe essersi stabilita nella regione. Tuttavia, è necessario attuare un piano di gestione per proteggere* C. maximus *e prevenire la totale scomparsa della specie nell'area.*

Parole chiave: *Cetorhinus maximus*, banco, popolazione, distribuzione, costa siriana, bacino del Levante

INTRODUCTION

The basking shark, *Cetorhinus maximus* (Gunnerus, 1765), is a large, highly migratory species with worldwide distribution (Quéro, 1984). It is a massive coastal pelagic shark, generally found in boreal to warm-temperate waters and frequently sighted in the open sea. There have been instances of specimens entering enclosed bays and usually being captured, as well as others being found stranded on beaches (Compagno, 1984). Seasonal segregation appears to be characteristic of this species, which used to be the target of intensive fishery across the British Isles, Ireland, and in the southern coast of Britain (Chenard *et al*., 1951). The flesh was not highly valued for human consumption, but the large quantities of oil in the liver were used in cosmetics and pharmaceuticals, and the skin was made into leather (Chenard *et al*., 1951). Fishing pressure, together with the species' K-selected characteristics, contributed to a drastic decline of *C. maximus* in areas where it was previously abundant, leading to the cessation of some local fisheries (Compagno, 1984; Sims *et al*., 2003).

C. maximus is found in the Mediterranean Sea, where it has been more commonly recorded in the western basin (Mancusi *et al*., 2005) and in the Adriatic Sea (Soldo & Lipej, 2022). Lipej & Mavrič (2015) reported the capture of a juvenile basking shark measuring 217 cm in total length (TL) and weighing 40 kg in the northern Adriatic Sea, off Piran, and noted that the species, previously rare in this area, has been recorded with relative abundance since 1990, including 100 sightings or captures, with several specimens measuring less than 400 cm, or even less than 300 cm TL.

The species occurs southward along the Maghreb shore, from the Moroccan coast (Lloris & Rucabado, 1998), through Algeria (Mokrane, 2023) and Tunisia (Capapé *et al*., 2003) to the Libyan coast (Shakman *et al*., 2023). *C. maximus* is also reported from the marine waters around the Maltese Islands (Borg *et al*., 2023).

The basking shark was previously considered a rare species in the eastern Mediterranean. According to Ergüden *et al*. (2020), the first well-documented record of the species in this region came from the Gulf of Antalya, reported by Kideys (1997), while Kabasakal (2002) noted that the first sighting of the species in Turkish marine waters occurred during the 1950s. Kabasakal (2013) and Ergüden *et al*. (2020) both list the specimens recorded and sighted in the broader region, including the Levant Basin.

In this latter area, *C. maximus* appears to be caught only sporadically (Ben-Tuvia, 1971; Bariche & Fricke, 2020; Bitar & Badreddine, 2021). However, the capture of the young specimen described herein, along with that of a large pregnant female some years previously, offer an opportunity to comment on the true status of the species in the studied area, the Levant Basin and the eastern Mediterranean Sea.

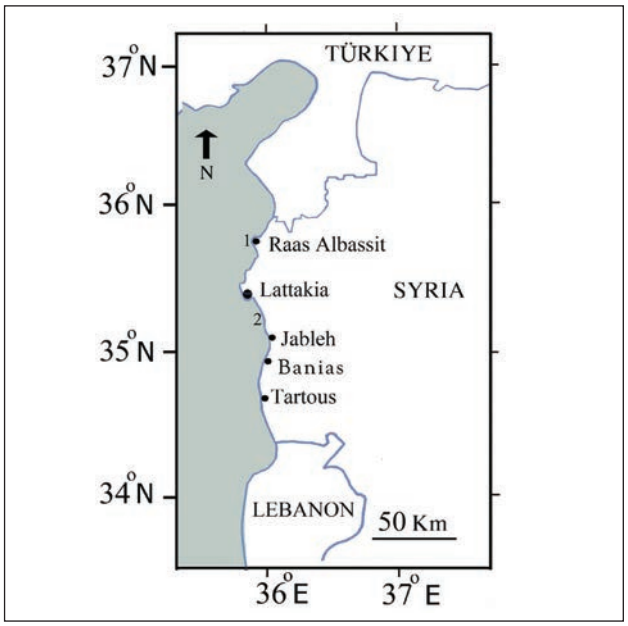

Fig. 1: Map of the Syrian coast with numbers indicating the capture sites of specimens of *Cetorhinus maximus****: 1. Ali et al. (2012); 2. this study.***
Sl. 1: Zemljevid sirske morske obale s številkami, ki označujejo lokalitete ulova primerkov vrste *Cetorhinus maximus****: 1. Ali in sod. (2012); 2. ta raziskava.***

MATERIAL AND METHODS

On 27 February 2024, a specimen of *C. maximus* was captured in Syrian marine waters (Fig. 1), using demersal fixed net, at a depth of 2 m, over a soft bottom, off the Al-Shkaifat site between Lattakia and Jableh city (35°24′50″ N; 35°53′45″ E). The fisherman reported that the specimen was part of a shoal of up to 40 young *C. maximus* of similar size.

Some morphometric measurements were taken and recorded to the nearest centimetre, with total body weight recorded to the nearest kilogram. These measurements are summarised in Table 1 and compared with similar features noted in a large female previously captured in the same area (Ali *et al*., 2012).

RESULTS AND DISCUSSION

C. maximus is considered the second largest fish in the world, following the whale shark, *Rhincodon typus* (Smith, 1828). Its maximum total length (TL) is noted to be between 12.2 and 15.2 m, although most specimens do not exceed 9.8 m (Compagno, 1984).

Large specimens display the following anatomic characteristics: trunk fusiform and stout; head long, but shorter than trunk; snout moderately long, pointed, and conical; eyes small; 5 extremely long gill slits extending onto dorsal and ventral surfaces of head, gill rakers present on internal

Tab. 1: The morphometric measurements in centimetres (cm) and as percentages of total length (%TL), along with the total body weight recorded for the current specimen of** C. maximus **captured off the Syrian coast, compared with those of a specimen captured in 2012 (Ali** et al.**, 2012).
Tab. 1: Morfometrične meritve v centimetrih (cm) in kot delež celotne dolžine (%TL) ter celokupna telesna teža za primerek morskega psa orjaka** C. maximus**, ujetega ob sirski obali, v primerjavi s primerkom, ujetim leta 2012 (Ali in sod., 2012).

References	**This study**		**Ali** *et al.* **(2012)**	
Morphometric measurements	cm	%TL	cm	%TL
Total length	259	100%	690	100%
Head length	78	30.1	128	18.6
Pre-branchial length	61	23.6	90	13.0
Pre-orbital length	27	10.4	32	4.6
Pre-first dorsal-fin length	120	46.3	244	35.4
Pre-second dorsal fin length	173	66.8	475	68.8
Pre-pectoral-fin length	58	22.4	-	-
Pre-pelvic-fin length	132	51.0	375	54.3
Pre-anal-fin length	191	73.7	485	70.3
Total weight (Kg)	63		2500	

gill slits; teeth minute and numerous; dermal denticles with extremely elongated crowns; caudal peduncle depressed, with strong lateral keels, caudal fin nearly asymmetrical, with a well-developed lower lobe.

The current specimen measured 259 cm TL and weighed 63 kg. It was a juvenile, displaying a rather elongated body (Fig. 2) and a large, pointed snout, compressed at the sides and slightly curved at the distal end (Fig. 3).

Kabasakal (2013) and Ergüden *et al.* (2020) provide two lists of *C. maximus* captures and/or sightings, one for the eastern Mediterranean in general and another focusing on the Levant Basin. They include male and female specimens of large sizes, as well as some juvenile individuals. Prior to the current specimen measuring 259 cm TL, young *C. maximus* were reported by Ben-Tuvia (1971) at 259 cm and 261 cm TL, Kabasakal (2013) at 236 cm and 300 cm TL, and Ergüden *et al.* (2020) at 275 cm TL. *C. maximus* appears to be rare, yet still present in the area (Kabasakal, 2013). However, Kabasakal (2013) also noted that the occurrence of young specimens does not indicate the presence of a nursery ground in the region but is likely a result of zooplankton abundance, as suggested by Sims *et al.* (1997) and Soldo *et al.* (2018).

Carpaye-Taïlamée (2019) noted that sightings of *C. maximus* were generally not abundant in the Gulf of Lion on the southern coast of France. However, observations

Fig. 2: A juvenile** C. maximus **captured off the Syrian coast, near the Al-Shkaifat site between Lattakia and Jableh city. Scale bar = 15 cm.
Sl. 2: Mladostni primerek vrste** C. maximus **ujet ob sirski obali blizu lokalitete Al-Shkaifat med Lattakio in Jableh city. Merilo = 15 cm.

Fig. 3: Head of the young specimen of** C. maximus **showing: 1. Curve at the distal end of the snout; 2. Snout; 3. Internal branchial arches. Scale bar = 10 cm.
Sl. 3: Glava mladega primerka vrste** C. maximus**, ki kaže: 1. ukrivljen distalni del gobca; 2. gobec; 3. notranji škržni loki. Merilo = 10 cm.

carried out over a brief period indicated that the species' occurrence in the area may be correlated with higher phytoplanktonic development. As phytoplankton (*sensu lato*) is consumed by zooplankton species, contributing to their reproduction and development – the relationship between phytoplankton and zooplankton has been well-documented in some regions of the eastern tropical Atlantic (Le Borgne, 1979) –, the increased phytoplanktonic development in the Gulf of Lion could explain the presence of *C. maximus* in the area.

The capture of the current specimen, the concomitant sighting of 40 young individuals, and the earlier capture of a pregnant female (Ali *et al.*, 2012) clearly suggest that a viable population exists in the area, which may also serve as a nursery ground for the species. This phenomenon is likely due to the abundance of several zooplanktonic species in the marine waters of the Levant Basin, but also in other areas of the eastern Mediterranean Sea according to Insibilir *et al*. (2022).

The abundance of zooplankton contributes to maintaining the occurrence of *C. maximus* in the Levant Basin, the broader eastern Mediterranean, and the Mediterranean Sea as a whole. Due to the species' K-selected biological characteristics (cf. Mellinger, 1989), and in total agreement with Ergüden *et al.* (2020), a management plan should be implemented in Syrian and other Mediterranean fisheries to protect *C. maximus* and prevent the decline and disappearance of the species.

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ULOV MLADOSTNEGA PRIMERKA MORSKEGA PSA ORJAKA, *CETORHINUS MAXIMUS* (CETORHINIDAE), OB SIRSKI OBALI S KOMENTARJI O POJAVLJANJU VRSTE V LEVANTSKEM BAZENU (VZHDONO SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o ulovu mladostnega morskega psa orjaka, Cetorhinus maximus*, v levantskem bazenu, ki je meril 259 cm v dolžino in tehtal 63 kg. Po navedbah ribiča, ki ga je ujel, naj bi bil primerek del jate 40 mladih morskih psov orjakov. Nadalje avtorji navajajo primere številnih ulovov mladostnih primerkov vrste* C. maximus *v seznamu ulovov v Levantskem bazenu skupaj z ulovom velike breje samice izpred nekaj let. To kaže na dejstvo, da se lahko na raziskovanem območju vzpostavi viabilna populacija te vrste. S tem v zvezi je potrebno pripraviti načrt upravljanja z namenom varovanja vrste* C. maximus *in preprečiti njeno izginotje na obravnavanem območju.*

Ključe besede: *Cetorhinus maximus*, jata, populacija, razširjenost, sirska obala, levantski bazen

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IMPACT OF FISHING CAPACITY AND ENVIRONMENTAL PARAMETERS ON LANDINGS OF *HEXANCHUS GRISEUS* IN THE SEA OF MARMARA

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ABSTRACT

Between July 1967 and December 2023, 136 bluntnose sixgill sharks, Hexanchus griseus*, were caught in the Sea of Marmara (SoM). Although both a generalised linear model (GLM) and the Mann-Kendall trend test indicated an increasing trend in annual landings of* H. griseus*, the estimated smoothing splines of the GLM regression trend line revealed a sharp decline in landings after 2017. While the capture depths ranged from 10 to 1,000 m since the early 2000s, the majority of specimens were caught in the shallow waters of the continental shelf. Deteriorating environmental conditions and increasing deoxygenation in the deep waters of the SoM coincide with a reduction in the capture depth of bluntnose sixgill sharks over the continental shelf. The evidence suggests an ongoing process of vertical habitat compression, which appears to be increasing the vulnerability of* H. griseus *to commercial fisheries in the SoM.*

Key words: Sixgill shark, overfishing, vulnerability, pollution, oxygen, decline

IMPATTO DELLA CAPACITÀ DI PESCA E DEI PARAMETRI AMBIENTALI SUGLI SBARCHI DI *HEXANCHUS GRISEUS* NEL MAR DI MARMARA

SINTESI

Tra il luglio 1967 e il dicembre 2023, nel Mar di Marmara sono stati catturati 136 squali capopiatto, Hexanchus griseus*. Sebbene sia il modello lineare generalizzato (GLM) che il test di tendenza di Mann-Kendall abbiano indicato una tendenza all'aumento degli sbarchi annuali di* H. griseus*, le spline di attenuazione stimate della linea di tendenza della regressione GLM hanno rivelato un forte calo degli sbarchi dopo il 2017. Mentre la profondità di cattura variava da 10 a 1.000 m dai primi anni 2000, la maggior parte degli esemplari è stata catturata nelle acque poco profonde della piattaforma continentale. Il peggioramento delle condizioni ambientali e l'aumento della deossigenazione nelle acque profonde nel Mar di Marmara coincidono con la riduzione della profondità di cattura degli squali capopiatto sulla piattaforma continentale. I dati suggeriscono un processo di compressione verticale dell'habitat in corso, che sembra aumentare la vulnerabilità di* H. griseus *alla pesca commerciale nel Mar di Marmara.*

Parole chiave: squalo capopiatto, pesca eccessiva, vulnerabilità, inquinamento, ossigeno, declino

INTRODUCTION

From a conservation perspective, well-managed shark fisheries require robust scientific research into various aspects of shark life history and population status to protect them from overexploitation (Shiffman & Hammerschlag, 2016). However, due to the scarcity of long-term systematic data on the distribution and abundance of many shark species (McPherson & Myers, 2009), fishery-dependent data collection or opportunistically collected data, such as anecdotal reports of incidental landings or catches, often constitute the only source of information on large predatory sharks (Morgan & Burgess, 2005). The value of "opportunistic records", i.e., observations not directly derived from scientific field surveys aimed at quantifying fish abundance (Hiddink *et al*., 2023), has been confirmed in several studies (Bengil, 2020; Bargnesi *et al*., 2020, 2022; Kabasakal & Bilecenoğlu, 2020; Kabasakal, 2023a) highlighting the effectiveness of opportunistic methods, such as citizen science, social media, etc., in providing additional or complementary data on elasmobranchs.

The bluntnose sixgill shark, *Hexanchus griseus* (Bonnaterre, 1788) (Hexanchiformes: Hexanchidae), is a large predatory shark species with a confirmed maximum total length (TL) of 570 cm (Lipej *et al*., 2022) and an estimated trophic level of 4.3 (Ferretti *et al*., 2008). With a patchy circumglobal distribution, *H. griseus* is one of the most well-known large demersal predators inhabiting continental shelves and slopes down to depths of 2,500 m, though it typically prefers depths between 200 and 1,100 m (Ebert *et al*., 2021). The bluntnose sixgill shark is found throughout the Mediterranean (Serena *et al*., 2020; Barone *et al*., 2022), with its range extending to the Sea of Marmara (SoM) and the Black Sea, where records are extremely scarce (Kabasakal, 2023b). Unlike several large Mediterranean shark species whose populations are estimated to have declined by over 90% from their former abundance (Ferretti *et al*., 2008), *H. griseus* is estimated to have 'only' declined by 20–29% across its global range (Finucci *et al*., 2020). A recent assessment of the status of *H. griseus* in the Mediterranean has emphasised the importance of collecting region-specific data on its abundance to obtain reliable estimates of population trends throughout the region (Nuez *et al*., 2023). Although the distribution and status of *H. griseus* in Turkish waters have been evaluated in previous studies (Kabasakal *et al*., 2017; Kabasakal & Bilecenoğlu, 2020; Kabasakal, 2023b), the impact of fishing capacity and environmental degradation on bluntnose sixgill shark landings remains unexplored. Aiming to correct that shortfall, in this study we analyse the temporal trends of *H. griseus* landings in the SoM. Additionally, we examine the effects of fishing capacity and environmental parameters on landings of incidentally caught bluntnose sixgill sharks.

MATERIAL AND METHODS

Study area

In the General Fisheries Council of the Mediterranean (GFCM) Geographical Subarea (GSA) classification, the SoM is designated as GSA 28 (Fig. 1) (Carpentieri *et al*., 2021). Identified as the easternmost extension of the Mediterranean ecosystem (Stanley & Blanpied, 1980), the SoM is a small basin located between Europe and Asia, covering a surface area of 11,500 km^2 and reaching a maximum depth of 1,390 m (Beşiktepe *et al*., 1994). Due to anthropogenic impacts, primarily from the disposal of urban and industrial waste and nutrient runoff from surrounding agricultural fields, dissolved oxygen levels have fallen below the hypoxic threshold (80 µmol/L) in shelf waters deeper than 25 m, while anoxic conditions with low levels of hydrogen sulphide formation prevail at depths below 500 m (Yücel *et al*., 2023). Despite being one of the most disturbed marine ecosystems in the Mediterranean today (Saygu *et al*., 2023), the SoM has historically been considered one of Turkey's most productive fishing grounds (Yıldız & Karakulak, 2016).

Bluntnose sixgill shark landing data sources

Opportunistic records of *H. griseus* landings include newspaper articles and social media posts reporting the capture and/or display of bluntnose sixgill shark in the SoM. Prior to 2006, reports of *H. griseus* comprised articles published in printed newspapers and/or angling magazines, peer-reviewed articles, and fishermen's logs. Records for the period from 2006 to 2023 are limited to internet media articles and social media posts. Opportunistic records can be problematic due to inconsistent time series and unclear observation effort (Swetnam *et al*., 1999); however, they can still serve as valuable data sources for indicating local population status (Grant *et al*., 2022).

A 'record' refers to an individual bluntnose sixgill shark encountered on a specific date, whereas a 'report' denotes a single bluntnose sixgill shark encounter event; therefore, a report may include several bluntnose sixgill shark records (Hiddink *et al*., 2023). Following the recommended procedure (Hiddink *et al*., 2023), our search for opportunistic records involved examining all pages of daily newspapers from Turkish mainstream media, currently archived at the Atatürk Library in Istanbul,

for reports of bluntnose sixgill shark encounters from July 1967 to June 2005. We also conducted data mining on the Internet to extract web articles and social media posts related to the bluntnose sixgill shark. To streamline the search and filter relevant information (Kim *et al*., 2016), we used the following hashtags in Turkish: "*köpekbalıkları (sharks)*, *yakalandı (captured)*, *bozcamgöz (bluntnose sixgill shark)*, *canavar (sea monster)*, *Marmara Denizi (SoM)*". To avoid repetition or duplication of records and to confirm their provenance, we contacted the original post or article owner for each occurrence and obtained a photograph of each landed bluntnose sixgill shark (Kabasakal, 2023a). As online communities and website administrators may respond negatively to the use of their content by researchers, all Internet content scraping activities were conducted responsibly following the proposed code of ethics (Monkman *et al*., 2017) to avoid compromising personal data or images. Where possible, the following information was collected either by contacting the owner of the post or article, or extracted from the media report: number of individuals, total length (TL, cm), total weight (TW, kg), depth of capture (echo-sounder screen image), and location of capture.

Fishing capacity and environmental parameter data sources

According to Saygu *et al*. (2023), the fisheries of the SoM are mainly coastal for demersal species, using beam trawling, while the rest of the fishery is pelagic, employing gill- and trammel-netting, as well as purse-seining. Bottom (or otter) trawling is strictly prohibited. The total fishing capacity (TFC) of the commercial fishing fleets operating in the SoM is recorded annually either by vessel length or by gross registered tonnes (GRT) of the fishing vessels, without distinguishing the type of fishing gear used (TURKSTAT, 2023). The types of fishing vessels include gill- and trammel-netters,

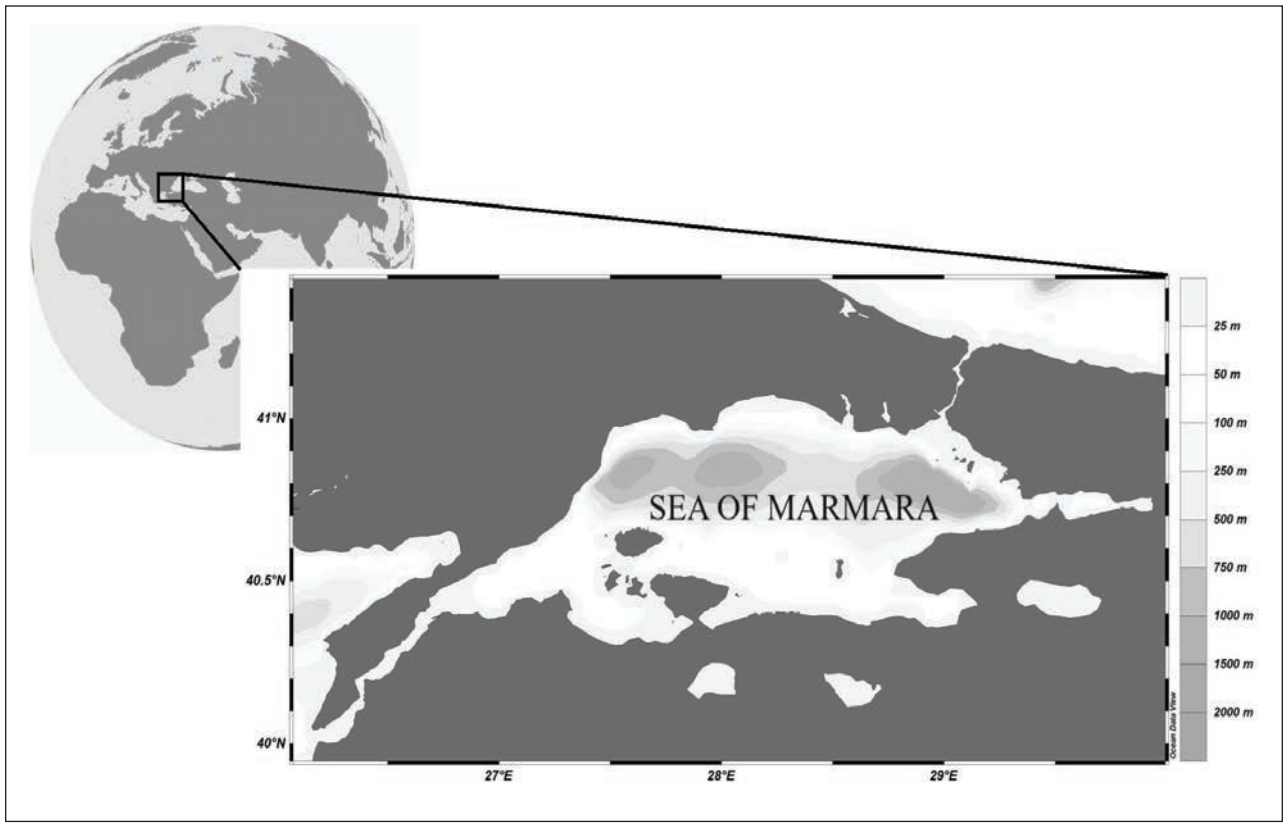

Fig. 1: Map showing the geographical position of the SoM in the Mediterranean ecosystem. Bathyal depressions, where seafloor depth exceeds 1,000 m and anoxic conditions are imminent, are shown as the darkest grey areas in the north of the SoM basin.
Sl. 1: Zemljevid prikazuje geografski položaj Marmarskega morja v sredozemskem ekosistemu. Batialne depresije, kjer globina morskega dna presega 1000 m in v katerih so anoksične razmere neizbežne, so prikazane kot najtemnejša siva območja na severu Marmarskega morja.

purse-seiners, and beam-trawlers, and range from 4 to over 500+ gross tonnes (TURKSTAT, 2023). In the absence of long-term records of *H. griseus*-specific fishing efforts in the SoM, the TFC of the fishing fleet registered to operate in the SoM (TURKSTAT, 2023), expressed in GRT, was used as a proxy for fishing pressure in the analyses. The use of TFC as a proxy for fishing pressure in the absence of long-term records of fishing effort by gear type has been reported in the literature (Barausse *et al.*, 2014). Landings were analysed in relation to several environmental parameters. Annual loads of phosphates (P, micromoles per litre), and nitrates and nitrites (N, micromoles per litre) were included to represent the effects of past anthropogenic nutrient enrichment and current oligotrophication of the basin (Yücel *et al.*, 2023). Relevant data were extracted from the Marmara Sea Integrated Strategic Plan (Marmara Denizi Bütünleşik Stratejik Planı 2021-2024).

Data analyses

All data are presented as log-transformed values. Parametric or non-parametric tests were used depending on data distribution as determined by the Shapiro-Wilk normality test (Legendre & Legendre, 1998). Since the p-values resulting from the normality tests were less than 0.05, the non-parametric Mann-Whitney test was used to identify any statistically significant differences between landings and fishing capacities for the periods up to 2006 and from 2006 to 2023 (Parab & Bhalerao, 2010). The Mann-Kendall time series trend test was used to detect annual trends in the landings data (Gilbert, 1987).

A generalised linear model (GLM) with a Poisson distribution and associated bootstrapped 95% confidence intervals was used to detect trends between fishing capacity per year and bluntnose

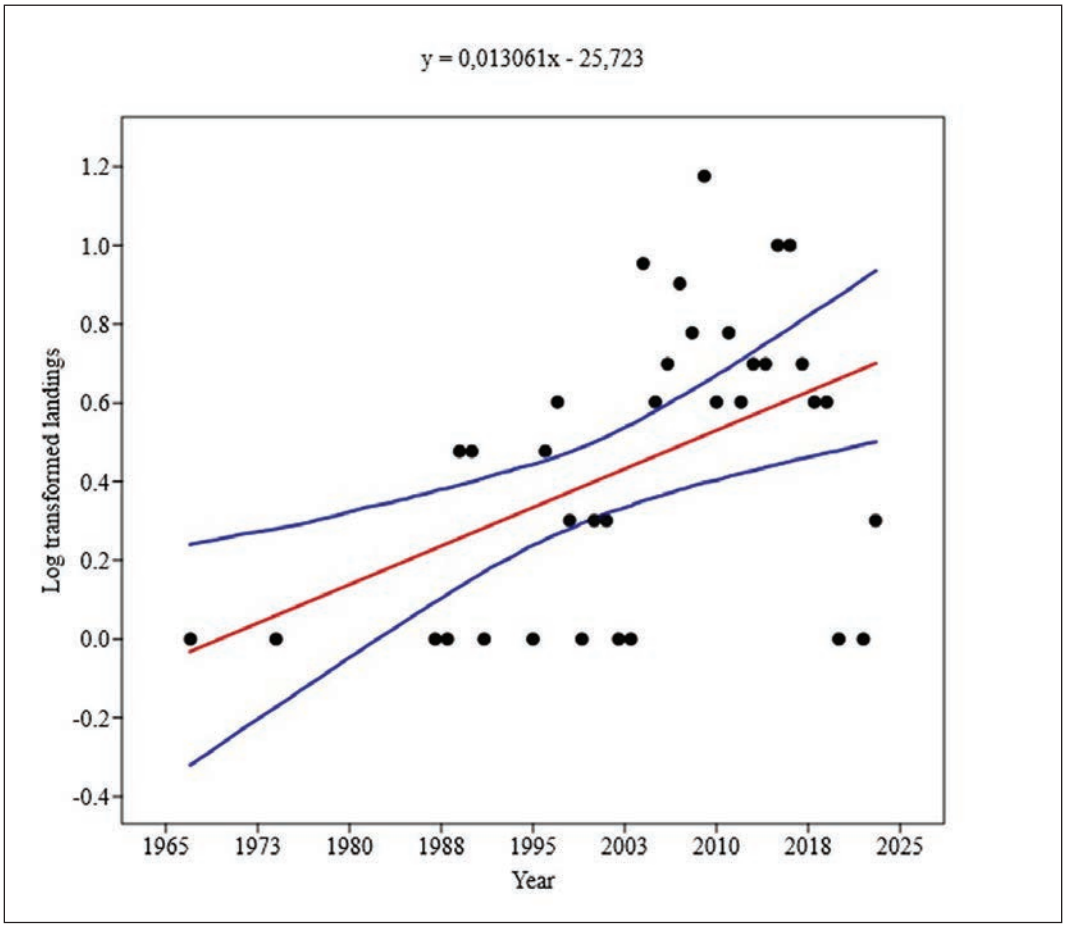

Fig. 2: Annual trends of** H. griseus **landings in the SoM between 1967 and 2023, based on GLM Poisson regression. Blue lines indicate the 95% confidence interval.
Sl. 2: Letni trendi ulova vrste** H. griseus **v Marmarskem morju med letoma 1967 in 2023 na podlagi Poissonove regresije GLM. Modre črte označujejo 95-odstotni interval zaupanja.

sixgill shark landings, TL of specimens landed per year, and the number of specimens landed per year (Coelho *et al.*, 2013). Each GLM analysis was conducted separately. As the data sets produced noisy curves, smooth curves were created for modelling using the algorithm proposed in the literature (de Boor, 2001). Differences in bluntnose sixgill shark landings by data source and depth of capture were tested using the Mann-Whitney test to determine whether the temporal differences were statistically significant. Correlations between annual bluntnose sixgill shark landings in the periods before 2006 and from 2006 to 2023, fishing capacity, and environmental parameters were assessed using Spearman's rank correlation coefficient (Barausse *et al.*, 2014). Models were fitted using Akaike's Information Criterion (AIC). For the examined individuals where the type of the fishing gear and depth of capture were recorded, the Mann-Whitney test was used to detect any statistically significant differences between gear type and depth of capture (≤200 m vs. >200 m). All analyses were performed using the statistical software PAST, version 4.03 (Hammer *et al.*, 2001), and a p-value of 0.05 was defined as statistical significance (Parab & Bhalerao, 2010).

RESULTS

Bluntnose sixgill shark landings vs. year

Between July 1967 and December 2023, a total of 136 specimens of *H. griseus* were landed in several fishing ports around the SoM, after being caught incidentally in commercial fisheries operating in the region. GLM regression and Mann-Kendall trend analyses showed an increasing trend in the number of bluntnose sixgill sharks landed with respect to the year of capture (Poisson regression AIC=7.88; Mann-Kendall trend analyses, Z=2.68, S=186, $p<0.05$, p=0.007; Fig. 2). The highest number of *H. griseus* landings in the SoM occurred in 2009 (n=15), followed by a decrease between 2010 and 2014 (n_{max}=6, in 2011). An increase was noted in 2015 and 2016 (n=10, for both years), but from 2017 onwards, the annual landings of bluntnose sixgill sharks declined dramatically.

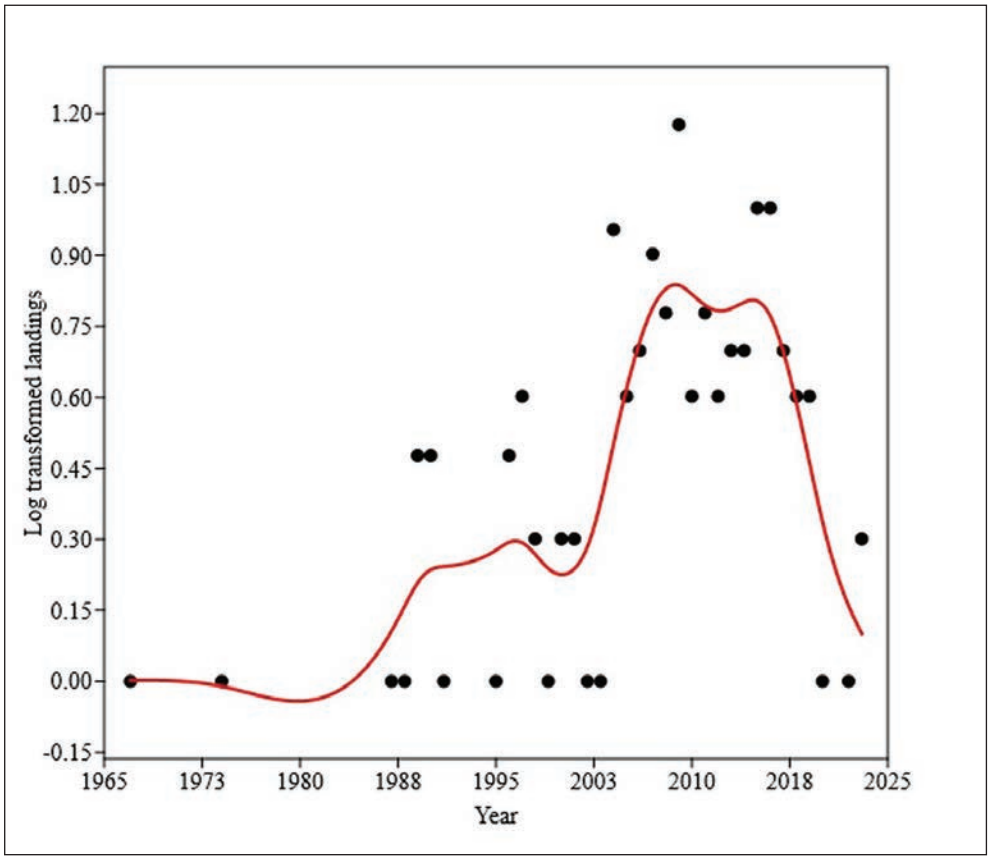

Fig. 3: Estimated smoothing spline of the GLM plot of** H. griseus **landings from 1967 to 2023.
Sl. 3: Ocenjeni izravnalni zlepek grafa GLM, ki prikazuje ulov vrste** H. griseus **od leta 1967 do 2023.

A clear increase in landings of *H. griseus* can be seen between the 1980s and mid-2010s; however, applying a smoothing spline to the noisy data of annual bluntnose sixgill shark landings revealed an instance of steep decline (Fig. 3). While the GLM and Mann-Kendall trend analysis failed to detect the dramatic decrease in annual landings of *H. griseus* from 2017 onwards, this became apparent after the application of the smoothing spline (Fig. 3).

Bluntnose sixgill shark landings vs. fishing capacity

Despite fluctuations, the registered annual fishing capacity (GRT) in the SoM has increased from 1,099 GRT (1975) to 1,877 GRT (2023) (Fig. 4 and 5). In contrast to the increase in annual fishing capacity since 1975, GLM regression showed a remarkable decreasing trend in landings of bluntnose sixgill sharks (AIC=8.27) (Fig. 4 and 5). Landings of bluntnose sixgill sharks in the SoM did not correlate with fishing capacity (Spearman's r=-0.221, p>0.05; Fig. 7).

Bluntnose sixgill shark landings vs. data sources

Considering the nature of the data sources used in this study, all sources prior to 2006 consist of non-digital records of *H. griseus* landings (n=41) reported in peer-reviewed articles, printed newspapers and/or fishing magazines, or fishermen's logs. In contrast, records of bluntnose sixgill shark landings from 2006 onwards (n=95) are derived exclusively from digital sources such as Internet media articles and social media posts. A statistically significant difference was found between the number of landing records in the two periods (Mann-Whitney test, p<0.05, p=0.0006). Thus, the likelihood of finding information about bluntnose sixgill shark landings through Internet and social

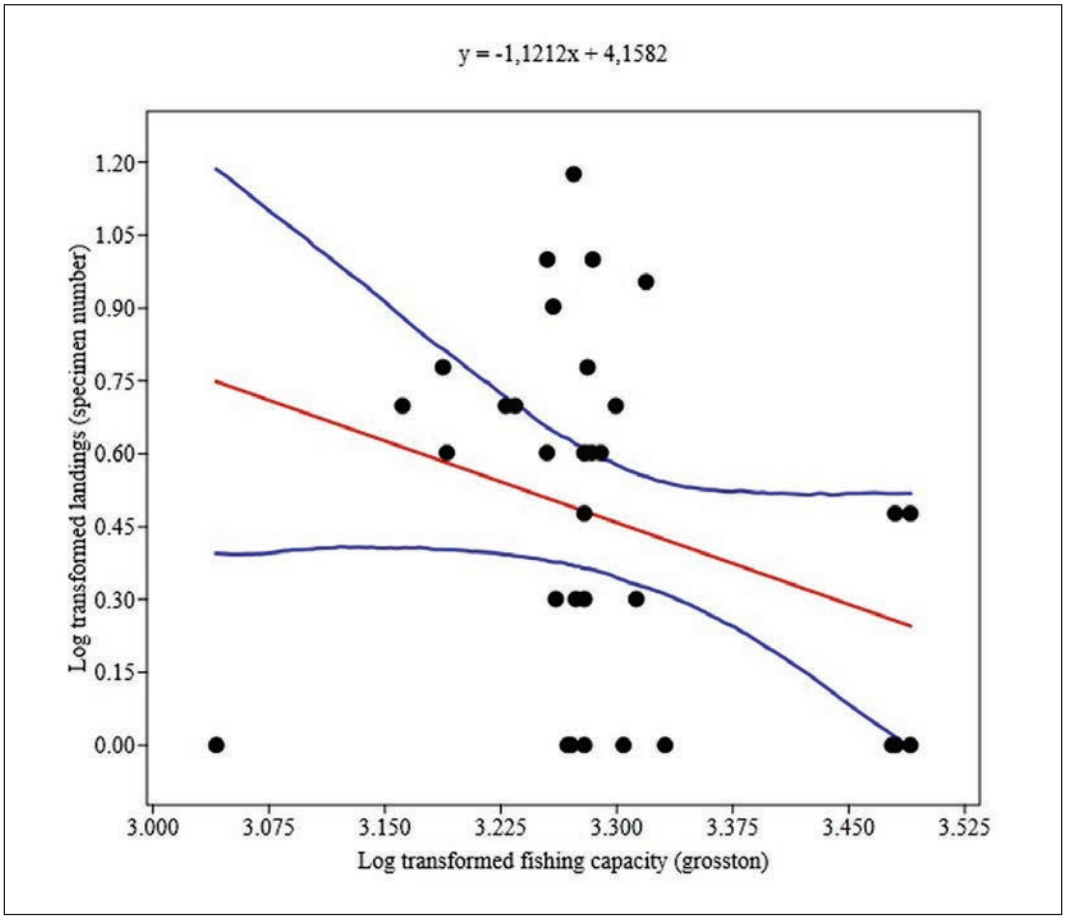

Fig. 4: Landings of** H. griseus **in relation to registered fishing capacity in the SoM. The blue lines indicate the 95% confidence interval.
Sl. 4: Ulov vrste** H. griseus **glede na registrirano ribolovno zmogljivost v Marmarskem morju. Modre črte označujejo 95-odstotni interval zaupanja.

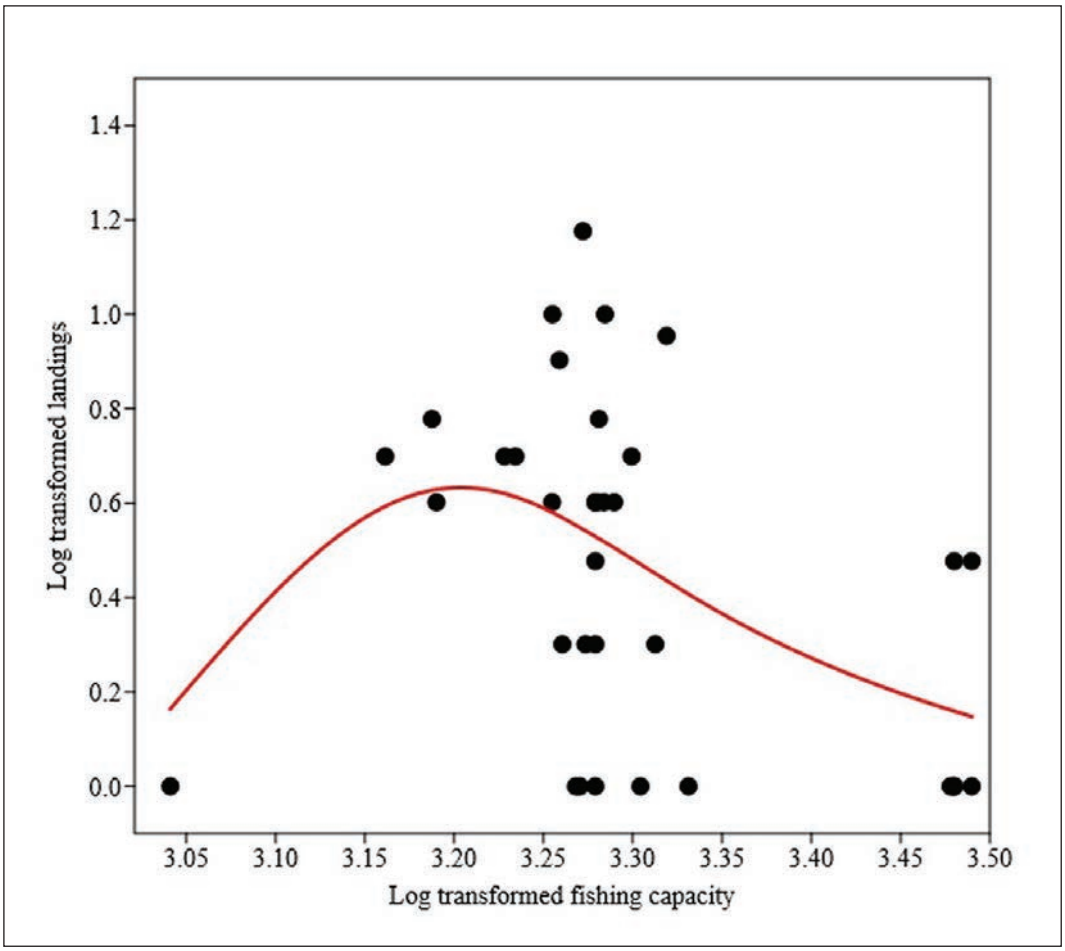

Fig. 5: Estimated smoothing spline of the GLM plot of** H. griseus **landings versus registered fishing capacity in the SoM.
Sl. 5: Ocenjeni izravnalni zlepek grafa GLM, ki prikazuje ulov vrste** H. griseus **v primerjavi z registrirano ribolovno zmogljivostjo v Marmarskem morju.

media posts has significantly increased since 2006 compared to the period from 1967 to 2005.

Bluntnose sixgill shark landings vs. environmental parameters

Incidental catches of *H. griseus* in the continental shelf zones of the SoM indicated a positive correlation with increases in annual loads of dissolved phosphate (PO_4, micromoles per litre) and dissolved nitrogen (NO_3+NO_2, micromoles per litre), but a negative correlation with dissolved oxygen (DO, mg per litre) at bathyal depths (Spearman's r=-0. 11 for DO; $p>0.05$; r=0.271 for PO_4, $p>0.05$; and r=0.345 for NO_3+NO_2, $p<0.05$; Fig. 6). Based on the correlations between captures of *H. griseus* and environmental parameters, it is suggested that the recent increase in catches in continental shelf waters is primarily associated with the annual rise in dissolved organic compounds in bathyal waters, rather than the decline in dissolved oxygen. However, only the annual increase in nitrogen loads showed a statistically significant correlation with catches and landings (Spearman's r=0.345, $p<0.05$; Fig. 6).

Bluntnose sixgill shark landings vs. depth of capture

Depths of capture were recorded for 69 specimens (50.73%) of *H. griseus*, ranging from 10 to 1,000 m. Fourteen (20.28%) of the 69 specimens were caught at depths spanning the upper continental slope to the deep bathyal zone, while the remaining 55 (79.71%) were caught in continental shelf waters. While most captures from 1967 to 1991 occurred in the deep parts of the continental shelf and upper slope waters (n=9; 13.04%), 46

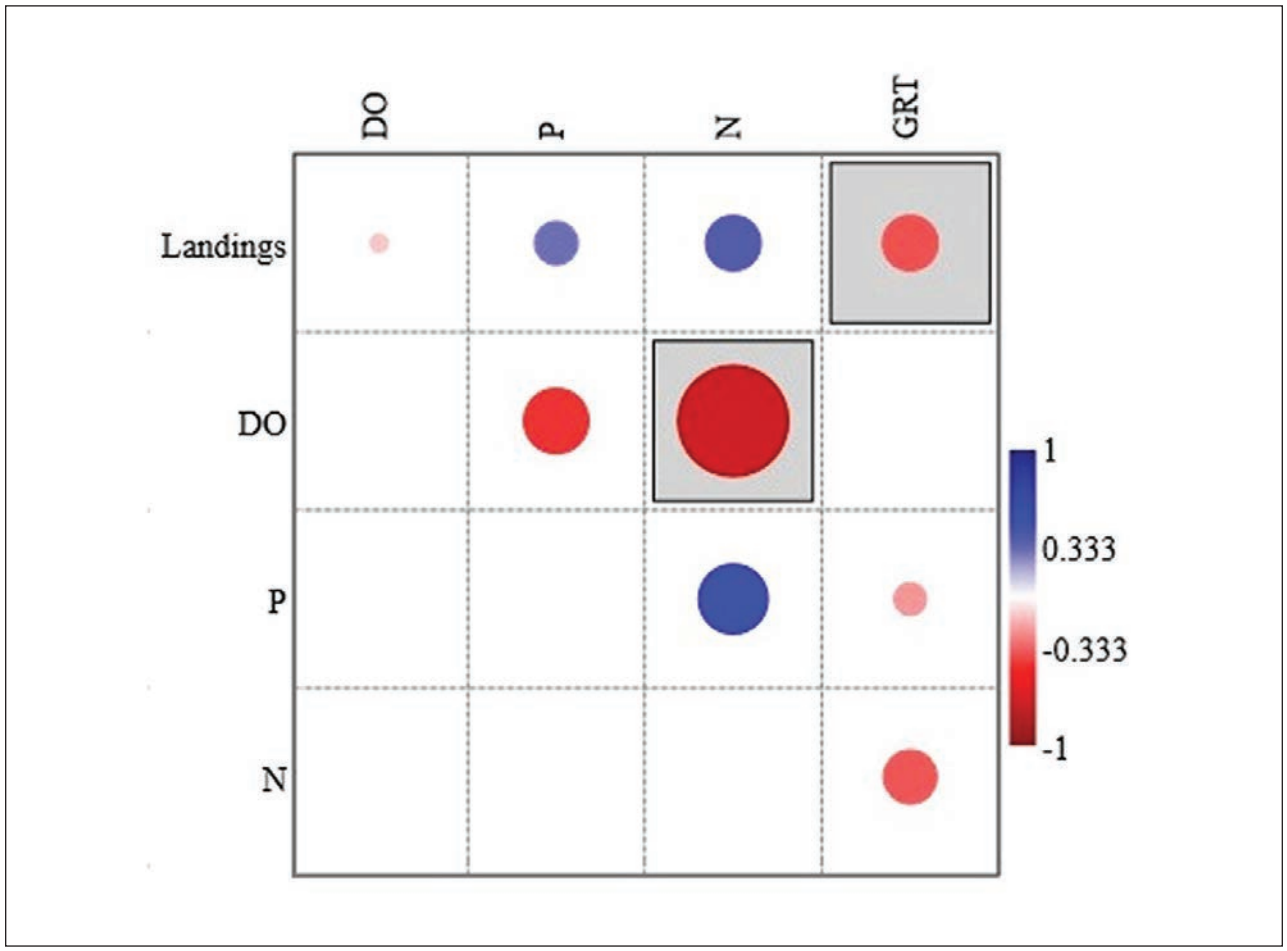

Fig. 6: Spearman's correlation plot between** H. griseus **catches, fishing capacity, and environmental parameters in the SoM. Statistically significant differences are shown in boxes (p<0.05). Abbreviations as follows: DO - dissolved oxygen; P, PO_4 - phosphate; N, NO_3+NO_2 - nitrogen, and GT - fishing capacity as gross tonnage.
Sl. 6: Spearmanov korelacijski prikaz med ulovi** H. griseus**, ribolovno zmogljivostjo in okoljskimi parametri v Marmarskem morju. Statistično pomembne razlike so prikazane v okvirčkih (p<0,05). Okrajšave: DO - raztopljeni kisik; P, PO_4 - fosfat; N, NO_3+NO_2, dušik in GT - ribolovna zmogljivost kot bruto tonaža.

specimens (82.14%) were captured in moderate to shallow shelf depths in 1995 and later (Fig. 7). Only 17.85% (n=10) of the post-1995 captures of *H. griseus* were recorded in the upper slope and deep bathyal zones.

In the early 1990s, in the deep waters (900–1,250 m) of the SoM, dissolved oxygen began to decrease below the hypoxia threshold (2 mg per litre), while dissolved nitrogen (NO_3+NO_2) and phosphate started to increase (Yücel *et al.*, 2023). Using this timeframe as a reference point, the difference in the capture depths of bluntnose sixgill sharks between the 1967–1991 and 1995–2023 periods was not statistically significant (Mann-Whitney test, p=0.05). However, after excluding the depths of the few specimens caught in the upper slope or deep bathyal zones (n=10; 300–1,000 m) during the 1995–2023 period, the difference in the depths of capture between these periods became statistically significant (Mann-Whitney test, p<0.05, p=0.0013).

Type of fishing gear vs. depth of capture

Information on the type of fishing gear was recorded for 58 (42.64%) of the 136 specimens of *H. griseus*. Purse-seine was the main fishing gear used (n=33; 56.9%), followed by a gill- and trammel-net composite (n=21; 36.21%), illegal bottom-trawling (n=3; 5.17%), and recreational hand-lining with a heavy-tackle shark rig (n=1; 1.72%). In addition to the type of fishing gear, information on the depth of capture was available for 46 (79.31%) of these 58 specimens. Although purse-seining was the

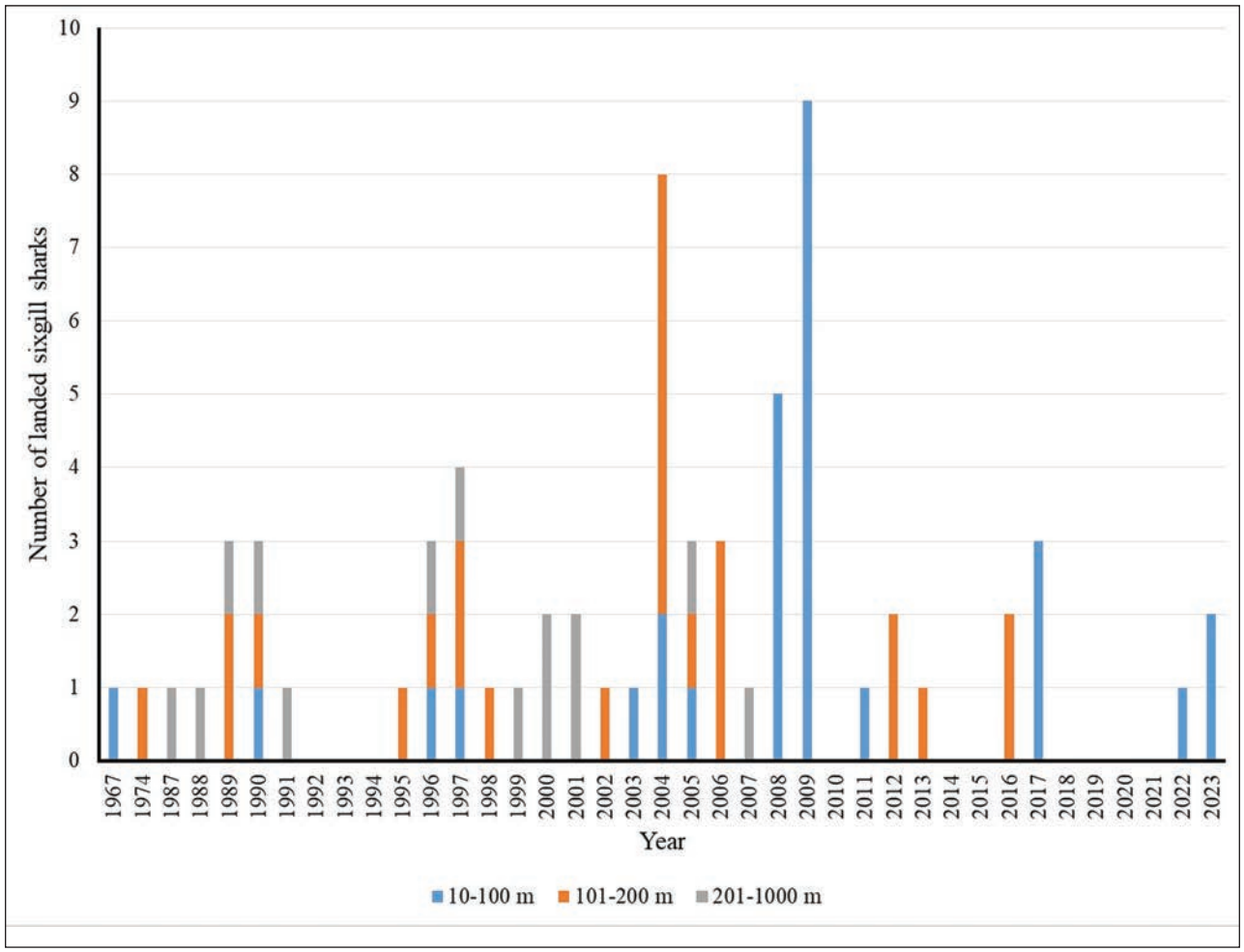

Fig. 7: Depths of capture of landed bluntnose sixgill sharks in the SoM between 1967 and 2023.
Sl. 7: Globine ulova morskih psov šesteroškrgarjev v Marmarskem morju med letoma 1967 in 2023.

primary fishing method in this subgroup as well (n=24; 52.17% vs. n=19; 41.3% for the gill- and trammel-net composite), the majority of captures in slope waters (>200 m depth) were associated with the gill- and trammel-net composite (n=7 vs. n=1 for purse-seining). However, the difference between fishing gear type and depth of capture was not statistically significant (Mann-Whitney test, p=0.38).

DISCUSSION AND CONCLUSIONS

In all geographical sub-regions of the Mediterranean Sea, *H. griseus* is considered a common bycatch species, primarily caught using demersal fishing gear, especially bottom trawls (Carpentieri *et al.*, 2021). A recent study based on local ecological knowledge (Nuez *et al.*, 2023) reported the capture of 2,111 specimens of *H. griseus* between 2007 and 2017, with the majority of captures concentrated in the western basin (n=1,152) and a significantly lower number of records in the eastern basin (n=284). During extensive MEDITS surveys investigating the spatial variation of demersal chondrichthyans in the northern Mediterranean, the frequency of occurrence of *H. griseus* varied from 0.9% (GSA9) to 9.5% (GSA25) from the western to the eastern basin (Follesa *et al.*, 2019). Between 1967 and 2022, a total of 234 specimens of *H. griseus* were recorded in Turkish marine waters, of which 131 were incidentally caught and landed in the SoM (Kabasakal, 2023b). With the recent addition of five bluntnose sixgill sharks, the current number of landed specimens in the SoM has increased to 136. Compared to the Mediterranean Sea, the SoM is a relatively small and semi-enclosed sea; however, the number of landed specimens, representing 6.44% of all Mediterranean records, suggests that a significant subpopulation of *H. griseus* inhabits this region.

Unfortunately, the findings of this study indicate that the bluntnose sixgill shark population in the SoM faces multiple threats.

Although *H. griseus* was not considered a commonly encountered shark species in the initial assessment of the MEDLEM database (Mancusi *et al.*, 2020), in the second phase of the MEDLEM project, covering the period from 2017 to 2022, it accounted for 20.5% of all reported large shark records from the Mediterranean (Gallo *et al.*, 2022). Therefore, as indicated in Lipej *et al.* (2022), it can be assumed that the population declines observed in many large shark species in the Mediterranean are not affecting *H. griseus*. Although both GLM regression and the Mann-Kendall trend analysis indicated an increasing trend in landings of *H. griseus* in the SoM, the smoothing spline model of the GLM regression revealed a dramatic decrease after 2017. Notably, the rise in *H. griseus* landings observed in the SoM between 2009 and 2016 started to decline in the following years, even as fishing capacity increased. Similar dramatic reductions in the biomass of elasmobranchs landed as a result of increased fishing capacity have been observed in other regions of the Mediterranean, such as the Adriatic, where an extraordinary decline in the abundance of demersal elasmobranchs has occurred (Barausse *et al.*, 2014). Therefore, although the registered fishing capacity in the SoM was lower from 2009 to 2016 than after 2017, the higher number of bluntnose sixgill shark landings can be explained by a greater recognition of the landed specimens.

In parallel with the growing use of social media, citizen science, and local ecological knowledge, there has been a notable rise in records of elasmobranch bycatch in commercial fisheries and sightings (Kabasakal & Bilecenoğlu, 2020; Bargnesi *et al.*, 2020, 2022; Mancusi *et al.*, 2020; Gallo *et al.*, 2022). Compared to the period from 1967 to 2005, the likelihood of finding information on the capture and/or landing of a bluntnose sixgill shark has increased with statistical significance since 2006, due to the rise of Internet media and social media posts. However, this increase did not reach the extent predicted by the accumulation curve model in this study, which was based on registered fishing capacity in the SoM and *H. griseus* landings per year.

As one of the deepest dwelling sharks, *H. griseus* can reach depths of at least 2,500 m, but is commonly found between 200 and 1,100 m (Ebert *et al.*, 2021). In terms of bathymetric distribution, *H. griseus* generally inhabits continental slope habitats; however, in certain parts of the world, such as the Flora Islets (Strait of Georgia, Canadian Pacific) or Puget Sound, bluntnose sixgill sharks are known to regularly visit very shallow reefs for unknown reasons (Dunbrack & Zielinski, 2003; Griffing *et al.*, 2014). In the present study, bluntnose sixgill sharks for which capture depth data were recorded (n=69) were caught incidentally at depths ranging from 10 to 1,000 m (Fig. 7). It has been observed in the SoM that bluntnose sixgill sharks can leave their usual depths on the continental slope and ascend to the very shallow waters of the continental shelf, and while the reasons for their migration may not be well understood in the Canadian Pacific, in the SoM, it is most likely due to progressive deoxygenation caused by the deterioration of environmental conditions in the bathyal region, or even the anoxia that is beginning to be observed in some regions of the SoM bathyal.

Over the last 40 years, the influx of excessive organic matter from terrestrial sources has caused nitrogen-phosphorus levels in the SoM to reach alarming heights, leading to conditions of hypoxia and even anoxia (Yücel *et al.*, 2023). Although dissolved oxygen levels remained above the hypoxia threshold (>80 µmol/L), which was tolerable for the survival of oxygen-dependent marine life up to the early 2000s, oxygen is now depleted in the deep zones (>500 m depth) of the SoM, and low levels of hydrogen sulphide (3–10 µM) have been observed (Yücel *et al.*, 2023). If the early 1990s is taken as a reference point, when dissolved oxygen in the deep waters (900–1,250 m) of the SoM began to fall below the hypoxia threshold (80 µmol/L) and a sudden, continuous increase in nitrogen and phosphorus levels was recorded, the observed increase in incidental catches of *H. griseus* in the shallow continental shelf, where dissolved oxygen levels remain higher than in deep waters, may be attributed to the deterioration of the bathyal ecosystem. Furthermore, the exclusion of records of bluntnose sixgill sharks caught above the continental slope at depths between 300 and 1,000 m (n=10) resulted in a statistically significant difference in the depth of capture of *H. griseus* between the 1967–1991 and 1995–2023 periods (Mann-Whitney test, $p<0.05$, $p=0.0013$), suggesting a bathymetric shift response to environmental degradation in the bathyal ecosystem. However, *H. griseus* is known to occur in deep-water oxygen minimum zones and has even spent daylight hours in hypoxic deep habitats (Comfort & Weng, 2015). The deepest capture of *H. griseus* in the SoM (1,000 m) was recorded in June 2005, coinciding with beginning of the drastic deterioration of environmental conditions in the bathyal ecosystem, and a few bluntnose sixgill sharks were caught in hypoxic regions during the 2000s. This suggests that *H. griseus* may still inhabit the bathyal zone of the SoM despite oxygen depletion. However, the

increasing number of captures in the upper continental slope indicates that this region of the SoM is becoming a more frequently used habitat for *H. griseus* (Kabasakal, 2017). As an active demersal predator, *H. griseus* can ascend to shallower waters where dissolved oxygen concentrations are higher and exhibit more active foraging behaviour (Comfort & Weng, 2015). Ram-ventilating sharks often respond to environmental degradation, particularly deoxygenation, with vertical habitat compression (Sims, 2019). The results of the present study suggest that the bluntnose sixgill shark may be experiencing vertical habitat compression for the first time, throughout its Mediterranean range in the SoM. However, the fact that it is still recorded on the upper continental slope suggests that habitat compression has not yet reached a critical level and may have only recently begun.

Overfishing combined with environmental degradation in the northern Adriatic Sea have caused dramatic declines (≥ 80%) in elasmobranch stocks since the 1940s (Barausse *et al.*, 2014). Another example of a shark whose vulnerability to fishing is increased by deoxygenation is *Prionace glauca*, which has been linked to increased blue shark bycatch in the Atlantic Ocean due to oceanic habitat compression from deoxygenation (Vedor *et al.*, 2021). Captures of the deep-sea shark *Echinorhinus brucus* in shallow waters (<120 m) in the SoM have increased in recent years (Kabasakal *et al.*, 2023), suggesting that the deterioration of environmental conditions in the SoM bathyal zone is forcing sharks to migrate to shallower areas. Furthermore, a study investigating the demersal fish fauna in the SoM, reported the maximum CPUE value of *H. griseus* (29.89 kg/km^2) at depths between 100 and 200 m (Daban *et al.*, 2021). So how might the vertical habitat compression that *H. griseus* appears to be experiencing in the SoM affect the bycatch of this species in commercial fisheries?

A recent study has linked increased catches of *H. griseus* in the Mediterranean between May and October to a higher likelihood of bycatch as the species migrates into shallower waters during the warmer months (Nuez *et al.*, 2023). According to previous studies in the SoM, *H. griseus* is a bycatch shark, typically caught in multimodal demersal and purse seine fisheries (Kabasakal, 2023b). In two studies assessing large shark captures in Turkish commercial fisheries, *H. griseus* was reported as the primary bycatch species, with frequencies ranging from 38.6% to 51.8% (Kabasakal *et al.*, 2017; Kabasakal & Bilecenoğlu, 2020). Until the early 2000s, *H. griseus* was primarily caught as bycatch in the SoM where fishing gears were deployed in the deep waters of the continental shelf and the continental slope (Meriç, 1995; Kabasakal, 2023b); however, since 2002, the depth of capture has decreased significantly and, with few exceptions, the species has become bycatch in the shallow waters of the continental shelf. Although *H. griseus* is thought to have a high tolerance to hypoxia (Comfort & Weng, 2015), environmental shifts in the bathyal zone of the SoM are pushing the area towards anoxic conditions, gradually making it uninhabitable for the bluntnose sixgill shark.

H. griseus is a viviparous shark with large litters ranging from 47 to 108 pups (Ebert *et al.*, 2021). Despite larger litter size in comparison to most other shark species, *H. griseus* is a typical example of a K-selected species with a notable generation length (53 years), which makes it vulnerable to overfishing and subsequent population declines (Finucci *et al.*, 2020). Incidental captures of pregnant females (e.g., Ounifi-Ben Amor *et al.*, 2017) or schools of individuals (e.g., Ben Amor *et al.*, 2019) may exacerbate the already existent vulnerability of bluntnose sixgill sharks throughout their distribution range. Therefore, in accordance with Annex 1 of Highly Migratory Species listed in UNCLOS, a bycatch limitation warning has been added for *H. griseus* in the Mediterranean Sea (Barone *et al.*, 2022), as most captured individuals tend to be immature (e.g., in Tunisian waters) or the average total length gradually falls below the length required for attaining sexual maturity (e.g., in Turkish waters). It has been emphasised that fishery managers should prioritise a better conservation plan and sustainable exploitation of this species, which is considered to have a very fragile stock, like in Tunisian waters (Mili *et al.*, 2021), Otherwise, a complete ban on the catch of the species may be necessary (Kabasakal, 2023b). According to Mili *et al.* (2021), landings of *H. griseus* are not abundant in the Mediterranean, which is an alarming situation, and the drastic reduction in landings in the SoM further jeopardises the future presence of the species in the region.

In conclusion, the triple threat of overfishing, habitat degradation or loss, and pollution now poses a significant threat to all elasmobranchs (Dulvy *et al.*, 2021; Pacoureau *et al.*, 2023) and represents a serious challenge for the *H. griseus* population in the SoM. Considering that the current organic matter load in the sea must be reduced by at least 50%, particularly in the deep regions, restoring suitable conditions for marine life will take at least six years (Yücel *et al.*, 2023). It is evident that the return of *H. griseus* to its safe habitat in the SoM bathyal will not be a quick or easy process. It is therefore vital to educate and encourage fishermen to release individuals of *H. griseus* (and other sharks, such as *E. brucus*) caught as bycatch in continental shelf fisheries, back to the environment alive and unharmed.

Unfortunately, in line with the old axiom that 'bad news sells', incidentally captured sixgill sharks, which have never had any economic importance in Turkish marine fisheries, have been landed for many years solely to create striking headlines in the newspapers (Kabasakal, 2010). Moreover, many individuals, often still alive when landed, are displayed for a few days to attract customers and then carelessly discarded, exploited by fishmongers just to increase their sales (Kabasakal, 2010). Recently, *H. griseus* has been declared a protected shark species in Turkish waters, and the statements regarding the dramatic declines in regional landings support this decision. However, educating fishermen remains a key issue to ensure the shark's proper handling and survival after release into the sea. As emphasised in the literature (Pacoureau *et al.*, 2023), the risk of shark extinction increases in seas with high fishing pressure, and it is only possible to overcome this situation with strong fisheries management. Fisheries management plans, also known as 'shark plans' could halt the decline of elasmobranch stocks, subsequently increasing them or slowing down the ongoing decline (Pacoureau *et al.*, 2023). Therefore, a holistic management plan should be prepared and implemented without delay to successfully protect *H. griseus* and other elasmobranchs occurring in the SoM.

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VPLIV RIBOLOVNE ZMOGLJIVOSTI IN OKOLJSKIH PARAMETROV NA ULOV VRSTE *HEXANCHUS GRISEUS* V MARMARSKEM MORJU

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POVZETEK

Med julijem 1967 in decembrom 2023 je bilo v Marmarskem morju (SoM) ujetih 136 morskih psov šesteroškrgarjev, Hexanchus griseus. *Čeprav sta tako generalizirani linearni model (GLM) kot Mann-Kendallov test trenda pokazala porast ulova vrste* H. griseus*, so ocenjeni izravnalni zlepki regresijske trendne črte GLM razkrili močan upad ulova po letu 2017. Medtem ko so se globine ulova od začetka leta 2000 gibale med 10 in 1000 m, je bila večina osebkov ujetih v plitvih vodah epikontinentalnega pasu. Slabše okoljske razmere in vse večja deoksigenacija v globokih vodah SoM sovpadajo z zmanjšanjem globine ulova morskih psov šesteroškrgarjev v epikontinentalnem pasu. Ugotovitve kažejo na stalen proces navpičnega krčenja habitatov, za katerega se zdi, da povečuje ranljivost* H. griseus *za komercialni ribolov v Marmarskem morju.*

Ključne besede: morski pes šesteroškrgar, prelov, ranljivost, onesnaževanje okolja, kisikove razmere, upad

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MORSKA FAVNA

FAUNA MARINA

MARINE FAUNA

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AN INSIGHT INTO THE HETEROBRANCH FAUNA OF FIESA (SLOVENIA, NORTHERN ADRIATIC SEA)

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ABSTRACT

The authors investigated the marine heterobranch fauna (Heterobranchia, Gastropoda) in Fiesa, a tourist destination and one of the most popular diving sites in the Gulf of Trieste (northern Adriatic Sea). Specimens of heterobranchs were collected during sporadic sampling between November 2021 and January 2022. A total of 30 species from 6 higher taxa (Cephalaspidea 1, Aplysiida 1, Umbraculida 1, Sacoglossa 3, Pleurobranchida 2, Nudibranchia 22) were recorded and identified. Including previously published and recorded data, the total number of species currently known in the study area has increased to 51. Future surveys, involving additional sampling methods and carried out during other seasons of the year, are expected to further increase the number of recorded marine heterobranch species inhabiting the area.

Key words: marine heterobranchs, checklist, SCUBA diving, Fiesa, recreational divers

UNO SGUARDO ALLA FAUNA DEGLI ETEROBRANCHI DI FIESSO (SLOVENIA, ADRIATICO SETTENTRIONALE)

SINTESI

Gli autori hanno studiato la fauna marina di eterobranchi (Heterobranchia, Gastropoda) a Fiesso, una destinazione turistica e uno dei siti di immersione più popolari del Golfo di Trieste (Adriatico settentrionale). Gli esemplari di eterobranchi sono stati raccolti durante campionamenti sporadici tra novembre 2021 e gennaio 2022. In totale sono state registrate e identificate 30 specie appartenenti a 6 taxa superiori (Cephalaspidea 1, Aplysiida 1, Umbraculida 1, Sacoglossa 3, Pleurobranchida 2, Nudibranchia 22). Includendo i dati pubblicati e registrati in precedenza, il numero totale di specie attualmente conosciute nell'area di studio è salito a 51. Le indagini future, che prevedono ulteriori metodi di campionamento e che saranno condotte in altre stagioni dell'anno, dovrebbero aumentare ulteriormente il numero di specie di eterobranchi marini registrate nell'area.

Parole chiave: eterobranchi marini, lista, immersioni, Fiesso, subacquei ricreativi

INTRODUCTION

The first checklist of marine gastropod fauna in the Gulf of Trieste (northern Adriatic Sea) including information on heterobranchs was published over 120 years ago (Graeffe, 1903). The earliest reports for the Slovenian part of the gulf date to the late 20th century and are based on the works of De Min & Vio (1997). The number of heterobranch species reported at the time was limited, as samples were mainly collected using sedimentary bottom sampling gear such as Van Veen and Petersen grabs. Later, a first checklist specifically focused on marine sea slugs was published (Turk, 2000), followed by several other studies aimed at assessing the heterobranch fauna in the area, which resulted in a rapidly increasing number of recorded species (Turk, 2005; Lipej *et al.*, 2008, 2012; Mavrič & Lipej, 2012; Lipej *et al.*, 2014; Zenetos *et al.*, 2016). According to Ciriaco & Poloniato (2016), at least 73 species have been recorded in the Italian part of the Gulf of Trieste, while the Slovenian part has recorded 141 species to date (Lipej *et al.*, 2018).

The aim of the present work is to provide the first list of marine heterobranchs for Fiesa, one of the sites in the Gulf of Trieste most frequented by recreational divers.

MATERIAL AND METHODS

Study area

The Slovenian coastline is relatively short, covering only 46 km. Fiesa (45°31′31.0″ N 13°34′53.9″ E) is a quiet bay located between Piran and Strunjan (Fig. 1), lined on both sides by the steep walls of a flysch cliff. The sea bed begins with a shallow stony-sandy plain, transitioning at a depth of 4–5 m into a distinct flysch sill, and changing at 8–9 m to a silty sandy bottom interspersed with patches of biogenically hardened substrate (Fig. 2). The silty sandy bottom slowly descends to a maximum depth of 18 m, with the precoralligenous type of biogenic formation in this area supporting a wide range of habitat types that play an important role biodiversity.

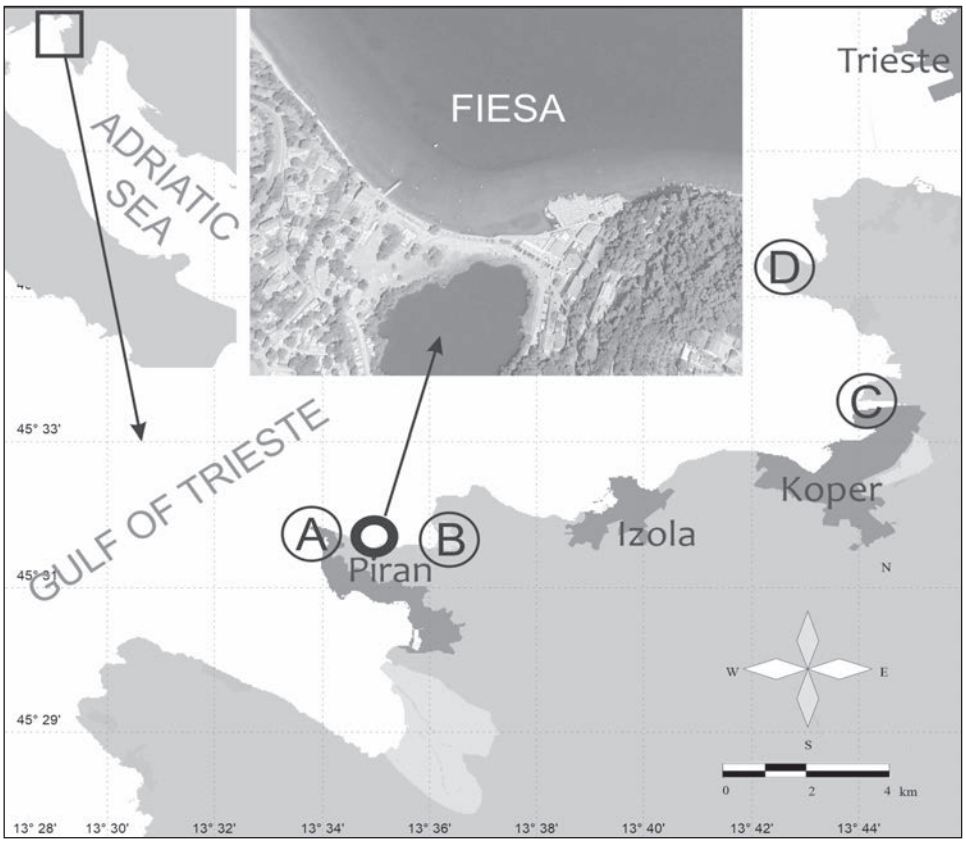

Fig. 1: The studied locality of Fiesa (right above) and its position in the Adriatic Sea (left above) as well as in the Slovenian part of the Adriatic Sea (below), along with the areas to which it was compared: A – waters off the old town of Piran, B – Stjuža lagoon (Strunjan), C – Koper harbour, and D – Nature Monument Debeli rtič (Ankaran).
Sl. 1: Raziskovana lokaliteta Fiesa (desno zgoraj) in njena lega v Jadranskem morju (levo zgoraj) in v slovenskem delu Jadranskega morja (spodaj), skupaj z območji, s katerimi je bila primerjana: A – akvatorij ob starem mestnem jedru Pirana, B – laguna Stjuža (Strunjan), C – koprsko pristanišče in D – Naravni spomenik Debeli rtič (Ankaran).

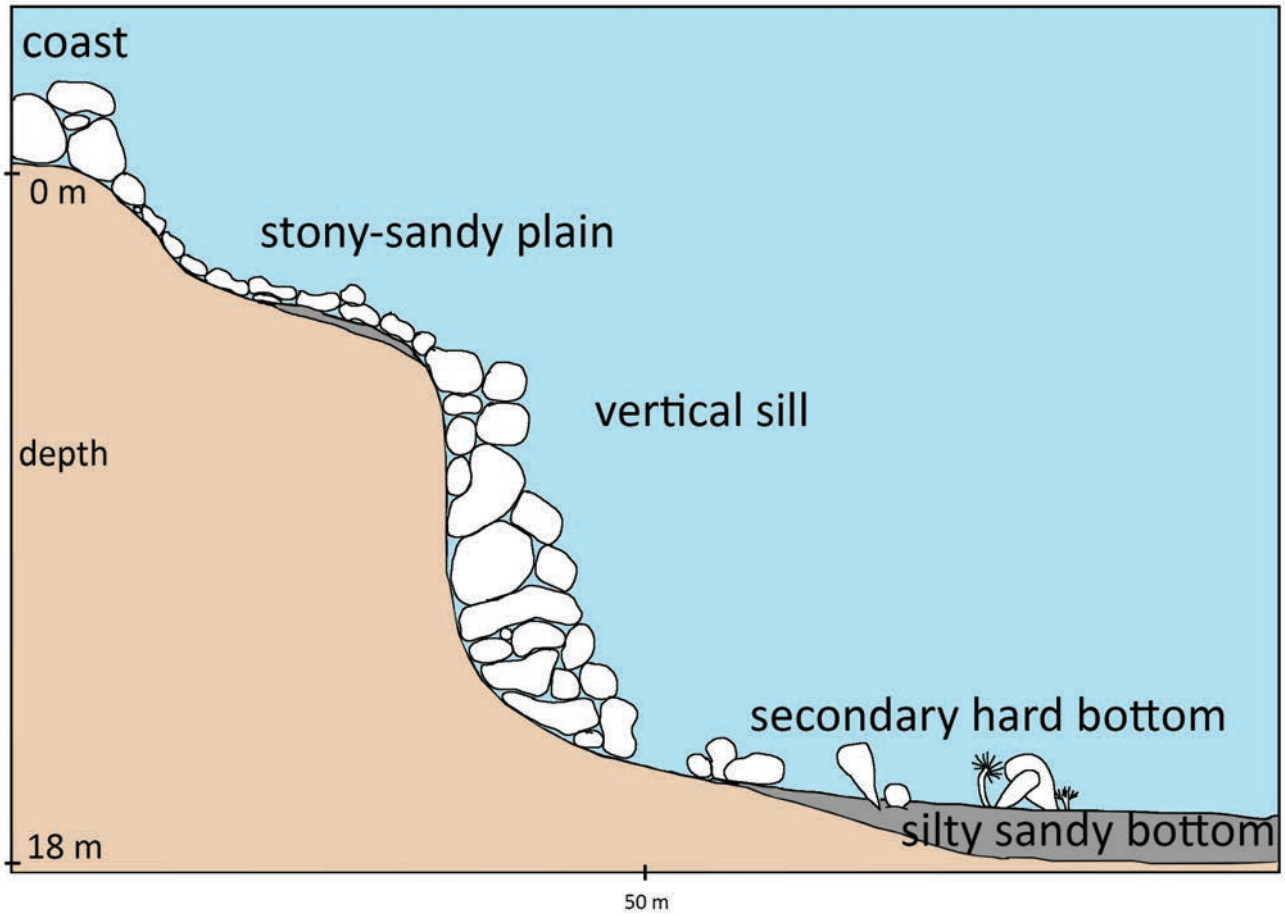

Fig 2: Cross-section of the main habitats present in the studied area across the depth range.
Sl. 2: Prečni prerez glavnih habitatov, prisotnih na proučevanem območju v globinskem razponu.

The present work is based on data collected during 12 recreational scuba diving trips in Fiesa between November 2021 and January 2022. All dives were conducted at night, with a maximum depth of 12 m (the boundary between rocky and sandy bottoms), and water temperatures varying from 17°C in November to 8°C in January. Data was collected by documenting the sightings of each species and photographing them using an Olympus TG6 underwater camera. Photographs of each sighting were re-examined to confirm identification and make other observations. No attempt was made to preserve collected or sighted specimens.

Specimens were identified based on their external morphology as observed in detailed photographs and through comparison with relevant literature (Schmekel & Portmann, 1982; Trainito & Doneddu, 2014; Lipej *et al.*, 2018; Prkič *et al.*, 2018). To determine whether a species could be considered a new record for the study area, the data on heterobranch species reported by Lipej *et al.* (2018) were consulted. The taxonomy and nomenclature conform to the World Register of Marine Species - WoRMS (2024). For a detailed survey of heterobranch fauna in the studied area, other available data published in previous studies (Lipej *et al.*, 2008, 2012, 2014, 2018) or obtained through social media were analysed. The number of species recorded in Fiesa was compared with those reported from other areas (Fig. 1), such as the Natural Monument of Debeli rtič (Lipej *et al.*, 2016), the Stjuža lagoon in Strunjan (Lipej *et al.*, 2019), the area of the Port of Koper (Lipej *et al.*, 2020), and the waters off the old town of Piran (Lipej *et al.*, 2022).

RESULTS AND DISCUSSION

Heterobranch fauna

A total of 30 heterobranch species from six higher taxonomic groups (Cephalaspidea 1, Aplysiida 1, Umbraculida 1, Sacoglossa 3, Pleurobranchida 2, Nudibranchia 22) were recorded and identified in this study, six of which are new records for Fiesa: *Eubranchus viriola* (Korshunova, Malmberg, Prkić, Petani, Fletcher, Lundin & Martynov, 2020), *Idaliadoris depressa* (Alder & Hancock, 1842), *Berthella plumula* (Montagu, 1803),

Tab. 1: Heterobranch species recorded in the study area in the period November 2021–January 2022. The plus signs denote an estimate of heterobranch abundance.
Tab. 1: Zabeležene vrste polžev zaškrgarjev na obravnavanem območju v obdobju november 2021–januar 2022. Znaki plus označujejo oceno številčnosti polžev zaškrgarjev.

	date/ species		2021								2022		
		21 nov	27 nov	29 nov	4 dec	5 dec	12 dec	15 dec	26 dec	29 dec	9 jan	15 jan	22 jan	30 jan
1	*Antiopella cristata*						1							
2	*Amphorina linensis*							1						
3	*Aplysia punctata*			1					2				3	5
4	*Berthella ocellata*										1			
5	*Berthella plumula*					1								
6	*Cratena peregrina*			5		3	2	2		1				
7	*Dendrodoris grandiflora*							1			1		4	1
8	*Dendrodoris limbata*		1				1	1	1			2	2	3
9	*Discodoris rosi*									1	1			
10	*Doris pseudoargus*	1			2		2	4						
11	*Doris sp.*					1					1			
12	*Elysia gordanae*											1	1	1
13	*Elysia timida*					1			1					
14	*Elysia viridis*							5+	5+		5+	10+	10+	10+
15	*Facelina fusca*			5+	5+	5+	5+	5+	10+	5+			10+	10+
16	*Eubranchus viriola*							5		2				
17	*Felimare picta*	3	2	1		5+	1	2	1			1	1	1
18	*Felimare villafranca*	1		2	1		4	1	1					1
19	*Felimida krohni*													1
20	*Felimida luteorosea*	1												
21	*Geitodoris planata*												1	
22	*Idaliadoris depressa*													2
23	*Paraflabellina ischitana*					1								
24	*Philinopsis depicta*		1											
25	*Polycera quadrilineata*				1			1				1		
26	*Spurilla neapolitana*						1			1				
27	*Thuridilla hopei*					1								
28	*Trapania maculata*										1			
29	*Trapania lineata*										1			

Discodoris rosi Ortea, 1979, and *Philinopsis depicta* (Renier, 1807) (Tab. 1). The 31 heterobranch species recorded are presented in Figures 3 and 4.

The most notable new addition to the Fiesa heterobranch checklist may be *Eubranchus viriola*, which was described only recently, in 2020 (Korshunova *et al.*, 2020). Specimens were mainly translucent white; however, some brown specimens were also observed, distinguished from the similar species *Amphorina farrani* (Alder & Hancock, 1842) by the absence of a yellow-orange spot on the tail. During sampling, some specimens matching the description of the recently discovered species *Amphorina viriola* were found (Korshunova *et al.,* 2020). However, due to recent doubts regarding the distinction between similar species of the genus *Amphorina* and the validity of this genus, along with the

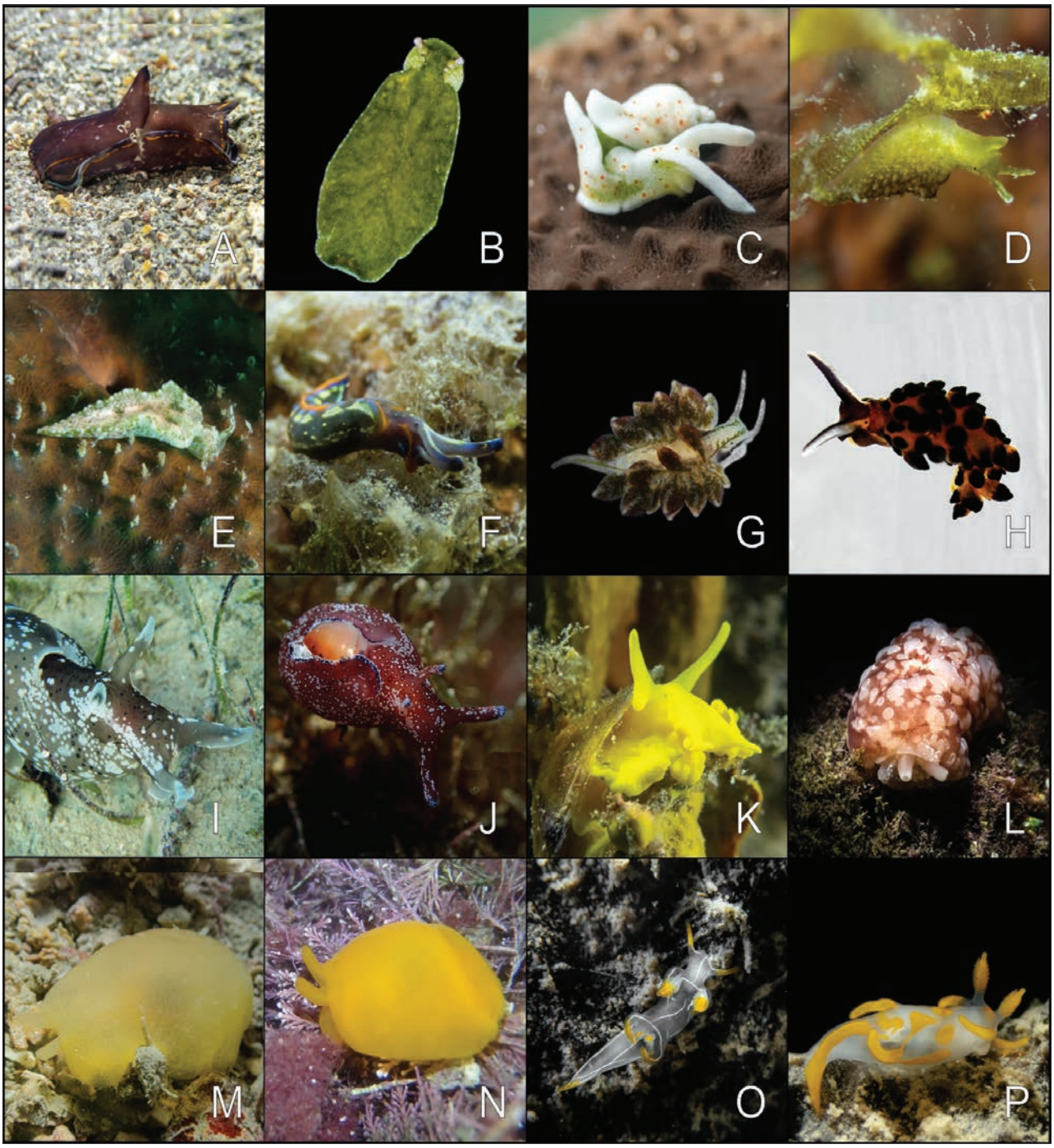

Fig. 3: Heterobranch species recorded in the study area. ***A*** *– Philinopsis depicta,* ***B*** *– Boselia mimetica,* ***C*** *– Elysia timida,* ***D*** *– Elysia viridis,* ***E*** *– Elysia gordanae,* ***F*** *– Thuridilla hopei,* ***G*** *– Ercolania viridis,* ***H*** *– Placida cremoniana,* ***I*** *– Aplysia punctata,* ***J*** *– a small specimen of Aplysia punctata (formerly Aplysia parvula),* ***K*** *– Tylodina perversa,* ***L*** *– Berthella ocellata,* ***M*** *– Berthella plumula,* ***N*** *– Berthellina edwardsi,* ***O*** *– Trapania lineata, and* ***P*** *– Trapania maculata* ***(Photos: Tea Knapič: A, C, D, F, K, L, M, O, P; Irena Frkovič: J; Borut Mavrič: B, E, G, H, I, N).***
SL. 3: Favna polžev zaškrgarjev na obravnavanem območju. ***A*** *– Philinopsis depicta,* ***B*** *– Boselia mimetica,* ***C*** *– Elysia timida,* ***D*** *– Elysia viridis,* ***E*** *– Elysia gordanae,* ***F*** *– Thuridilla hopei,* ***G*** *– Ercolania viridis,* ***H*** *– Placida cremoniana,* ***I*** *– Aplysia punctata,* ***J*** *– majhen primerek vrste Aplysia punctata (prej Aplysia parvula),* ***K*** *– Tylodina perversa,* ***L*** *– Berthella ocellata,* ***M*** *– Berthella plumula,* ***N*** *– Berthellina edwardsi,* ***O*** *– Trapania lineata, in* ***P*** *– Trapania maculata* ***(Fotografije: Tea Knapič: A, C, D, F, K, L, M, O, P; Irena Frkovič: J; Borut Mavrič: B, E, G, H, I, N).***

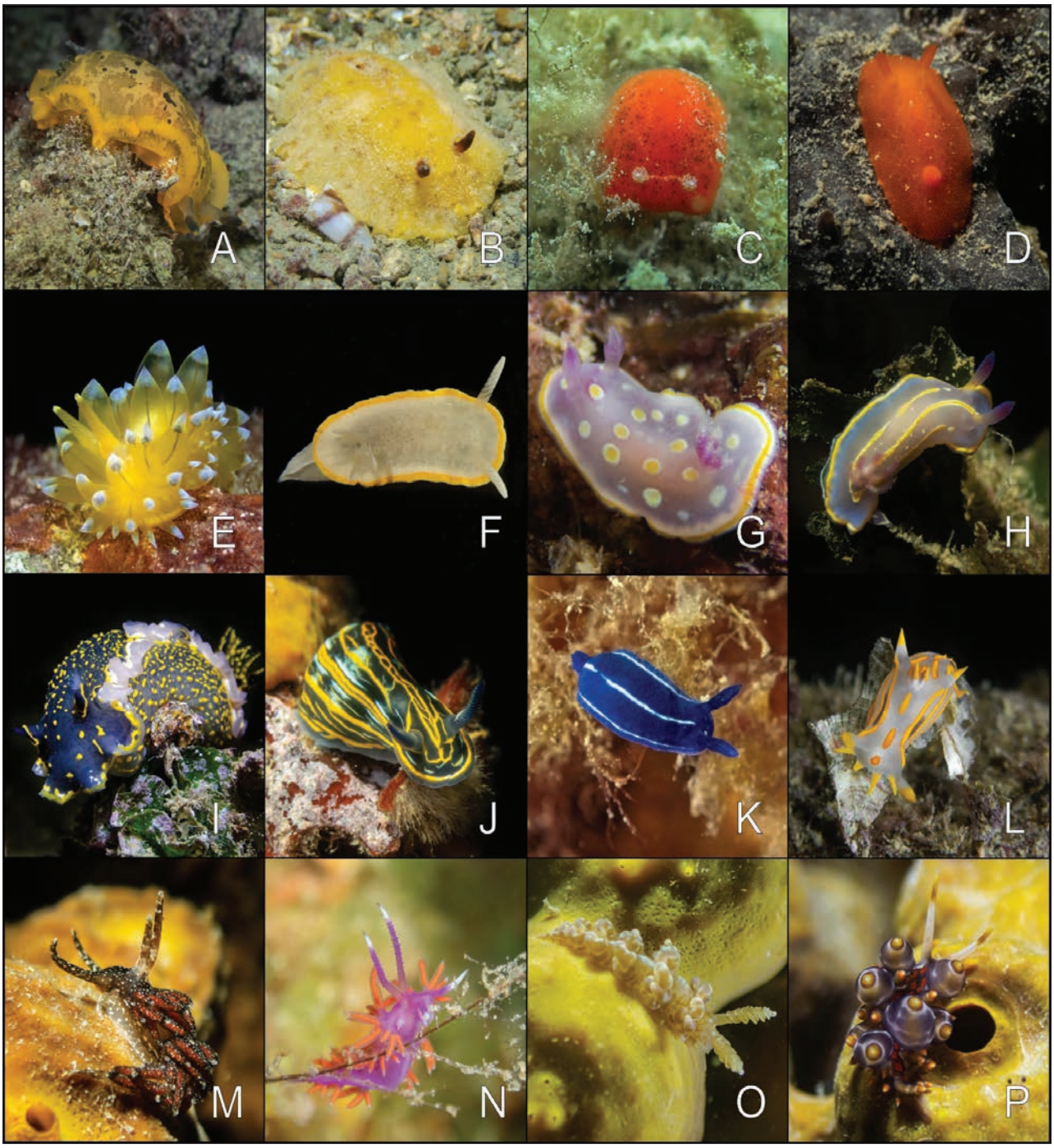

Fig. 4: Heterobranch species recorded in the study area. ***A*** *– Dendrodoris limbata,* ***B*** *– Doris cf. pseudoargus,* ***C*** *– Rostanga rubra,* ***D*** *– Discodoris rosi,* ***E*** *– Antiopella cristata,* ***F*** *– Diaphorodoris alba,* ***G*** *– Felimida luteorosa,* ***H*** *– Felimida krohni,* ***I*** *– Felimare picta,* ***J*** *– Felimare villafranca,* ***K*** *– Felimare orsinii,* ***L*** *– Polycera quadrilineata,* ***M*** *– Facelina fusca,* ***N*** *– Paraflabellina ischitana,* ***O*** *– Spurilla neapolitana, and* ***P*** *– Eubranchus viriola* ***(Photos: Tea Knapič: A, B, D, E, G, H, I, J, K, L, M, N, O, P; Tihomir Makovec: C; Domen Trkov: F).***

Sl. 4: Favna polžev zaškrgarjev na obravnavanem območju. ***A*** *– Dendrodoris limbata,* ***B*** *– Doris cf. pseudoargus,* ***C*** *– Rostanga rubra,* ***D*** *– Discodoris rosi,* ***E*** *– Antiopella cristata,* ***F*** *– Diaphorodoris alba,* ***G*** *– Felimida luteorosa,* ***H*** *– Felimida krohni,* ***I*** *– Felimare picta,* ***J*** *– Felimare villafranca,* ***K*** *– Felimare orsinii,* ***L*** *– Polycera quadrilineata,* ***M*** *– Facelina fusca,* ***N*** *– Paraflabellina ischitana,* ***O*** *– Spurilla neapolitana, in* ***P*** *– Eubranchus viriola* ***(Fotografije: Tea Knapič: A, B, D, E, G, H, I, J, K, L, M, N, O, P; Tihomir Makovec: C; Domen Trkov: F).***

lack of a comprehensive review of the genus *Eubranchus*, we prefer to use the Latin name *Eubranchus viriola* (see Toso *et al.*, 2024).

Checklist of species

Counting the species observed in the studied area, alongside those reported in previous publications (Lipej *et al*., 2008, 2012, 2014, 2018) (Tab. 2), the total number of heterobranch species registered in the Fiesa area to date is 51. The discovery of 30 species over three months and a comprehensive checklist of 51 documented species indicate Fiesa to be a species-rich area. If we compare the number of heterobranch species recorded for Fiesa with the previously reported survey of species in Slovenian waters (141 species) compiled by Lipej *et al*. (2018), it accounts for over 1/3 of all species ever reported in these waters. However, since many common sea slug species present in neighbouring areas were not confirmed in this study, it may be speculated that the 51 species recorded so far are an underestimation of the true number of heterobranch species in the study area.

Such heterobranch diversity can be attributed to the high spatial heterogeneity and the variety of habitat types present in the studied area. It is well known that the abundance and distribution patterns of benthic biodiversity are influenced by spatial heterogeneity (Zuschin *et al.,* 2001; Bouchet *et al.,* 2002; Romoth *et al.*, 2023).

Many heterobranch species are characterized by vivid coloration, but as typically small animals that only occur in low densities and in specific habitats (Zenetos *et al*., 2016), they may not be easily spotted. Some cryptic species, such as those from the family Onchidorididae. were often overlooked in the past due to their excellent camouflage. An onchidorid species, *Atalodoris pictoni* (Furfaro & Trainito, 2017) (Fig. 5), which feeds on the encrusting bryozoan *Reptadeonella violacea* (Johnston, 1847), was previously reported in the area by Fortič *et al*. (2021). A new species, *Atalodoris camassae* (Furfaro & Trainito, 2022) (Fig. 6), was recently described from the studied area by Furfaro *et al*. (2023). It was observed feeding on the cheilostomatid bryozoan *Calpensia nobilis* (Esper, 1796).

Tab. 2: Heterobranch species previously recorded in the studied area (with date of first record) according to published papers (pp) and social media (sm).
Tab. 2: Vrste polžev zaškrgarjev, predhodno zabeležene na obravnavanem proučevanem območju (z datumom prvega zapisa o pojavljanju) glede na objavljene članke (pp) in družbena omrežja (sm).

	date/ species	source	date of first record	type
1	*Armina rubida*	Knapič *et al*. (2024)	10.10.2023	pp
2	*Atalodoris camassae*	Furfaro *et al*. (2023)	March 2021	pp
3	*Atalodoris pictoni*	Fortič *et al*. (2021)	20.07.2021	pp
4	*Baptodoris cinnabarina*	Frković (2022)	13.02.2021	sm
5	*Berghia coerulescens*	Knapič (2023)	20.08.2023	sm
6	*Berthellina edwardsi*	Novak Srke (2023)	1.01.2023	sm
7	*Bosellia mimetica*	Lipej *et al*. (2018)	24.09.2014	pp
8	*Bursatella leachi*	Lipej *et al*. (2018)	19.10.2014	pp
9	*Diaphorodoris alba*	Trkov & Lipej (2022)	12.07.2021	pp
10	*Doris ocelligera*	Lipej *et al*. (2018)	12.01.2017	pp
11	*Ercolanea coerulea*	Lipej *et al*. (2018)	24.09.2014	pp
12	*Ercolanea viridis*	Lipej *et al*. (2018)	24.09.2014	pp
13	*Favorinus branchialis*	Lipej *et al*. (2018)	24.09.2014	pp
14	*Felimare orsinii*	Lipej *et al*. (2018)	10.06.2011	pp
15	*Jorunna tomentosa*	Lipej *et al*. (2018)	27.03.2011	pp
16	*Placida cremoniana*	Lipej *et al*. (2018)	11.09.2016	pp
17	*Placida dendritica*	Lipej *et al*. (2018)	24.09.2014	pp
18	*Rostanga rubra*	Lipej *et al*. (2018)	27.03.2011	pp
19	*Tayuva iliacina*	Lipej *et al*. (2018)	12.01.2017	pp
20	*Tethys fimbria*	Godnič (2023)	3.06.2023	sm
21	*Trinchesia genovae*	Lipej *et al*. (2018)	24.09.2014	pp

Fig. 5: Atalodoris pictoni, a recently discovered, lesser-known nudibranch from the area of Fiesa (Photo: M. Fantin).
Sl. 5: Atalodoris pictoni, nedavno odkrita, manj znana vrsta gološkrgarja iz okolice Fiese (Foto: M. Fantin).

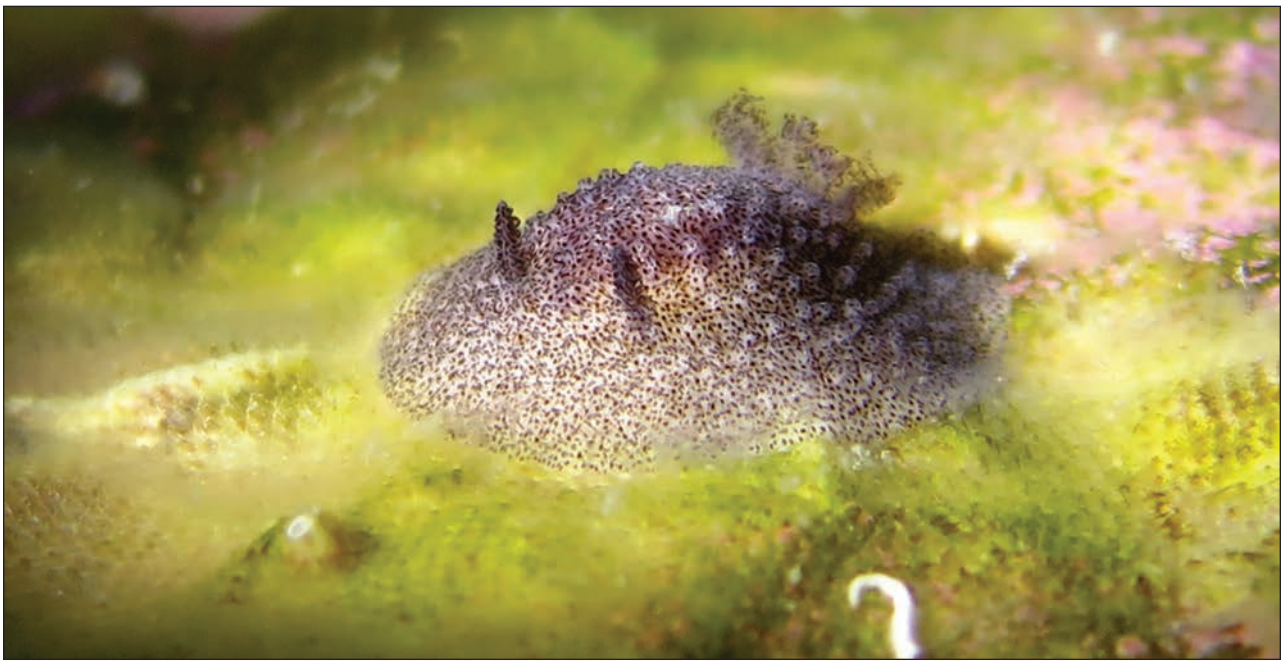

Fig. 6: Atalodoris camassae, a recently discovered heterobranch species, described as new species with the locus typicus in Fiesa (Photo: I. Frkovič).
Sl. 6: Atalodoris camassae, nedavno odkrita vrsta polža zaškrgarja, opisana kot nova vrsta z locus typicus v Fiesi. (Foto: I. Frkovič).

Fig. 7: Armina rubida, an alien heterobranch species, recently discovered in the studied area (Photo: T. Knapič).
Sl. 7: Na proučevanem območju nedavno odkrita tujerodna vrsta polža zaškrgarja Armina rubida (Foto: T. Knapič).

Among the 51 species of heterobranchs recorded in the Fiesa area, two are non-indigenous: *Bursatella leachi* Blainville, 1817 and *Armina rubida* (A. Gould, 1852). The former has regularly occurred in Slovenian waters since 2007 (see Lipej *et al.*, 2018), while *A. rubida* (Fig. 7) was only recently discovered on the sedimentary bottom in Fiesa (Knapič *et al.*, 2024). It was found on a bare muddy bottom during a night dive. However, after being spotted and illuminated by a torch, it immediately began burrowing into the mud. This finding was the second record of the species in the Adriatic Sea (Knapič *et al.*, 2024) and the first sighting in the northern Adriatic. We also found a specimen that matched the characteristics of the former *Aplysia parvula* Mörch, 1863 (Fig. 3J); however, based on new discoveries, Mediterranean specimens previously identified as this species are now considered to be small specimens of *Aplysia punctata* (Cuvier, 1803) (*sensu* Golestani *et al.*, 2019).

The list of species inhabiting the Fiesa area is far from complete. As heterobranchs are known to be stenophagous, specialising in specific diets of algae, cnidarians, sponges, and bryozoans (McDonald & Nybakken, 1997; Furfaro *et al.*, 2017), surveys targeting specific prey species may help record some previously overlooked heterobranch in the future. While most data on heterobranchs originate from summer sampling (Zenetos *et al.*, 2016), our study, in contrast, highlights heterobranch fauna during the coldest period of the year.

Comparison with adjacent areas

When comparing the data on heterobranch species in Fiesa with those from other areas in the Slovenian part of the Adriatic Sea where lists of marine fauna and flora have been compiled (Tab. 3), Fiesa emerges as a heterobranch hotspot, with the highest number of

Tab. 3: Updated list of Heterobranchia species identified in Fiesa compared to heterobranch fauna from other areas of the Slovenian part of the Adriatic Sea.
Tab. 3: Posodobljen seznam vrst polžev zaškrgarjev, ugotovljenih v Fiesi, v primerjavi s favno zaškrgarjev iz drugih območij slovenskega dela Jadranskega morja.

		FIESA	Nature Monument DEBELI RTIČ	Stjuža lagoon STRUNJAN	Port of Koper, KOPER	waters off the old city, PIRAN
"n"	heterobranch species	THIS WORK	Lipej *et al.* (2016)	Lipej *et al.* (2019)	Lipej *et al.* (2020)	Lipej *et al.* (2022)
1	*Acteon tornatilis*		X		X	
2	*Aegires pallensis*					X
3	*Akera bullata*		X	X	X	
4	*Amphorina linensis*	X				
5	*Antiopella cristata*	X	X			X
6	*Aplysia punctata*	X		X		
7	*Atalodoris camassae*	X				
8	*Atalodoris pictoni*	X				
9	*Baptodoris cinnabarina*	X				X
10	*Berghia coerulescens*	X	X			X
11	*Berghia verrucicornis*			X		
12	*Berthella ocellata*	X				X
13	*Berthella plumula*	X				
14	*Berthellina edwardsi*	X				
15	*Bosellia mimetica*	X				X
16	*Bursatella leachi*	X		X	X	X
17	*Calliopaea bellula*					X
18	*Calmella cavolini*			X		
19	*Capellinia doriae*			X		
20	*Catriona gymnota*			X		
21	*Cratena peregrina*	X	X	X	X	X
22	*Cylichna cylindracea*			X	X	
23	*Dendrodoris grandiflora*	X	X			
24	*Dendrodoris limbata*	X		X		X
25	*Armina rubida*	X				
26	*Diaphorodoris alba*	X				

27	*Discodoris rosi*	X				
28	*Doris bertholotti*					X
29	*Doris ocelligera*	X				X
30	*Doris pseudoargus*	X				X
31	*Doris sp.*	X				
32	*Doto acuta*			X		
33	*Doto coronata*			X	X	
34	*Doto cervicenigra*			X	X	X
35	*Doto rosea*			X	X	
36	*Edmundsella pedata*					X
37	*Elysia gordanae*	X				X
38	*Elysia timida*	X	X			X
39	*Elysia viridis*	X	X	X		X
40	*Ercolanea coerulea*	X				
41	*Ercolanea viridis*	X		X		
42	*Eubranchus viriola*	X		X		
434	*Eubranchus exiguus*			X		X
44	*Facelina dubia*			X		
45	*Facelina fusca*	X	X			X
46	*Favorinus branchialis*	X		X		X
47	*Felimare orsinii*	X				
48	*Felimare picta*	X				
49	*Felimare villafranca*	X	X			X
50	*Felimida krohni*	X	X			X
51	*Felimida purpurea*		X			
52	*Felimida luteorosea*	X	X			
53	*Geitodoris planata*	X				
54	*Haminea fusari*					X
55	*Haminea hydatis*		X			
56	*Haminea navicula*		X			
57	*Haloa japonica*			X		
58	*Hancockia uncinata*			X		

59	*Idaliadoris depressa*	X				
60	*Idaliadoris neapolitana*				X	
61	*Jorunna tomentosa*	X		X		
62	*Paraflabellina ischitana*	X	X			X
63	*Petalifera petalifera*		X			
64	*Philine quadripartita*		X			
65	*Philinopsis depicta*	X	X			
66	*Piseinotecus sphaerifera*				X	
67	*Placida cremoniana*	X				
68	*Placida dendritica*	X				
69	*Pleurehdera stellata*		X	X	X	X
70	*Polycera quadrilineata*	X		X		X
71	*Polycera hedgpethi*			X		X
72	*Polycerella emmertoni*			X		X
73	*Retusa mammillata*		X			
74	*Retusa truncatula*					
75	*Rostanga rubra*	X				
76	*Runcina adriatica*					X
77	*Runcina ferruginea*					X
78	*Spurilla neapolitana*	X	X	X		
79	*Stiliger fuscovittatus*			X		
80	*Tayuva iliacina*	X				X
81	*Tergipes tergipes*			X		
82	*Tethys fimbria*	X				
83	*Thuridilla hopei*	X	X			X
84	*Trapania lineata*	X				
85	*Trapania maculata*	X	X			
86	*Trinchesia genovae*	X		X		X
87	*Tylodina perversa*	X				
88	*Weinkauffia turgidula*					X
	Number of species	51	24	31	11	34

observed species and 19 heterobranch species recorded exclusively in this area. The current checklist of heterobranchs from Fiesa could serve as a baseline for future monitoring of this area, which is currently subject to intense recreational diving tourism. Future surveys, especially during other seasons, are necessary to gather more information about the presence and seasonality of marine heterobranch fauna.

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VPOGLED V FAVNO POLŽEV ZAŠKRGARJEV FIESE (SLOVENIJA, SEVERNI JADRAN)

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POVZETEK

Avtorji so raziskovali favno morskih polžev zaškrgarjev (Heterobranchia, Gastropoda) v Fiesi, turistični destinaciji in enem najbolj priljubljenih potapljaških krajev v Tržaškem zalivu (severni Jadran). Primerke zaškrgarjev so popisovali med novembrom 2021 in januarjem 2022. Popisali in določili so skupno 30 vrst iz 6 višjih taksonov (Cephalaspidea 1, Aplysiida 1, Umbraculida 1, Sacoglossa 3, Pleurobranchida 2, Nudibranchia 22). Vključno s predhodno objavljenimi in zabeleženimi podatki se je skupno število trenutno znanih vrst na območju raziskave povečalo na 51. Smiselno je pričakovati, da bodo prihodnje raziskave, ki bodo vključevale dodatne metode vzorčenja in bodo izvedene v drugih letnih časih, še povečale število zabeleženih morskih vrst polžev zaškrgarjev, ki naseljujejo to območje.

Ključne besede: morski polži zaškrgarji, seznam vrst, potapljanje z avtonomno potapljaško opremo, Fiesa, rekreativni potapljači

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WOUNDS INFLICTED ON HUMANS BY THE WHITE SEABREAM (*DIPLODUS SARGUS*): FIRST SCIENTIFIC REPORT OF AGGRESSIVE BEHAVIOR

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ABSTRACT

Fish bites at sea are typically attributed to aggressive and large-sized species, such as sharks, while reports of attacks by smaller, non-aggressive species are usually rare. This study presents the first documented cases of Diplodus sargus *(the White Seabream) bites on humans. Two episodes involving minor injuries to swimmers, while in one of the cases medical treatments were needed. The bites affected the limbs and resulted in medium/small though relatively deep wounds. Over the last 15 years, similar cases have been reported elsewhere in the Mediterranean Sea, raising some alarm among beach users and stakeholders. Anecdotal speculation, unsupported by experimental evidence, has been made on the role of factors such as heatwaves and increased water temperatures in the shift toward aggressive behavior in typically non-threatening species. This study provides the first account of three such incidents of this kind and prompt scientific research aimed at unveiling their causes.*

Key words: fish attacks, behavioral change, coastal water, Sparidae, wounds

FERITE INFERTE ALL'UOMO DAL SARAGO MAGGIORE (*DIPLODUS SARGUS*): PRIMA SEGNALAZIONE SCIENTIFICA DI COMPORTAMENTO AGGRESSIVO

SINTESI

I morsi di pesci in mare sono tipicamente associati a specie aggressive e di grandi dimensioni come gli squali, mentre le segnalazioni di attacchi da parte di specie più piccole e non aggressive sono solitamente rare. Questo studio presenta i primi casi documentati di morsi di Diplodus sargus *(il sarago maggiore) su esseri umani. Due episodi hanno coinvolto lievi ferite ai nuotatori, mentre in uno dei casi sono stati necessari trattamenti medici. I morsi hanno interessato gli arti e hanno provocato ferite di media/piccola entità, ma relativamente profonde. Negli ultimi 15 anni, casi simili sono stati segnalati altrove nel Mar Mediterraneo, suscitando una certa preoccupazione tra i bagnanti e gli operatori del settore. Speculazioni aneddotiche, non supportate da prove sperimentali, hanno suggerito il potenziale ruolo di fattori come le ondate di calore e l'aumento delle temperature dell'acqua nello sviluppo di comportamenti aggressivi in specie tipicamente non pericolose. Questo studio mira a fornire un primo resoconto dettagliato di questi incidenti e a stimolare la ricerca scientifica per svelare le cause dei comportamenti osservati.*

Parole chiave: attacchi di pesci, variazioni comportamentali, acque costiere, Sparidae, ferite

INTRODUCTION

Encounters with dangerous marine organisms can be harmful to or even deadly for humans, potentially involving stings, bites, blunt trauma, and other types of injuries, envenomation or accidental ingestion (James & Mark, 2019; Geng *et al*., 2023). Fish bites are generally rare, especially in the Mediterranean Sea, and are often attributed to species with well-documented aggressive behavior, such as sharks (Lowry *et al*., 2009); some species of fish and other marine fauna are known to be potentially aggressive if manipulated (e.g., during fishing activities) (Nascimiento Da Costa *et al*., 2020). Reports of bites by common, typically non-aggressive fish species have been scarce or undocumented in scientific literature, although the study of such unexpected behavior could represent an intriguing aspect of marine biology.

Lesions in fishermen and bathers caused by fish bites primarily affect the hands and limbs, resulting in pain and bleeding (Berkowitz & Goldsmith, 2016; Nascimiento Da Costa *et al*., 2020). In addition to physical damage – which, depending on the species involved and its size, can also affect tendons and nerves, requiring thus sutures – the wounds can become infected due to bacteria (both Gram-positive and Gram-negative) and mycobacteria (von Graevenitz *et al*., 2020; Strutt & Avendano, 2022), as is the case with any wound exposed to seawater. It is worth mentioning that, in most cases, individuals bitten by fish are unable to identify the species responsible, as they are often not experts and, especially in the case of recreational swimmers, may find it difficult to even locate the individual(s) responsible for the bite underwater (Vanni *et al*., 2022).

The White Seabream (*Diplodus sargus*) is a sparid species widely distributed in the Mediterranean Sea and the adjacent northeastern Atlantic waters. It is a coastal fish that primarily feeds on crustaceans, bivalves, and sea urchins, with larger specimens also preying on bigger species, such as other fish (Guidetti, 2006; Osman & Mahmoud, 2009; Miccoli *et al*., 2021). It is primarily known for its importance in commercial and recreational fisheries (e.g., Tiralongo *et al*., 2023), while its aggressive behavior toward humans and the related safety risks have not been treated in scientific literature yet.

In this study, we present the first documented scientific records of *D. sargus* attacks resulting in injury to humans. The incidents, which occurred along the Italian coasts during recreational activities, highlighted unexpected behavioral interactions between this species and bathers. A total of three cases were recorded and documented photographically in summer 2024, providing concrete evidence of this uncommon behavior. To the best of our knowledge, there are no scientific reports of similar events involving the White Seabream. However, newspapers from Spain, Israel, and Croatia have reported several cases of humans being attacked by fish often referred to as *D. sargus*. The objective of this work is to describe these incidents in detail, analyze factors potentially contributing to such unusual interactions, discuss their possible causes, and consider the implications they may have for human activities in the Mediterranean region. This report aims to fill a gap in the current understanding of *D. sargus* behavior and contribute to a better understanding of human–wildlife interactions in marine environments.

MATERIAL AND METHODS

The data for this study were collected through detailed, unstructured telephone interviews with individuals involved in fish biting attacks or, in the case of one minor, their relatives. These interviews were complemented by photographic evidence of the injuries, providing comprehensive and accurate documentation of each case. The photos were initially shared by the interviewees within the Fauna Marina Mediterranea Facebook group, which currently has over 28,000, mostly Italian, members. Administered by one of the authors (FT), the group is frequented by specialists and researchers in marine biology, as well as a diverse community of marine enthusiasts, including divers, recreational and professional fishermen, and beachgoers. The photographic posts prompted further inquiry and facilitated accurate documentation and validation of each case.

The fish bite injuries of the first case were documented on 21 August 2024, at Lido Arenella, Syracuse (Mediterranean Sea, Ionian Sea, southeastern Sicily - 36.99641 N, 15.26467 E), in shallow waters approximately 1 m deep. The area features a small beach, about 200 m long, located south of the city of Syracuse and the Plemmirio Marine Protected Area. The seabed here is very shallow, with small rocky formations and patches of *Posidonia oceanica* (L.) Delile located a bit further offshore and along the sides. The beach is very popular during the summer months. The incident involved a 70-year-old female swimmer entering deeper waters. A single fish, approximately 15-20 cm in size (total length), repeatedly attacked her legs at multiple spots and followed her to the shore. At the time of the incident, the water conditions were calm and clear.

A second case was recorded on 5 September 2024 at Morghella Beach, Portopalo di Capo Passero (Mediterranean Sea, Ionian Sea, southeastern Sicily - 36.70297 N, 15.12330 E), involving an 11-year-old boy who suffered multiple bites from White Seabreams (*Diplodus sargus*) over several days, always at the same location, in waters approximately 1 meter deep. The father of the boy observed a single fish biting the boy during snorkeling, each time in

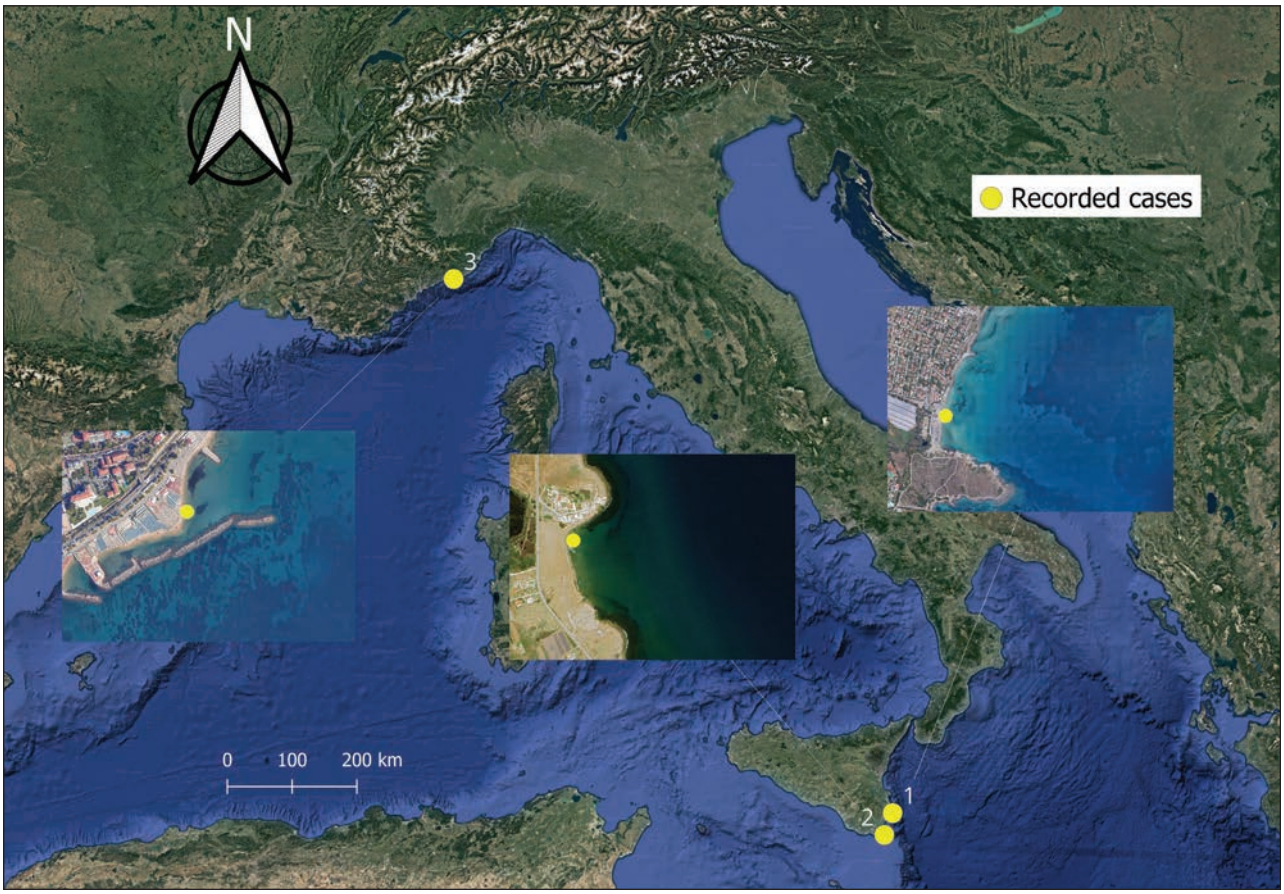

Fig. 1: Documented records (yellow circles) reported in this study of wounds inflicted on humans by *Diplodus sargus* ***in the Mediterranean Sea (1: Syracuse; 2: Portopalo di Capo Passero; 3: Sanremo).***
Sl. 1: Dokumentirani zapisi (rumeni krogi), ki jih v tej študiji avtorji poročajo o ranah, ki jih je *Diplodus sargus* ***prizadejal ljudem v Sredozemskem morju (1: Sirakuze; 2: Portopalo di Capo Passero; 3: Sanremo).***

the same spot, and was able to identify the species responsible for the injuries. Morghella Beach is very similar to Lido Arenella in Syracuse in size and environmental features: it is shallow, with a mix of sandy stretches and small rocky areas that provide a habitat for *P. oceanica*. Morghella is a popular summer destination, attracting many visitors due to its beautiful setting and accessible location.

A third case was documented on 4 August 2024 near Sanremo, in the Ligurian Sea (Mediterranean Sea, Italy, 43.81023 N, 7.76619 E). The incident involved a 60-year-old man who was bitten once by an unidentified fish near the shoreline (in waters approximately 0.5 m deep). The beach where the incident occurred is about 400 m long and protected by a breakwater made of artificial blocks. This, too, is a very crowded location during the summer months and characterized by calm waters.

The locations of the three recorded cases are shown in Figure 1 and discussed below in order of relevance based on the severity of the reported injury.

RESULTS AND DISCUSSION

First case – 21 August 2024

The attacking fish was almost certainly a White Seabream (*D. sargus*), with an estimated total length of 15–20 cm. It was described as having an oval-shaped body, white coloration, distinctive vertical grey stripes, and a black spot on the caudal peduncle – all diagnostic features of the White Seabream. Its identity was confirmed by the individual who was bitten, upon examining photos of sparid species which typically inhabit shallow beach waters, including the White Seabream (*D. sargus*), the Sand Steenbras (*Lithognathus mormyrus*), and the Saddled Seabream (*Oblada melanura*). After the initial bite, the fish continued to follow the woman to the shore, repeatedly and violently biting her. The most severe wound the woman suffered was to her left calf, measuring approximately 4–5 cm in diameter and likely resulting from multiple bites (Fig. 2a).

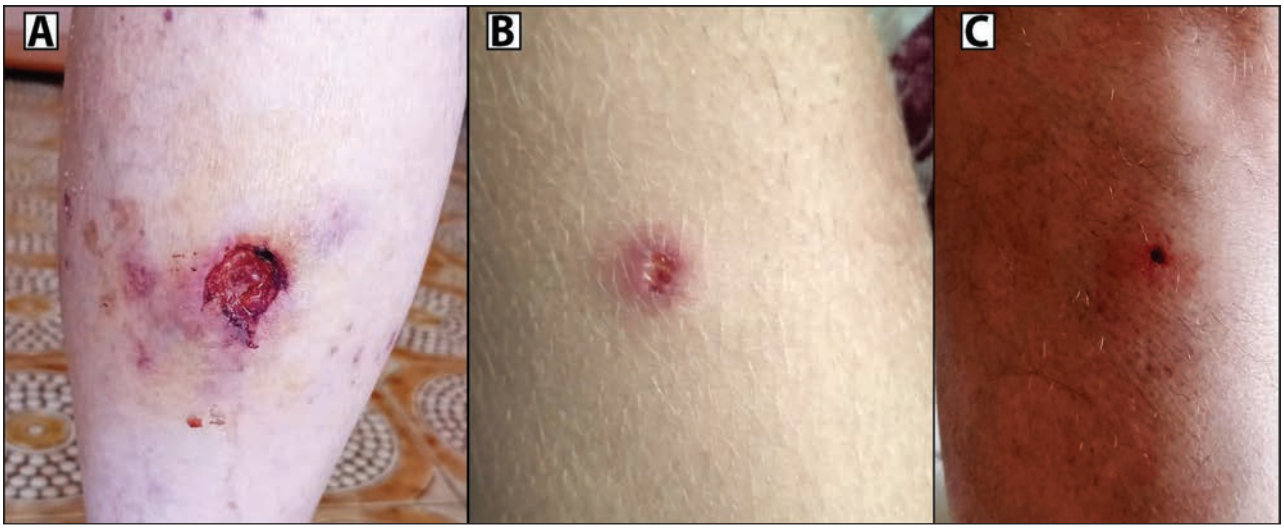

Fig. 2: Wounds inflicted on humans by** D. sargus **(A= 1 in map; B= 2 in map; C= 3 in map).
Sl. 2: Rane, ki jih je** D. sargus **prizadejal ljudem (A= 1 na zemljevidu; B= 2 na zemljevidu; C= 3 na zemljevidu).

She also sustained smaller injuries on her right leg, around 1 cm in diameter. She was bleeding profusely from all her wounds as she exited the water, screaming for help. Medical treatment included the application of antibiotic and healing ointments (e.g., connectivine) following a medical consultation. There was no need for hospitalization. The 70-year-old woman reported coagulopathy, advanced age, fragile skin, and a propensity for easy bruising and micro-injuries. These factors, combined with the repeated aggressive behavior of the fish, underscore the severity of the incident.

Second case - 5 September 2024

The injury in this case was located on the right shin, consisting of a single wound approximately 5 mm in diameter and caused by the repeated biting actions of the fish (Fig. 2b). The phenomenon of White Seabream (*D. sargus*) attacks in this area has been known for over 10 years, with increases in the frequency during warmer water periods. But the trend concerning the individuals involved has shifted from smaller to larger seabreams reaching sizes of up to a hand (15–20 cm) and inflicting more severe wounds. The studied biting attacks were not isolated incidents, but occurred repeatedly over several days, with the fish targeting the boy's pre-existing minor wounds, such as mosquito bites, scabs, and other skin abrasions. Despite the presence of various fish species in the area, the boy's father confirmed that only White Seabreams were seen engaging in this aggressive behavior toward swimmers. Immediate care for the wounds involved cleaning and monitoring for signs of infection, but no major medical intervention was needed.

Third case - 4 August 2024

The man sustained a single, relatively deep wound below the right knee, measuring approximately 3 mm (Fig. 2c). Despite its small size, the wound was notably deep, but no medical treatment was necessary. The fish's attack near the shore highlights the potential for such incidents to occur even in shallow, sheltered waters. After conducting research online, the man who was bitten concluded that it might have been a Saddled Seabream (*O. melanura*) rather than a White Seabream (*D. sargus*); however, the lack of direct observation makes the identification uncertain.

Considerations

Fish bites, although relatively rare compared to other injuries caused by marine animals – especially in the Mediterranean Sea – raise medical concerns due to their potential for severe tissue damage and subsequent infections (Berkowitz & Goldsmith, 2016; Lowry *et al.*, 2009; Nascimiento Da Costa *et al.*, 2020; Geng *et al.*, 2023). These injuries are primarily associated with predatory or aggressive fish species, such as sharks and bluefish (*Pomatomus saltatrix*). Although the Bluefish – a species widely distributed in the Mediterranean Sea – despite it is smaller than potentially dangerous sharks, it has very sharp teeth. Its bite can result in deep lacerations and even amputations (Vanni *et al.*, 2022).

A rather emblematic event in the Mediterranean Sea was the recent attack of a *Lagocephalus sceleratus* (pufferfish), a non-indigenous Lessepsian species, on an 8-year-old girl. The fish bite resulted in the partial amputation of the girl's finger. This incident

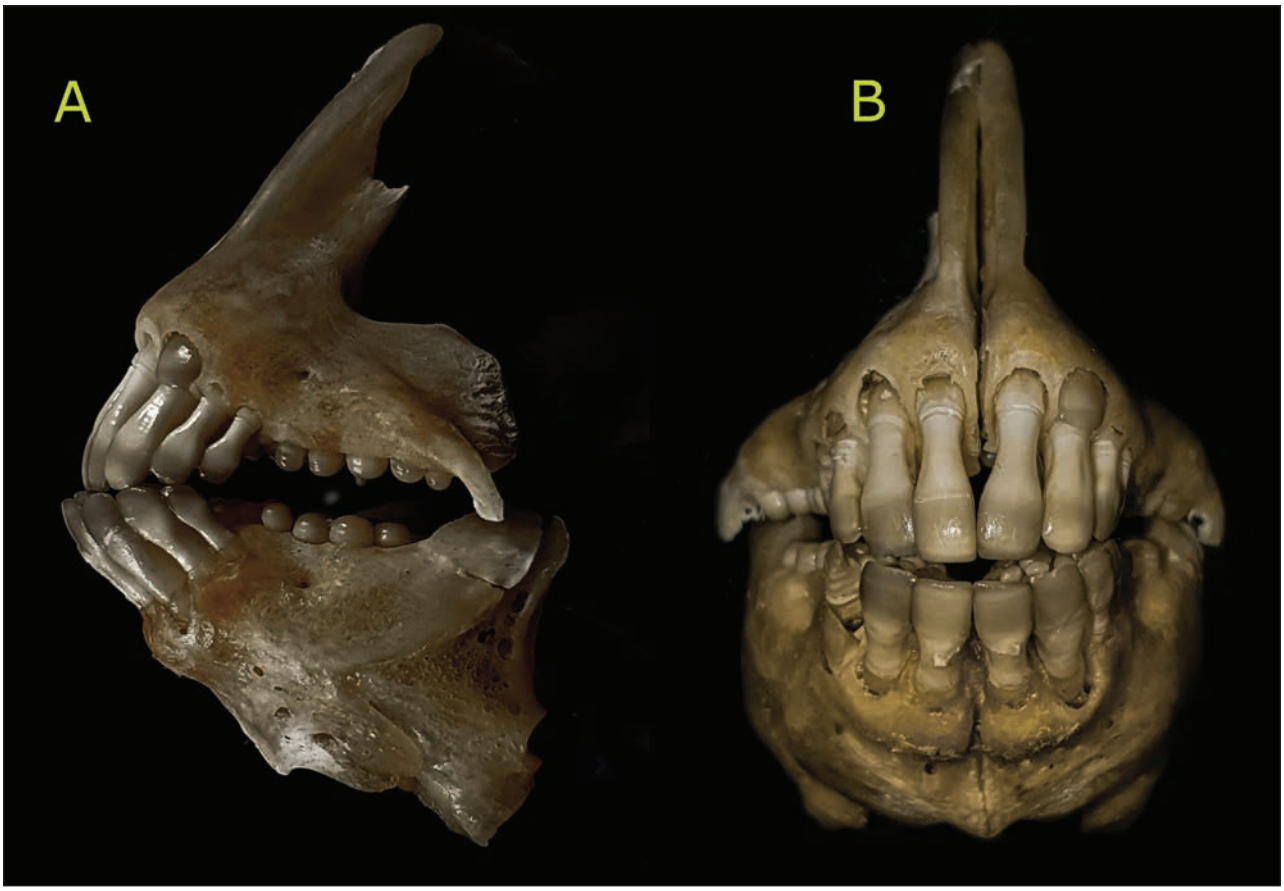

Fig. 3: Jaws and dentition of the White Seabream** (D. sargus) **in lateral (A) and frontal (B) view. Note that this specimen is much larger than those which attacked the swimmers. It was caught in September 2024 in southeastern Sicily (Avola) and weighed 924 grams (photo by F. Tiralongo).
Sl. 3: Čeljusti in zobovje šarga** (D. sargus) **s strani (A) in od spredaj (B). Upoštevajte, da je ta primerek veliko večji od tistih, ki so napadli plavalce. Ujet je bil septembra 2024 na jugovzhodni Siciliji (Avola) in je tehtal 924 gramov (foto: F. Tiralongo).

highlights how anthropogenic changes in biodiversity can directly and indirectly increase the occurrence of such accidents (Sümen & Bilecenoğlu, 2019).

Anecdotal evidence from media interviews in newspapers and websites indicates that *D. sargus* specimens of various sizes have occasionally been involved in biting incidents with swimmers in summer vacation areas of the Mediterranean Sea. It is speculated that such events occur particularly during warm periods or heatwaves, when the fish may be more active or agitated. However, it is not possible to determine whether increased aggressiveness of *D. sargus* is in direct correlation with rising seawater temperatures, also considering that holiday vacation sites in the Mediterranean Sea are typically overcrowded with tourists during the warmer season, increasing the likelihood of encounters between fish and humans. Focused experiments are needed to ascertain the effect of rising seawater temperatures on the behavior of the White Seabream.

Young *D. sargus* are not as elusive as other juvenile fish and typically do not flee from humans. It is common for curious young fish of both *D. sargus* and *O. melanura* species to approach bathers along the sandy shores of the Italian coast, often nibbling on human limbs without causing injury – only mild pain. This was confirmed by an informal survey conducted among knowledgeable Italian marine biologists, who reported that young specimens typically target individuals standing still on the sandy bottom in shallow waters (LM, pers. obs.). Other Mediterranean experts, interviewed by newspapers and websites, suggest that avoiding proximity to other swimmers and minimizing stationary positions in shallow waters could help prevent this behavior (UltimaHora, 2003; LaOpiniónDeMurcia, 2016; Austin, 2017; Menorca, 2023; CroatiaWeek, 2024; CrónicaBalear, 2024). A topic worth further investigation is why adult specimens of *D. sargus*

exhibit the juvenile-like behavior of biting humans, as this can result in more serious consequences. One of the most critical complications following a fish bite is the risk of bacterial infection (Strutt & Avendano, 2022), which may occur when wounds are inflicted by wild animals or come in contact with seawater. Additionally, the anatomical features of certain fish, such as bluefish or pufferfish, influence the extent and nature of the wounds they inflict. For example, the bluefish has powerful jaws and razor-sharp teeth, therefore its bite can cause significant tissue damage, often requiring surgical repair for tendon and nerve lesions. The need for forensic analysis to accurately identify the species responsible for a biting attack is critical in both medical and ecological studies, as it informs proper management and prevention strategies. With its well-developed forward-pointing incisor-like teeth at the front of the jaws, this sparid can cause relatively small (depending on the fish size) but deep wounds that may require medical care and could even result in permanent scars (Fig. 3).

Given the ever-increasing human interaction with marine environments, including the expansion of coastal activities, there has been a rising incidence of fish bite injuries (Newsom *et al.*, 2023). Despite this new and aggressive behavior, clearly attributable to at least one species (*D. sargus*), no targeted scientific studies have been conducted to date. Moreover, all three beaches where interactions with humans occurred shared similar characteristics: they were small, nestled in rocky surroundings, and featuring a combination of rocky substrates and patches of *P. oceanica* in their immediate vicinity. Identifying the types of environments where these incidents are more likely to occur can help prevent them. White Seabreams are known to inhabit both rocky bottoms and mixed environments (sand and rock) but are seldom found in purely sandy areas far from other substrates.

The merit of this study lies in documenting attacks on humans by species commonly considered unharmful and providing detailed information on the dynamics and effects of the related injuries. The recurrence of these attacks along the Italian coasts in 2024, along with similar incidents observed elsewhere in the Mediterranean over the past 15 years, highlights a potential shift in adult White Seabream behavior toward aggressive interaction with humans. This calls for further investigation into the causes, potential environmental triggers, and the role of humans in behavioral changes.

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RANE, KI JIH LJUDEM ZADAJAJO ŠARGI (*DIPLODUS SARGUS*): PRVO ZNANSTVENO POROČILO O AGRESIVNEM VEDENJU

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POVZETEK

Ugrize rib v morju običajno pripisujejo agresivnim in velikim vrstam, kot so morski psi, medtem ko so poročila o napadih manjših, neagresivnih vrst običajno redka. Avtorji poročajo o prvih dokumentiranih primerih ugrizov vrste Diplodus sargus *pri ljudeh v italijanskih vodah. V dveh primerih je šlo za lažje poškodbe plavalcev, v enem od primerov pa je bila potrebna zdravniška oskrba. Ugrizi so prizadeli okončine in povzročili srednje/majhne, a relativno globoke rane. V zadnjih 15 letih so o podobnih primerih poročali tudi drugod v Sredozemskem morju, kar je sprožilo nekaj preplaha med uporabniki plaž in zainteresiranimi stranmi. Obstajajo nezanesljive špekulacije, ki niso podprte z eksperimentalnimi dokazi, o vlogi dejavnikov, kot so vročinski valovi in višje temperature vode, ki vplivajo na agresivno vedenje pri tipično nenevarnih vrstah. Ta študija predstavlja prvo poročilo o treh incidentih te vrste in hitro znanstveno raziskavo, katere cilj je razkriti njihove vzroke.*

Ključne besede: napadi rib, vedenjske spremembe, priobalne vode, Sparidae, rane

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NUOVO SITO DI NIDIFICAZIONE DI AQUILA REALE *AQUILA CHRYSAETOS* NEL SUBAPPENNINO ABRUZZESE

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SINTESI

*Le ragioni prevalenti di un confinamento dei grandi predatori alle aree montuose dell'Appennino sono da ricercare nella persecuzione diretta e nell'antropizzazione degli ambienti della fascia basale. La situazione dell'Aquila reale (*Aquila chrysaetos*) in Abruzzo non fa eccezione alla regola se, fino al 2017, il monitoraggio su scala regionale ha confermato per la specie una distribuzione ancora strettamente associata ai rilievi maggiori, con nessuna coppia nelle contigue aree subappenniniche. La scoperta (presente lavoro) nel 2017, di una coppia con giovane a seguito, all'interno di un settore collinare della media Valle del Sangro (Provincia di Chieti) rappresenta in tal senso un'eccezione, ed ha condotto ad ulteriori indagini, culminate nel monitoraggio (2017-2024) di quella che, al momento, rappresenta la realtà riproduttiva più orientale per la specie in ambito centro-appenninico. Il destino di questo avamposto dell'Aquila reale in direzione del Mar Adriatico appare ancora incerto.*

Parole chiave: Aquila reale, *Aquila chrysaetos*, nuova coppia, *Important Bird Area* 115, *rewilding area*

A NEW GOLDEN EAGLE BREEDING SITE IN THE ABRUZZO'S SUBAPENNINES (ITALY)

ABSTRACT

*Most likely, human persecution associated with the occupation of all suitable land at lower altitudes was the reason for the confinement of top predators to the mountain belt of the Apennines. The golden eagle (*Aquila chrysaetos*) is no exception to this rule, and until 2017 a population survey in the Abruzzo region confirmed that the distribution was strictly associated with the main mountain ranges, with no pairs documented in the associated outlying sub-Apennines. The discovery in late 2017 (this paper) of a pair with the fledged juvenile in the central Sangro valley (province of Chieti) triggered further investigations (2017-2024), which led to the assessment of a previously unknown breeding site (the easternmost in the Central Apennines to date) on a rugged slope less than 700 m a.s.l. on the right bank of the Sangro. Despite its location in a regional nature reserve, this outpost of the golden eagle towards the Adriatic Sea is characterised by a changing landscape whose uncertain fate oscillates between attempts at conservation and anthropogenic degradation.*

Key words: Golden eagle, *Aquila chrysaetos*, new pair, Important Bird Area 115, rewilding area

INTRODUZIONE

Il *trend* positivo della popolazione di Aquila reale (*Aquila chrysaetos*) in vari settori dell'Italia peninsulare e in particolare nell'Appennino centrale, a partire dai primi anni 2000 (Borlenghi *et al.*, 2014), rende conto di una popolazione attuale probabilmente ancora al di sotto della capacità portante e di contesti ecologici eterogenei all'interno dei quali sia possibile per la specie colonizzare nuovi territori (Campedelli *et al.*, 2020). Per quanto riguarda l'Abruzzo, la recente dinamica positiva è stata messa in relazione (Artese *et al.*, 2017) al raggiungimento di un rinnovato equilibrio naturale fondato sulla disponibilità trofica e sul sostanziale regime di tutela e protezione dell'ambiente montano all'interno del sistema di Parchi, Riserve e siti della Rete Natura 2000.

La distribuzione dell'Aquila reale sui rilievi abruzzesi (Artese *et al.*, 2017) risulta associata alle montagne e, in particolare, ai massicci principali, aree ad elevata altitudine di massa ove, al di sopra d'un ampia fascia di pertinenza delle formazioni forestali, in prevalenza faggete (*Fagus sylvatica*), siano disponibili vaste aree aperte (praterie primarie e secondarie, crinali), *habitat* di alcune tra le specie preda generalmente ritenute di primaria importanza per le esigenze trofiche della specie (Borlenghi, 2011). A dispetto dell'esistenza di alcuni ambiti considerati idonei alla nidificazione (Pellegrini & Pinchera, 2004 e 2005) l'Aquila reale risultava tuttavia assente nei settori montuosi e collinari pre-appenninici del versante adriatico.

Area di studio

L'area di studio considerata nel presente lavoro è estesa 254 km² (Fig. 1), centrata sul confine tra i territori di Borrello (804 m s.l.m.), Civitaluparella (903 m) e Fallo (575 m), comuni siti nella media vallata del Fiume Sangro in provincia di Chieti, a cavallo del bacino idrografico del fiume stesso nel settore chietino compreso tra le province di L'Aquila e Isernia; è in diretta continuità ecologica con la Maiella (M. Amaro: 2.795 m) attraverso l'allineamento del Monte Secine (1.866 m) con i Monti Pizzi (Monte Lucino, 1.626 m) ed i rilievi collinari della Valle dell'Aventino in sinistra orografica, e con l'Alto - Molise (Monte Campo, 1.746 m s.l.m.) nella parte destra. Nel contesto delle aree pre-appenniniche del settore adriatico abruzzese il Medio Sangro spicca per una generale eterogeneità ambientale la cui natura è da ricercare, prima di tutto, in una complessa caratterizzazione geologica. Si tratta infatti dei paesaggi montuosi e collinari impostati su serie sedimentarie (argille varicolori, argille marnose e arenarie) del Bacino Molisano con rilievi che raramente superano i 1.500 metri s.l.m. originati per sovrascorrimento di cospicui affioramenti carbonatici (brecce calcaree, calcareniti). I limiti, nella maggior parte dei casi tettonici, tra le diverse formazioni, sono segnati da veri e propri piani di faglia e scarpate morfologiche (Ranieri, 2005).

Le quote, affatto modeste, danno luogo ad una fascia occupata dal faggio ristretta in senso altitudinale che, soprattutto nei versanti freschi, risale sino ad avvolgere le cime principali. Nel piano sub-montano le morfologie collinari sono dominate da querceti a Cerro (*Quercus cerris*) e Roverella (*Quercus pubescens*) e da boschi misti di neo-formazione; in una ristretta zona di tensione tra i due piani sono presenti fitocenosi mesofile ad *Abies alba*, specie presente in nuclei a carattere relittuale, come quello della Riserva Naturale Regionale Abetina di Rosello (CH) al cui interno vegetano numerosi esemplari che superano i 40-50 metri di altezza. In altri contesti, condizioni edafo-xerofile marcate e critiche conducono a fisionomie, rispettivamente, del tipo *orno-ostrieto* e a formazioni rupestri di Leccio (*Quercus ilex*). Nel complesso (Fig.1) i boschi occupano il 40% dell'area di studio, per una superficie complessiva di 10.400 ettari. Le soluzioni di continuità alla copertura forestale sono rappresentate da pascoli (35%), incolti e pascoli cespugliati (15%), seminativi (5%), aree antropizzate (3%) e ambienti rocciosi (2%); i seminativi sono sovente accorpati sui terreni meno acclivi, in superfici aziendali relativamente ampie (anche > 100 ha) destinate prevalentemente a colture cerealicole. I pascoli sono estesi su un'area complessiva di 9.000 ettari, escluse le porzioni in abbandono (3.750 ha) e in lenta evoluzione verso varie forme di vegetazione legnosa.

Nella valle, attraversata da imponenti infrastrutture viarie impostate sull'asta fluviale del Sangro, le densità abitative umane risultano molto basse, concentrate in piccoli insediamenti di altura che raramente superano i 200-300 abitanti. A dispetto dell'inserimento di tutto il settore all'interno dell'I.B.A. 115 (Maiella, Monti Pizzi e Monti Frentani), nell'area sono presenti impianti con aerogeneratori (pale eoliche di media e grande taglia) per la produzione di energia elettrica. Gran parte del crinale dei Monti Frentani da Monteferrante a Castiglione Messer Marino è ormai occupato dalle pale eoliche, mentre nel settore di crinale in sinistra orografica (Monti Lupari) i progetti, avversati da rappresentanze della comunità locale e da alcune associazioni ambientaliste, ad oggi risultano scongiurati.

Oltre al settore sud-orientale del Parco Nazionale della Maiella con il comprensorio Pizzi-Secine, il Medio Sangro include le due Riserve Naturali Regionali dell'Abetina di Rosello e quella delle

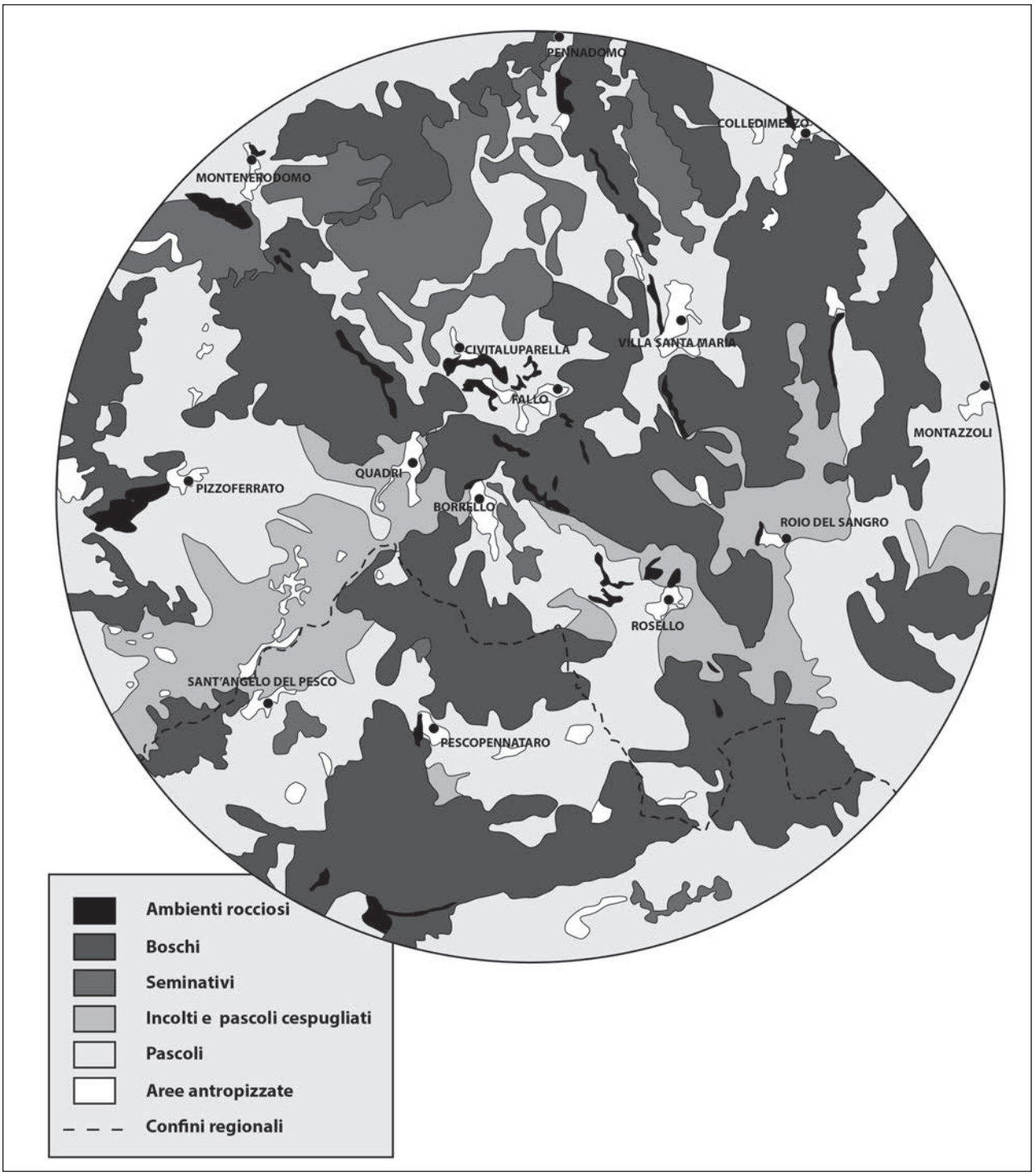

Fig. 1: Rappresentazione schematica dell'area di studio (254 km²) elaborata sulla base di un raggio pari a 9 km dalla collocazione del nido utilizzato nel 2020. In scala di grigio la caratterizzazione per categorie di uso del suolo: boschi (40%), pascoli (35%), incolti e pascoli cespugliati (15%), seminativi (5%), aree antropizzate (3%) e ambienti rocciosi (2%).
Sl. 1: Shematski prikaz obravnavanega območja (254 km²), izdelan na podlagi polmera, ki je enak 9 km od lokacije gnezdišča, uporabljenega v letu 2020. Siva lestvica prikazuje karakterizacijo po kategorijah rabe tal: gozd (40 %), pašniki (35 %), neobdelani in grmičasti pašniki (15 %), njive (5 %), antropizirane površine (3 %) in kamnita okolja (2 %).

Cascate del Verde di Borrello (entrambe afferenti alla ZSC/ZPS IT7140212), la ZSC/ZPS Bosco Paganello (IT7140115), la ZSC/ZPS Gole di Pennadomo e Torricella Peligna (IT7140210), la ZSC/ZPS Monte Pallano e Lecceta d'Isca d'Archi (IT7140211), le ZSC molisane Bosco di Vallazzuna (IT7218217) e Abeti Soprani – Monte Campo – Monte Castelbarone – Sorgenti del Verde (IT7218215). Da precisare, che tutte le ZSC del territorio abruzzese sopra citate, sono incluse nell'IBA 115 "Maiella e Monti Frentani" e sono state riconosciute anche come ZPS con D.G.R. 476/2018, proprio per la presenza di importanti specie ornitiche tra cui la più consistente popolazione in ambito regionale di Nibbio reale (*Milvus milvus*), concentrata proprio in quest'area.

Presenza storica recente

Tre uccisioni avvenute nel secolo appena trascorso rappresentano la parte più cospicua delle notizie sulla presenza storica dell'Aquila reale nel Medio Sangro. Il primo caso documentato (Associazione Pro-loco Rosello, 1999), dell'ottobre 1934, vide l'abbattimento nel territorio di Rosello (Monte La Rocca, 1.239 m) di un giovane individuo (Fig. 2). L'aquila uccisa a bastonate da un pastore a Borrello negli anni '80 (A. De Angelis, informazioni personali), in una località molto vicina alla precedente, era invece un esemplare con piumaggio da immaturo che fu poi imbalsamato e tuttora si conserva nei locali del municipio dello stesso comune. Stessa sorte per un altro esemplare, catturato negli anni '70 a Gesso-

Fig. 2: Un giovane individuo di Aquila reale catturato dal sig. Sorrento il 12 ottobre 1934, in località Monte La Rocca nel territorio di Rosello (CH).
Sl. 2: Mladosten primerek planinskega orla, ki ga je ujel g. Sorrento 12. oktobra 1934, na lokaliteti Monte La Rocca v območju Rosello (CH).

palena (CH) - territorio posto tra Maiella orientale e Medio Sangro - imbalsamato e tuttora conservato in una sala del municipio (A. Manzi, informazione personale). Un cenno, affatto vago e generico, alla percepita presenza di "qualche aquila" nel territorio di Borrello lo si ritrova solo in un contributo di topografia storica locale (Ferrari, 2009).

L'areale di distribuzione attualmente noto indica nelle coppie della Maiella sud-orientale (nidi di Taranta Peligna, Porrara e Fara San Martino) la porzione di popolazione attualmente più vicina all'area di studio; un terzo sito di nidificazione storico, posto al limite nord-occidentale della stessa, quello di Monte dell'Ellera (1.473 m) nel territorio di Ateleta (AQ), non risulta più utilizzato da almeno tre decenni. Nel Piano di Gestione della Riserva Naturale Regionale "Abetina di Rosello" (Pellegrini & Pinchera, 2004), per l'Aquila reale veniva "profeticamente" riportata la seguente nota: "*(…) nel comprensorio del Medio Sangro si stima la presenza di altri siti potenzialmente idonei alla specie (anche le balze rocciose all'interno della Riserva delle Cascate del Verde e le vicine pareti occidentali di Monte Campo, nel territorio molisano, hanno le potenzialità per ospitare il sito di nidificazione di una eventuale coppia), ipotesi da non escludere come area occupata in passato, seppure in assenza di riferimenti certi in letteratura* (Di Carlo, 1980). *Sul territorio della Riserva sono stati infatti osservati più volte individui in volo, sia giovani probabilmente erratici, sia individui adulti probabilmente appartenenti alle coppie più limitrofe, come quelle del versante orientale e meridionale della Maiella*".

Una serie di dati relativi al principio del nuovo millennio evidenziò proprio per il territorio compreso tra Medio Sangro e Maiella orientale un quadro di presenza occasionale e/o uno *status* della specie non determinato: al novembre 2004 risaliva l'avvistamento di un'Aquila reale compiuto da rocciatori in arrampicata nel territorio di Pizzoferrato (R. Iubatti, informazione personale). Altre segnalazioni (M. Pellegrini, informazione personale), tutte in Provincia di Chieti, riguardavano: un individuo sub-adulto osservato il 22 novembre 2013 posato sul Monte Serra (1.268 m) nel comune di Montenerodomo e poi scacciato da alcuni nibbi reali; due immaturi avvistati il 14 dicembre dello stesso anno nell'area collinare di Grotta Rimposta (quote medie inferiori ai 500 m) a Casoli; un immaturo sul Monte Tutoglio (355 m) a Pennadomo il 15 gennaio 2015. Il 12 ottobre dello stesso anno veniva fotografato (Cuomo & De Angelis, 2016) un esemplare dal piumaggio immaturo oggetto di *mobbing* da parte di due poiane sopra l'abitato di Fallo (575 m); si tratta quindi di un'area a ridosso del Fiume Sangro già più discosta dalla Maiella. Il 14 gennaio 2017 due individui furono osservati (A. Manzi, informazione personale) nei pressi della loc. La Morgia (827 m) nel territorio di Gessopalena (CH). Al mese di Febbraio 2017 risalgono invece due diversi avvistamenti (A. De Angelis, informazione personale), ancora riferibili all'area tra Fallo, Borrello (804 m) e Montelapiano (740 m).

MATERIALI E METODI

Al fine di individuare e localizzare il centro di gravitazione di questa nuova coppia di aquile che, da osservazioni dell'ottobre 2017, si ipotizzava ricadesse a cavallo di un'area tra le rive del Sangro nei comuni di Fallo, Borrello e Civitaluparella - si è affrontata una prima fase di studio incentrata sulla valutazione delle direttrici di volo d'ogni avvistamento diretto o raccolto da terzi ritenuti affidabili. A queste azioni abbiamo affiancato l'esecuzione di transetti di fondo-valle, in modo da avere la possibilità di effettuare osservazioni contestuali all'arrivo delle aquile su eventuali posatoi abituali. Una volta scoperta l'area dormitorio, la stessa è stata posta sotto controllo ed ha costituito il fulcro del monitoraggio, basato sull'osservazione da due postazioni favorevoli situate nella valle principale, a più di 1 km dalla zona dei posatoi. In nessun caso si è arrischiato un avvicinamento ulteriore e/o messi in atto comportamenti potenzialmente disruptivi per l'attività delle aquile (Walker, 2017). Ai dati raccolti - presenza, *status*, variabili ambientali - nelle sessioni da punto fisso nella *core area* di nidificazione (n. 230, pari a 318,24 ore complessive; tabella 1), sono stati integrati quelli ottenuti su base opportunistica compiuti dagli autori e da due persone locali ritenute, in base a comprovata esperienza, affidabili. Al fine di raccogliere dati sull'utilizzo del territorio al di fuori della zona dei posatoi si è adottato l'approccio di eseguire, con cadenza mensile, transetti su un'area circolare di circa 3 km di raggio, di cui il quartiere dormitorio rappresentasse il centro.

RISULTATI

2017 (sforzo di campo: 36 appostamenti pari a 56,83 ore):

Dal 2017 le osservazioni compiute opportunisticamente nell'area si intensificarono: nelle giornate tra il 23 e il 24 agosto a Rosello (927 m) vennero osservati un giovane dell'anno in volo tra il centro abitato e l'Abetina, e un individuo adulto presumibilmente in caccia, proveniente dal confinante territorio di Borrello e diretto verso Roio del Sangro (840 m). A partire dalla seconda settimana di ottobre dello stesso anno e all'interno d'un settore circoscritto (Borrello, Civitaluparella, Fallo, Montelapiano), la presenza di tre individui associati, una coppia riproduttiva e il giovane dell'anno, ha quindi determinato lo stimolo a cominciare un vero e proprio monitoraggio della specie sul territorio, su cui dati e risultati è basato il presente contributo.

Fig. 3: Il territorio della Riserva Naturale Regionale "Cascate del Rio Verde" nel Medio Sangro dove è localizzato il sito riproduttivo della nuova coppia di Aquila reale descritto in questo lavoro.
Sl. 3: Ozemlje regionalnega naravnega rezervata »Cascate del Rio Verde« v Medio Sangro, kjer se nahaja gnezdišče novega para planinskega orka, opisanega v tem delu.

Nel corso del mese di novembre 2017, finalmente individuammo la zona dei posatoi in una impervia valle secondaria dell'asta fluviale del Sangro (Fig. 3) caratterizzata dall'abbondanza di pareti rocciose, elevata copertura boschiva e scarsa presenza umana. I posatoi, molto ravvicinati, erano costituiti dalle branche secche esterne di lecci rupestri in formazione chiusa posta su gradoni rocciosi a mezza costa (650 m s.l.m.).

Le prime sessioni, nel corso dello stesso autunno 2017, confermarono l'utilizzo regolare da parte di almeno due aquile degli stessi posatoi notturni e portarono all'individuazione, a poche decine di metri dalla zona dei posatoi stessi, di un grosso nido (nido 1) collocato su una piccola cengia rocciosa alla quota di 670 m circa s.l.m. presso una parete con esposizione prevalente a nord-est; la nicchia è posta sull'orlo del salto orografico verticale tra la Valle del Sangro e il settore - per larghi tratti assimilabile ad un altopiano - di confine tra le province di Chieti ed Isernia coronato dal crinale di Monte Campo - Monte San Nicola. In considerazione della costante associazione del giovane dell'anno con gli adulti è indubbio che un evento riproduttivo avesse avuto luogo nella valle, anche se non si poteva avere nessuna certezza riguardo al nido utilizzato.

La copertura visiva di un'area più vasta, ha consentito l'osservazione dell'uso da parte delle aquile, e soprattutto del giovane dell'anno, di molteplici posatoi temporanei anche nella sinistra orografica (soprattutto nel territorio di Fallo), alcuni dei quali posti a distanze inferiori ad 1 km dai centri abitati più vicini all'area dei posatoi abituali.

2018 (sforzo di campo: 82 appostamenti pari a 108,33 ore):

L'ultimo avvistamento certo del giovane assieme ai genitori fu quello del 17 febbraio del 2018 a cui fece seguito una frequentazione costante, da parte degli adulti, dei posatoi abituali e del territorio circostante

sino al principio dell'estate (giugno), poi le osservazioni diminuirono drasticamente per cessare del tutto al principio di agosto. Nessun giovane dell'anno fu avvistato nell'area nel periodo tra tarda estate e principio dell'autunno, facendo quindi supporre che la stagione riproduttiva del 2018 fosse fallita, per motivi sconosciuti o che non vi fosse stata deposizione. La frequentazione dei posatoi abituali da parte della coppia è documentata fino al 18 ottobre mentre l'ultimo avvistamento dell'anno di un'aquila adulta nella stessa zona avvenne il 14 novembre.

2019 (sforzo di campo: 10 appostamenti pari a 20 ore):

Il 2019 è stato un anno contraddistinto da scarsissime attestazioni della presenza delle aquile nell'area consueta; gli unici dati riguardano due osservazioni opportunistiche (18 agosto e 26 settembre) di un individuo immaturo in volo sopra l'Abetina di Rosello. La mancanza di avvistamenti nei pressi del quartiere dormitorio si rispecchiò anche nell'assenza di segnalazioni da parte degli abitanti del settore interessato, a cavallo della Valle del Sangro, gli stessi che avevano fornito diversi dati di presenza nel corso dell'annata precedente (2017-2018). Possibile che anche nel 2019 la coppia di aquile non si sia riprodotta.

2020 (sforzo di campo: 31 appostamenti pari a 39 ore complessive):

Nelle prime giornate di gennaio del 2020 osservammo almeno un individuo adulto all'interno della presunta *core area* mostrando di far riferimento alla stessa per le ore di inattività notturne. A conferma della fedeltà al territorio, il 2 marzo una coppia di aquile adulte fu da noi osservata in volteggio sul limitrofo crinale di Roitello (608 m), nei pressi di Villa Santa Maria, a ridosso del torrente Turcano. Disturbati da alcune cornacchie, i due rapaci si allontanarono in direzione dell'area dormitorio esibendosi anche in una sequenza di volo a festoni.

Risale al successivo 30 aprile l'avvistamento di quattro aquile reali viste incrociare le traiettorie in volteggio, alte tra Fallo e Civitaluparella; due di queste si dirigeranno prontamente verso l'area dormitorio nota; lo stesso giorno, all'interno del nido 1, sul cui perimetro esterno si notava l'aggiunta di materiale vegetale fresco, veniva osservata un'aquila adulta in atteggiamenti di delicata dedizione e cura

Fig. 4: Il sito riproduttivo fotografato il 13 luglio 2020 con l'adulto sul posatoio abituale e il giovane ancora nel nido, involatosi pochi giorni dopo.
Sl. 4: Gnezdišče, fotografirano 13. julija 2020 z odraslim na običajnem počivališču, mladiči pa so še vedno v gnezdu, saj so odleteli nekaj dni kasneje.

verso la concavità interna. Al principio di maggio risale la prima osservazione e documentazione di uno degli adulti nell'atto di strappare pezzetti di carne da una carcassa di lepre (*Lepus* sp.) e avvicinarli col becco all'interno del nido. Le osservazioni dirette del pulcino, uno solo, partono dal primo di giugno e si protraggono per gran parte del periodo di allevamento al nido (Fig. 4). Negli ultimi due giorni precedenti l'involo, l'aquilotto sembrava indugiare sull'orlo del precipizio sottostante per poi ritirarsi in lunghe fasi di riposo. Il mattino del 23 luglio, dopo le ore 9:00 il nido è risultato vuoto; l'ultima osservazione del giovane nel nido è stata quella delle 19:30 della sera precedente.

A supporto dell'osservazione che il primo involo è spesso assimilabile ad un rocambolesco atterraggio nelle immediate vicinanze del nido (Walker, 2017), il 3 di agosto il giovane si trovava confinato, e parzialmente occultato dalla vegetazione, su una minuscola protuberanza rocciosa sulla stessa parete del nido, poche decine di metri discosto da questo ed a quota leggermente più bassa (660 m); le prime localizzazioni del giovane in volo, a meno di 1 km dal sito di nidificazione, riguardano la prima settimana di settembre. Diversamente dal giovane presente nella stessa area nel 2017-2018, per questo del 2020 non è stato documentato nessun episodio di vocalizzazione, né in fase di allevamento né nel corso dei voli insieme ai genitori. Le tre aquile sono state più volte individuate mentre sorvolavano le dorsali collinari ricche di pinnacoli rocciosi in sinistra orografica della valle del Sangro (territori di Fallo e Civitaluparella), immediatamente a nord del sito riproduttivo; tuttavia, dalla seconda decade di novembre gli avvistamenti sono cessati del tutto e quando, a metà dicembre, due individui hanno fatto la loro ricomparsa nella *core area*, si trattava di esemplari adulti.

2021 (sforzo di campo: 35 appostamenti pari a 52,17 ore)

Nel corso di gennaio e febbraio 2021 le due aquile venivano osservate strettamente associate sia in volo che nella scelta dei posatoi, le cui localizzazioni riguardano un settore posto a 1,3 km dalla zona dei posatoi notturni noti e a circa 1 km dal nido del 2020, in un'area più interna ed appartata rispetto alle infrastrutture viarie principali e al Fiume Sangro. Una delle aquile ha utilizzato anche un posatoio noto dal 2018 mentre particolare interesse veniva mostrato, da entrambe, per una postazione collocata su lecci rupestri le cui chiome orlano il salto verticale della parete principale a circa 700 m s.l.m. Su questa, appena sotto il suddetto posatoio tra i lecci, individuammo il secondo nido attivo (nido 2), sicuramente occupato in data 23 marzo. Si trattava di un esiguo accumulo di materiale vegetale su stretto ripiano roccioso associato ad una piccola cavità ove la luce diretta non penetra mai, a quota 670 m circa ed esposto a NE. La visuale sul sito è pessima, sia per la distanza maggiore dalle nostre postazioni consuete che per la scarsa illuminazione. Tuttavia, allo scopo di non rischiare, avvicinandosi, di arrecare qualsivoglia sorta di disturbo, si decise di continuare ad utilizzare le stesse postazioni di osservazione. A metà maggio risultava evidente che anche per quell'anno sarebbe stato solo un pulcino ad essere allevato; il *pullus* trascorreva il tempo intercorrente tra i pasti all'interno della cavità, pertanto era osservabile quasi esclusivamente all'arrivo degli adulti, quando si spingeva all'esterno del riparo per nutrirsi. Nel corso della sessione di controllo rispetto alla fase finale di allevamento al nido effettuata in data 19 luglio il nido risultava vuoto e le aquile adulte assenti; di pochi giorni dopo (9 agosto) è stata la segnalazione (A. Manzi, informazione personale) di una coppia di aquile adulte in volo sopra Coste Petrilli (1.036m) nel territorio di Rosello (CH), località che dista circa 3 km dal nido dell'anno. Altre cinque sessioni a cavallo della fine di settembre e il principio di ottobre non restituirono alcuna evidenza della presenza della specie all'interno della *core area* e/o nei settori limitrofi. Il 26 ottobre due aquile adulte effettuarono però quello che sembrò a tutti gli effetti un volo di *display* territoriale, proprio sopra l'area dei due siti di nidificazione noti; le successive nove sessioni, tra novembre e dicembre, avrebbero però dato tutte esito negativo, con nessun avvistamento. La mancanza di osservazioni di giovani dell'anno nell'area ci ha lasciato ipotizzare che l'aquilotto osservato nel nido a primavera inoltrata non fosse arrivato a completare lo sviluppo e quindi all'involo.

2022 (sforzo di campo: 26 appostamenti pari a 31,91 ore)

Al principio del 2022 la coppia fu osservata regolarmente all'interno della *core area*. Le due aquile mostrarono una stretta associazione nella fase di riposo e fu in seguito possibile osservare anche alcune episodi di accoppiamento. Dal 17 marzo osservammo l'inizio della fase di cova nel nido del 2020 (n.1); al principio di maggio risultò evidente l'allevamento di almeno un pulcino ma, esattamente un mese dopo il nido risultava abbandonato (F in tabella 1) con nessuna evidenza della presenza delle aquile all'interno dell'area.

2023 (sforzo di campo: 5 appostamenti pari a 5 ore)

Nel 2023, in due sessioni, fine aprile e inizio giugno, viene documentata l'avvenuta nidificazione nel nido utilizzato negli anni 2020 e 2022, con l'allevamento di un solo pulcino. Non abbiamo però dati sull'esito della stagione riproduttiva.

Tab. 1: Quadro riepilogativo delle annate riproduttive dell'Aquila reale nell'area oggetto di studio e dello sforzo di campo profuso (monitoraggio da punti fissi nella core area di nidificazione, esclusi transetti). Le campiture evidenziate (in grigio) indicano il riscontro positivo delle singole fasi del ciclo riproduttivo. Il punto interrogativo è utilizzato in assenza di dati. Id. nido: numero identificativo del nido utilizzato; F= fallimento di allevamento accertato; la data (6/04) si riferisce all'ultima osservazione utile compiuta durante la stesura di questo lavoro.
Tab. 1: Povzetek gnezditvenih let planinskega orla na proučevanem območju in opravljenega terenskega dela (monitoring s stalnih postaj v osrednjem gnezditvenem območju, razen transektov). Poudarjene celice (v sivi barvi) označujejo pozitivne povratne informacije posameznih faz razmnoževalnega cikla. Vprašaj je uporabljen v primeru pomanjkanja podatkov. ID gnezda: identifikacijska številka uporabljenega gnezda; F= potrjen neuspeh vzreje; datum (6/04) se nanaša na zadnjo uporabno ugotovitev med pisanjem tega dela.

Anno	Sforzo di campo (giornate ed ore complessive)	Presenza (nella *core area*)	Deposizione	Cova	Allevamento (n. pulli rilevati)	Involo (data)	Post-involo (ultima osservazione)	Identificativo nido
2017	36 (56,83)						**1 (17/02/2018)**	**?**
2018	82 (108,33)							
2019	10 (20)							
2020	31 (39)				**1**	**23/07**	**20/11/2020**	**1**
2021	35 (52,17)				**1**			**2**
2022	26 (31,91)				**1 (F)**			**1**
2023	5 (5)				**1**	**?**	**?**	**1**
2024	5 (5)			**(6/04)**	**?**	**?**	**?**	**1**
totale	230 (318,24)							

2024 (sforzo di campo: 5 appostamenti pari a 5 ore)

Lo stesso vale per il 2024 ove pure è stata osservata la fase di cova (aprile) all'interno dello stesso nido ma non si è avuto possibilità di monitoare il resto della stagione riproduttiva.

DISCUSSIONE E CONCLUSIONI

Un'*escalation* di avvistamenti occasionali (2004-2017) di individui di Aquila reale su aree ricadenti in un settore esterno all'areale di distribuzione noto per la specie ha stimolato una ricerca che a partire dall'autunno del 2017 ha raccolto le prime evidenze della presenza di una nuova coppia per l'Abruzzo nel Medio Sangro. Distaccata geograficamente dal baricentro della popolazione appenninica coincidente con l'asse della dorsale dai massici e le montagne più elevate, la coppia rappresenta attualmente l'avamposto orientale della popolazione regionale (Fig. 5). Il sito di nidificazione più vicino, tra quelli storicamente noti, risulta essere quello di Monte dell'Ellera (Ateleta), localizzato a soli 11 km di distanza, ma non viene più occupato da almeno tre decenni. Le coppie più prossime all'area di studio sono invece quelle della Maiella SE - nidi di Taranta Peligna e Porrara, distanti entrambi circa 19 km e Fara San Martino a 22 km. Altri siti, sulla Maiella e nell'Alto Sangro (Parco Nazionale d'Abruzzo, Lazio e Molise) distano circa 30 km; molto più distanti i siti del Molise. La quota dei nidi della coppia studiata (670 e 700m s.l.m.) è significativamente bassa se confrontata con altri areali dell'Appenino centrale e dell'Italia in generale (Borlenghi, 2014).

Il territorio della nuova coppia, caratterizzato da una elevata varietà di specie preda potenziali (Pellegrini & Pinchera, 2014; Masciovecchio *et al.,* 2015), sembrerebbe un contesto adeguato alle esigenze trofiche dell'Aquila reale. Tra gli ungulati selvatici, oltre al Capriolo (*Capreolus capreolus*) e al Cinghiale (*Sus scrofa*) presumibilmente presenti con popolazioni abbondanti - il Cervo (*Cervus elaphus*) è protagonista di un lento fenomeno di ricolonizzazione a partire dalle popolazioni "serbatoio" dei vicini parchi nazionali, probabilmente rallentato dal perdurare di un fenomeno strisciante di prelievo illegale (A. De Angelis, informazione personale). Nel quadro faunistico generale dell'area di studio, tra gli altri mammiferi che rientrano nello spettro trofico dell'Aquila reale, oltre alla Lepre comune e alla Volpe (*Vulpes vulpes*), sono rappresentati tutti i mustelidi della fauna appenninica, lo Scoiattolo nero (*Sciurus meridionalis*) ed il Ghiro (*Glis glis*), quest'ultimo particolarmente abbondante nei querceti con piante mature (A. De

Angelis, informazione personale) e nei boschi misti, soprattutto nelle formazioni forestali con presenza di Abete bianco (Pellegrini & Pinchera, 2014).

A parziale completamento del quadro generale di prede potenziali delle aquile, in un settore di pascoli abbandonati tra i comuni di Fallo, Civitaluparella e Montelapiano (740 m) è stata segnalata (A. De Angelis, osservazione personale) anche la Starna (*Perdix perdix*), specie oggetto di un contestuale tentativo di reintroduzione a scopo venatorio. Sono inoltre presenti abbondanti popolazioni di turdidi, corvidi e columbidi (*Columba palumbus* in particolare) e si presume che il sorvolo occasionale da parte delle aquile del Lago del Sangro, bacino di origine artificiale per sbarramento del fiume stesso, possa anche essere messo in relazione alla presenza di numerose specie ornitiche (Pellegrini, 2018) potenzialmente predabili.

Non essendo state compiute osservazioni di alimentazione su carcasse o di predazione diretta, si ignora il peso relativo del bestiame domestico - presente limitatamente a piccole realtà sparse di allevamento di ovi-caprini e a pochi capi bovini al pascolo semi-brado, concentrati nell'area tra la provincia di Chieti e l'Alto Molise - nella dieta delle aquile.

Il monitoraggio del nuovo sito riproduttivo e dell'area circostante ha raccolto elementi utili a ritenere molto plausibile la nidificazione per il 2017 (adulti e giovane dell'anno associati e presenti continuativamente fino alla primavera successiva) e, soprattutto, ha documentato l'allevamento di quattro pulli (dal 2020 al 2023), dopo due annate (2018 e 2019) apparentemente fallimentari in cui l'effettiva riproduzione non è stata confermata. Sulla base delle numerose osservazioni primaverili ed estive della coppia svincolata da qualsiasi attività di cura parentale, e sulla scorta dell'assenza di avvistamenti/segnalazione di giovani aquile nell'area, escluderemmo infatti che nel 2018 la coppia abbia allevato con successo. Va forse osservato che i mesi di maggio e giugno 2018 sono stati straordinariamente piovosi e la pioggia incessante avrebbe potuto influire (Walker, 2017) sia sul potere di termoregolazione dei pulcini che sulla capacità da parte degli adulti di cacciare e rifornire adeguatamente la prole.

Per il 2019 il fallimento è più incerto perché gli stessi avvistamenti della specie sono stati scarsissimi e coincidenti con due osservazioni consecutive di un giovane immaturo; rimane il dubbio che potrebbe essersi trattato di un giovane allevato in un nido non individuato perché posto in un altro settore della valle.

Nella stagione riproduttiva del 2020 abbiamo documentato lo sviluppo di un solo aquilotto che si è involato tra il 22 e il 23 luglio, ed ha frequentato l'area circostante almeno fino al mese di Novembre; nel 2021, l'unico pulcino presente, allevato in un nido diverso da quello della precedente annata riproduttiva, è stato monitorato con continuità fino al mese di maggio, mese in cui, nonostante le difficoltà dovute alla distanza di osservazione e alla collocazione del nido (cavità mai illuminata) l'aquilotto è sembrato essere in salute e molto reattivo al momento dell'arrivo dei genitori. Tuttavia, il nido 2 è risultato deserto alla sessione di controllo calibrata sul periodo di involo avuto nel 2018 e non si hanno quindi dati sull'effettiva conclusione, e coronamento, del periodo di allevamento. Nei tre anni successivi (2022, 2023 e 2024) è stato riutilizzato il nido 1 e, nei primi due casi, è stato osservato un solo pulcino; nel 2022, per cause ignote, l'allevamento non è stato portato a termine e già a giugno il nido risultava abbandonato. Sull'esito delle stagioni riproduttive del 2023 (un pulcino) e del 2024 (deposizione avvenuta) - per cui è confermato l'uso del nido 1 - non abbiamo, per difetto di monitoraggio, dati disponibili.

La localizzazione dei nidi utilizzati dalla nuova coppia su pareti rocciose praticamente inaccessibili all'uomo nel contesto di ambiti vallivi e versanti apparentemente poco disturbati, conferma il *pattern* noto per la specie sull'Appennino. Va tuttavia osservato come, ad una posizione "sicura e protetta" dell'area riproduttiva e posatoi abituali corrisponda, in questo caso di studio, un immediato intorno antropizzato che comprende centri abitati, una ferrovia dismessa, un sito d'interesse turistico normalmente molto frequentato, importanti strade ed altre infrastrutture viarie, linee dell'alta tensione e, al margine dell'area di studio considerata, un cospicuo allineamento di crinale di pale eoliche. L'area prescelta dalla nuova coppia del Medio Sangro quale centro dell'attività circannuale si caratterizza per aver conosciuto un ritorno al selvatico dopo una fase storicamente non troppo lontana di affrancamento, dissodamento e messa a coltura di terre marginali in possesso feudale (Ferrari, 2009). All'interno di quello che oggi appare un ambiente forestale compatto e a tratti impenetrabile, i resti di imponenti infrastrutture in pietra a secco (muri, sostruzioni, canali, ecc.) realizzate tra '800 e '900, testimoniano l'enorme sforzo profuso dalla comunità locale per conquistarsi nuove superfici coltivabili (Manzi, 2013). All'abbandono sostanziale delle attività agro- silvo-pastorali (nel cui contesto sociale ed economico si erano verificate le uccisioni di giovani aquile), coincidente con la metà del secolo scorso, i generosi serbatoi di naturalità residua costituiti da parchi e riserve del sistema di aree protette abruzzesi, hanno verosimilmente e lentamente nutrito il processo lento di auto-organizzazione tramite il quale l'area ha riconquistato l'attuale assetto naturalistico, con

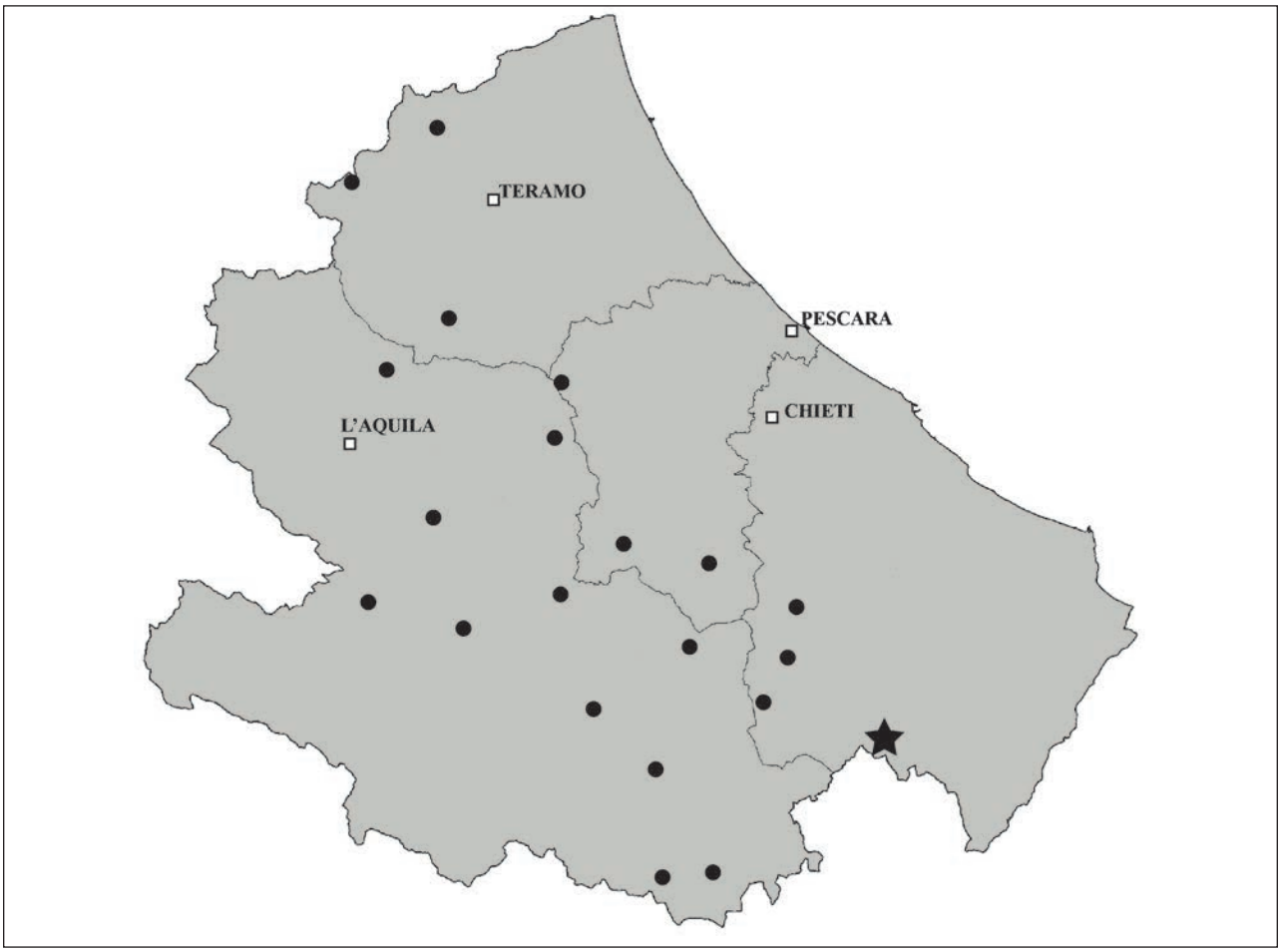

Fig. 5: Distribuzione dei siti di nidificazione certa delle 20 coppie di Aquila reale presenti in Abruzzo nel 2016 (Artese et al., 2017), con la stella viene indicato il sito della nuova coppia oggetto del presente contributo.
Sl. 5: Razširjenost gnezdišč 20 parov planinskih orlov, prisotnih v Abrucih leta 2016 (Artese in sod., 2017), z zvezdico, ki označuje gnezdo novega para, obravnavanega v tem prispevku.

l'Aquila reale e il Lupo (*Canis lupus*) al vertice della piramide alimentare. Pur non disponendo di dati certi circa la consistenza numerica delle popolazioni di ungulati selvatici e di altre potenziali prede del rapace nell'area di studio, la costanza della nostra presenza sul campo può ragionevolmente testimoniare per una abbondante e diversificata disponibilità trofica, soprattutto di prede vive. La distanza di osservazione dai nidi, adottata per ovvie ragioni di minimizzazione del disturbo, non ha finora consentito un'adeguata introspezione nella dieta del periodo riproduttivo; se la predazione sulla lepre (resti nel nido) e sul colombaccio (osservazione diretta) erano in qualche modo prevedibili, quella sul ghiro (un caso documentato di trasporto al nido) ci è sembrata degna di interesse. Il ghiro è risultato essere infatti una risorsa determinante nella dieta dell'Aquila reale sulle Alpi - Dolomiti Friulane (Borgo, 2009) e in un settore del Preappennino centrale (Monti Lucretili; Confaloni *et al.*, 2013) ove risulta la specie numericamente più frequente (21,3 %) tra quelle riportate al nido. Il roditore è presente in gran parte degli ambienti forestali dell'area di studio e le osservazioni di volteggi persistenti sopra le cime degli alberi, in particolare sull'Abetina di Rosello che ne ospita una popolazione numerosa, potrebbero, in accordo con quanto rilevato in altri contesti di faggeta (Borlenghi, informazione personale), confermare questo tipo di caccia. Che la coppia utilizzi ambienti, e quindi risorse, diversificate, potrebbe essere dedotto dalla contestualizzazione ambientale e fisionomica-vegetazionale dei voli al di fuori della valle riproduttiva: aste fluviali, pendici erbose, orli boschivi, crinali scoperti, seminativi e quindi boschi ripariali, querceti termofili, boschi mesofili (cerrete, boschi misti, faggete, abieti-faggete), ecc. In particolare, l'importanza strategica di alcuni settori esterni alla valle riproduttiva ci è

apparsa più evidente nel corso del periodo successivo all'"involo" del giovane, nella fase cioè di cure parentali slegate dal nido: i giovani hanno sorvolato spesso i centri abitati, apparentemente soli e/o insieme agli adulti, utilizzando posatoi occasionali collocati sulle numerose formazioni rocciose libere da vegetazione presenti tra gli abitati di Civitaluparella e Fallo. Viceversa, con la sola coppia di adulti presente nella valle, la maggiore elusività e la selezione delle direttrici di volo ci ha restituito un quadro di maggior fedeltà ad alcuni capisaldi nella valle riproduttiva, comprese le vie di avvicinamento ad essa, decisamente defilate e percorse con voli spesso al di sotto della linea di crinale segnata dai boschi.

La presenza dell'Aquila Reale nel Medio Sangro, in un settore periferico all'areale di distribuzione finora conosciuto, oltre ad offrire interessanti prospettive di studio dell'ecologia della specie in ambito sub-montano, richiederà ulteriori sforzi di ricerca per approfondire l'incidenza di alcuni fattori di rischio e mortalità generalmente ritenuti di minaccia alla conservazione dei grossi rapaci, tra cui sicuramente la presenza di impianti eolici (Borgianni et al., 2023) ed altri (bracconaggio e cattura di rapaci a scopo commerciale, arrampicata in falesia in aree vietate) che ci sono stati segnalati nel corso degli anni di monitoraggio sul territorio (A. De Angelis, informazione personale). La scoperta di questo nuovo sito di nidificazione, oltre a far aumentare il numero delle coppie di Aquila reale per l'intera regione Abruzzo, peraltro, come già sottolineato, in un luogo insolito e ben distante dai grandi massicci montuosi appenninici, impreziosisce il già ricco elenco nel formulario del Sito Natura 2000 ZSC/ZPS IT7140212 "Abetina di Rosello e Cascate del Verde".

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NOVO GNEZDIŠČE PLANINSKEGA ORLA V SUBAPENINSKIH ABRUCIH

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POVZETEK

*Najverjetneje je bilo človeško preganjanje, povezano z zasedbo vseh primernih zemljišč na nižjih nadmorskih višinah, razlog za omejitev vrhunskih plenilcev v gorskem pasu Apeninov. To velja tudi za planinskega orla (*Aquila chrysaetos*), saj je do leta 2017 populacijska raziskava v Abrucih potrdila, da je bila razširjenost tesno povezana z glavnimi gorskimi verigami, brez dokumentiranih parov v pripadajočih obrobnih Podapeninih. Odkritje para z izvaljenim mladičem konec leta 2017 (ta prispevek) v osrednji dolini Sangro (provinca Chieti) je sprožilo nadaljnje preiskave (2017–2024), ki so vodile do odkritja prej neznanega gnezdišča (najvzhodnejšega v Srednjih Apeninih do danes) na razgibanem pobočju manj kot 700 m nadmorske višine. na desnem bregu reke Sangro. Kljub svoji legi v regionalnem naravnem rezervatu je za to gnezdišče planinskega orla proti Jadranskemu morju značilna spreminjajoča se pokrajina, katere negotova usoda niha med poskusi ohranjanja in antropogeno degradacijo.*

Ključne besede: planinski orel, *Aquila chrysaetos*, novi par, Important Bird Area 115, območje ponovne naselitve

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FLORA

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LA FLORA DI TARANTA PELIGNA (ABRUZZO, ITALIA)

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SINTESI

Il Comune di Taranta Peligna, situato in Provincia di Chieti (Regione Abruzzo), è parzialmente compreso nel Parco Nazionale della Majella e occupa una superficie di 21,65 km². Il presente lavoro riporta un elenco floristico dei taxa presenti nell'ambito di studio che comprende 1186 entità, tra cui 83 specie endemiche che accrescono la sua importanza fitogeografica. Lo spettro corologico mostra che le entità censite appartengono a 52 diversi corotipi ripartiti in 9 contingenti geografici.

Parole chiave: Taranta Peligna, Majella, Abruzzo, flora, fiume Aventino

THE FLORA OF TARANTA PELIGNA (ABRUZZO, ITALY)

ABSTRACT

The Municipality of Taranta Peligna, located in the Province of Chieti (Abruzzo Region), is partially included in the Majella National Park and occupies an area of 21.65 km². This paper reports a check-list of the taxa present in the study area that includes 1186 entity, including 83 endemic species that increase its phytogeographic importance. The chorological spectrum shows that the surveyed entities belong to 52 different chorotypes divided into 9 geographical contingents.

Key words: Taranta Peligna, Majella, Abruzzo, flora, Aventino River

INTRODUZIONE

Il presente articolo, attraverso le osservazioni personali degli autori e l'esame degli studi floristici noti in letteratura, è finalizzato a compilare una check-list delle specie di piante vascolari presenti nel territorio comunale di Taranta Peligna e a mettere in evidenza le sue principali caratteristiche fitogeografiche. Quest'ultimo aspetto si realizza evidenziando: 1) i corotipi a cui appartengono i taxa osservati; 2) quali di essi sono endemici, rari, invasivi, rappresentanti di particolari migrazioni floristiche avvenute in epoche passate e/o al limite del loro areale di distribuzione geografica. L'insieme di queste conoscenze è dimostrativo dell'importanza naturalistica dell'ambito di studio, è utilizzabile per una corretta gestione territoriale, tutelare le specie vulnerabili e favorire il turismo poiché la presenza di boschi e pascoli con alberi e fiori accrescono l'estetica paesaggistica, l'attrattività, il valore scientifico e ricreativo di un territorio.

Inquadramento dell'area d'indagine

Taranta Peligna (Fig. 1) è uno dei Comuni del Parco Nazionale della Majella, è situato in Provincia di Chieti, ha la popolazione di circa 300 individui che vive riunita in un unico centro compatto e la densità media è di circa 13,8 ab./km^2.

Il territorio tarantolese si trova nell'alta valle del fiume Aventino e alle pendici sud-orientali del massiccio della Majella (Fig. 2), copre la superficie di circa 21,65 km^2, si estende tra l'altitudine minima di 378 metri e quella massima di 2646 ed è caratterizzato da: 1) un settore montano con pascoli primari e secondari, rocce nude, colate detritiche e vari anfratti naturali; 2) un settore collinare con boschi in espansione, il centro urbano e terreni incolti e/o coltivati. I principali litotipi che lo costituiscono sono i seguenti: rocce calcaree paleoceniche e oligoceniche; arenarie e marne mioceniche; argille plioceniche; sabbie, detriti calcarei, depositi alluvionali ghiaioso-sabbiosi e conglomeratici olocenici (Accordi & Carboni, 1988).

Fig.1: Il centro abitato di Taranta Peligna.
Sl. 1: Mesto Taranta Peligna.

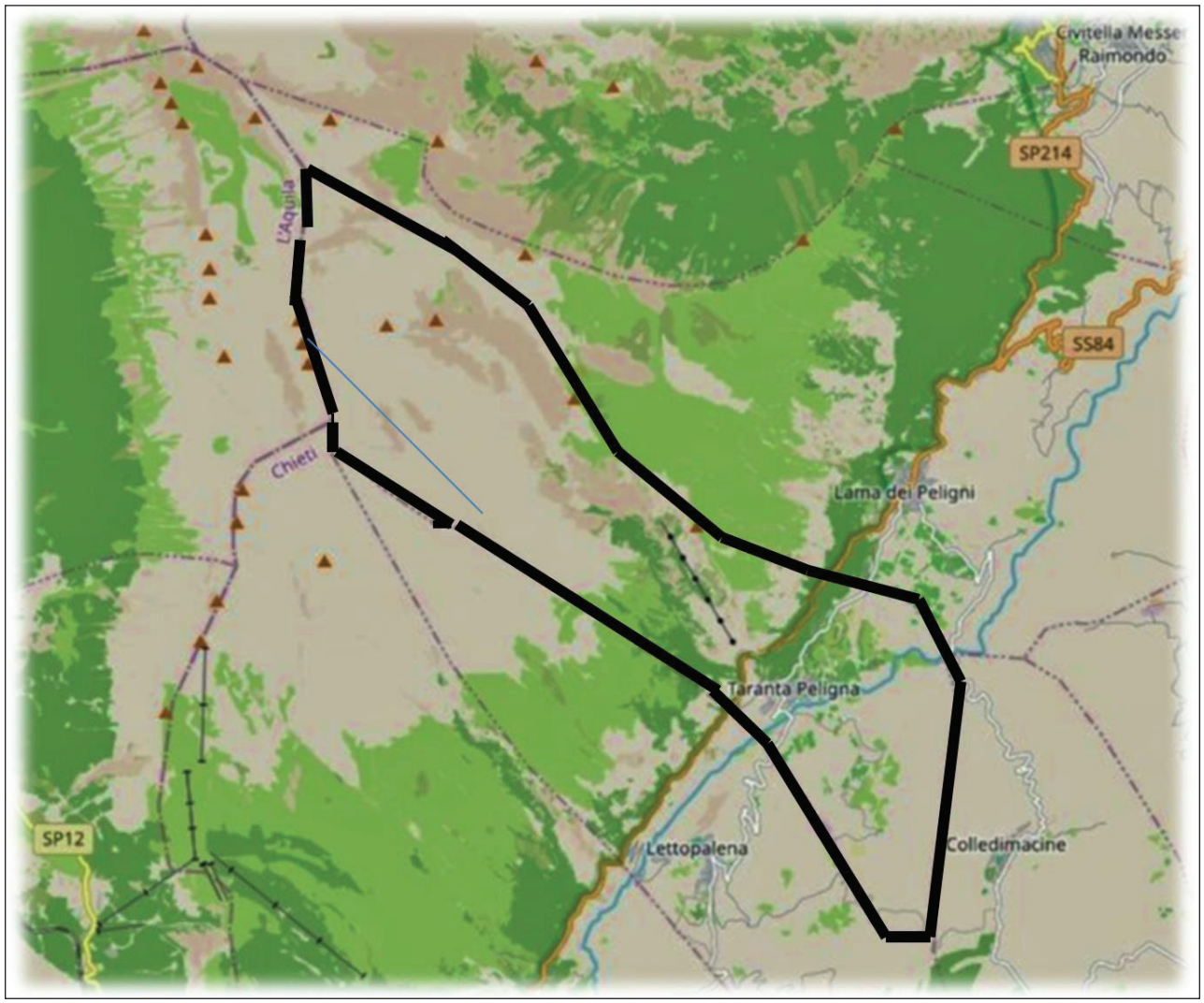

Fig.2: Il territorio di Taranta Peligna racchiuso entro la linea nera.
Sl. 2: Teritorij Tarnata Peligna označuje črna črta.

Tutta l'area dal punto di vista geologico è molto instabile e nel passato è stata interessata da numerose frane, terremoti e piene del fiume Aventino che hanno apportato notevoli distruzioni al centro abitato. Il versante comunale situato sulla destra orografica del fiume presenta una morfologia dolce, raggiunge l'altitudine massima di circa 750 metri e si sviluppa quasi completamente su terreni argillosi e marnoso-arenacei. Il versante comunale situato alla sinistra del fiume, invece si estende principalmente sui terreni e rocce calcaree del massiccio della Majella sino alla quota di 2646 metri del Monte Macellaro. Questo settore è caratterizzato da un importante squarcio vallivo simile a un canyon che è detto Valle di Taranta e dal crinale che lo orla a occidente (Fig. 3). In particolare, la Valle di Taranta occupa oltre due terzi del territorio comunale, si sviluppa completamente per circa 7 km lungo il versante orientale della Majella, copre la superficie di 16,25 km², non è percorsa da corsi d'acqua, la sua larghezza va da 0,25 a 1 km, mentre le pareti che la orlano hanno un'altezza compresa tra 150 e 300 metri. Nella sua quota più bassa (m 400 d'altitudine) inizia poco sopra il centro abitato e culmina in un vasto anfiteatro glaciale posto tra il monte Macellaro e Grotta Canosa (m 2604).

La valle tarantolese secondo Di Marco (1963) si originò durante il Quaternario da una frana di sfasciamento o scoscendimento e cioè un movimento franoso con crollo di blocchi e intere pareti rocciose causato da movimenti tettonici, fenomeni sismici, erosione meteorica, crioclastismo, ecc. Ad avviso di Carulli *et al*. (2020), invece all'evoluzione della valle hanno contribuito i movimenti delle

Fig. 3: Taranta Peligna e la sua valle.
Sl. 3: Taranta Peligna z dolino.

Fig. 4: L'alta valle di Taranta con in fondo l'Altare dello Stincone.
Sl. 4: Zgornja dolina Tarante z vršacem l'Altare dello Stincone v ozadju.

faglie, le frane e i terremoti. La sua parte più alta, in epoca prewurmiana si suppone fosse costituita da una conca più o meno pianeggiante, molto simile ad un'altra ad essa attigua e tuttora esistente: il vallone di Femmina Morta. Essa è caratterizzata da un ambiente naturale che annovera diversi fenomeni carsici, specie botaniche molto rare e una fauna tipica. In particolare, nel suo ambito si osservano i seguenti caratteri geo-morfologici: l'Altare dello Stincone (Fig. 4), un tipico bastione roccioso che si erge alla quota di 2426 metri; rocce calcaree compatte; ampie distese di colate detritiche poste alla base delle pareti rocciose; vari anfratti naturali tra cui la grotta del Cavallone (Fig. 5) che è visitabile, costituisce la principale risorsa turistica del Comune e si trova all'altitudine di 1475 metri.

Nel territorio tarantolese si trovano anche i seguenti siti di un certo interesse paesaggistico e turistico: 1) "La loggetta" che sovrasta il centro abitato ed è costituita dai resti di un condotto idrico d'origine medioevale scavato nella roccia; 2) l'oasi fluviale delle Acquevive (Fig. 6) che occupa un'area posta tra le pendici della Majella e le due sponde del fiume Aventino. Al suo interno sono presenti le sorgenti omonime da cui affiorano acque sorgive che in parte s'immettono nel fiume e il resto è captato per alimentare un acquedotto. La zona del Parco Fluviale oltre a presentare diverse attrattive turistiche, dal punto di vista botanico è caratterizzata dalla vegetazione igrofila e ripariale con vari tipi di salici ed essenze erbacee.

Per quanto riguarda il clima locale, una sua prima descrizione approssimativa la fornì Del Re (1835) che scrisse: *"Le nude rocce che s'innalzano al di sopra delle contrade di Lama e di Taranta, formano forti baluardi contro il rigido vento di tramontana e riconcentrano a guisa di specchi ustorii il calor della terra e del sole: cagioni che ne rendono il clima talmente temperato nella cruda stagion d'inverno, che la vegetazione ne risente influssi benefici".*

Tutto il territorio gode di una favorevole esposizione a sud il che comporta un notevole

Fig. 5: L'Ingresso della Grotta del Cavallone.
Sl. 5: Vhod v jamo Cavallone.

Fig. 6: Le Acquevive di Taranta.
Sl. 6: Acquevive iz Tarante.

soleggiamento e riscaldamento diurno. Inoltre, il massiccio della Majella, a causa del suo particolare orientamento territoriale, ripara la parte bassa del territorio comunale dai venti freddi settentrionali e favorisce l'esposizione ai venti d'origine meridionale e nord-orientale, tra cui la bora, detta localmente "la vuoiere", apportatrice di freddo e neve. A causa dell'elevata escursione altitudinale, nell'ambito in esame sono individuabili diverse tipologie climatiche. La porzione territoriale che va da 378 a 800 metri d'altitudine e comprende il centro abitato, in base alla classificazione climatica di Rivas Martinez (1996) rientra nel termotipo Mesotemperato superiore e nell'Ombrotipo Umido/Subumido. Nel caso in esame la Fig. 7 riporta l'andamento delle temperature e delle precipitazioni registrate nel centro abitato (altitudine m 460). I principali parametri cimatici che lo caratterizzano hanno i seguenti valori: temperatura media annua 20,1°C; temperatura media del mese più caldo (luglio) 30°C; temperatura media del mese più freddo (gennaio) 11°C; escursione termica media annua 19°C; precipitazioni medie annue 544 mm; stagione più piovosa l'autunno con 181 mm; stagione meno piovosa, l'estate con 127 mm; precipitazioni massime a novembre con 95 mm; minimo di precipitazioni in agosto con 20 mm (https://meteomondo.it/italia/taranta-peligna).

Man mano che l'altitudine cresce, diminuisce la temperatura e aumentano le precipitazioni, Infatti, nella parte più alta compresa tra l'altitudine di 2450 e 2650 m, la media delle temperature minime del mese più freddo è inferiore a –5°C e si ha l'innevamento per 7–8 mesi l'anno (Di Pietro *et al.*, 2008). Dal punto di vista bioclimatico tale zona appartiene alla sottoregione axerica fredda della regione temperata (Rivas-Martinez, 1996).

L'elevato gradiente altitudinale del territorio tarantolese, le varietà climatiche che lo accompagnano, le caratteristiche geo-morfologiche, la diversa esposizione solare e alle correnti d'aria e la pressione antropica attuale e del passato esercitata con l'agricoltura, il pascolo e il taglio degli alberi, sono le cause della presenza di numerose formazioni vegetali. In particolare, il taglio degli alberi e le pratiche agro-pastorali esercitate dalla popolazione locale da diversi millenni sino agli inizi degli anni 60 del secolo scorso, hanno portato alla riduzione delle superfici forestali e alla formazione

di terreni aperti. Ora la popolazione residente si è notevolmente ridotta, la pastorizia è pressoché assente e l'attività agricola è limitata alla cura di pochi terreni e colture specializzate (orti, uliveti e vigneti). Di conseguenza è in atto un processo di trasformazione del paesaggio vegetale che nel luogo ha portato alla riduzione dei terreni aperti e all'aumento della superficie forestale. Nel complesso del territorio comunale ora si osserva un mosaico vegetazionale costituito da: boschi ripariali disposti lungo il fiume Aventino; formazioni igrofile situate presso i corsi e i ristagni d'acqua; formazioni sinantropiche situate presso le abitazioni, le aree incolte e i campi coltivati o abbandonati; prati-pascoli collinari di diverse tipologie; formazioni arboreo-arbustive sparse; boschi termo-mesofili e termofili misti di caducifoglie con infiltrazioni di essenze arboree mediterranee sclerofille; una faggeta mista posta nella valle di Taranta; formazioni glareicole e rupestri poste a varie altitudini; pascoli montani secondari posti tra 1200-2200 metri di altitudine; formazioni arbustive alto-montane in fase di espansione sui pascoli abbandonati; zolle pioniere e praterie primarie d'altitudine poste oltre 2200 metri d'altitudine. Alla loro composizione concorrono le entità comprese nell'elenco floristico che segue.

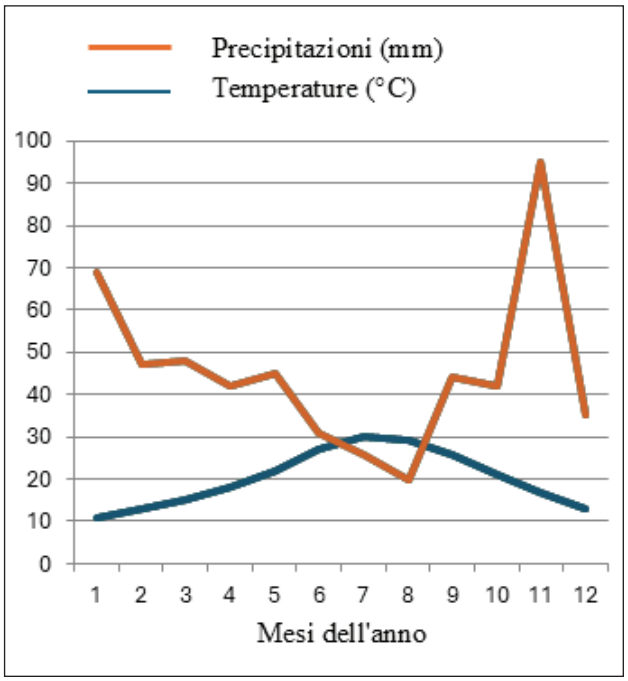

Fig. 7: Il climogramma di Taranta Peligna.
Sl. 7: Klimatogram območja Taranta Peligna.

Le ricerche botaniche nel territorio di Taranta Peligna

Il territorio di Taranta Peligna, a causa della sua particolare collocazione nel massiccio della Majella, è stato oggetto di diverse esplorazioni floristiche che sono iniziate nel XIX secolo. Il pioniere di tali ricerche è stato il botanico napoletano Michele Tenore che nel 1831 fece un viaggio in Abruzzo, visitò anche l'ambito di studio e nel 1832 pubblicò i dati riassuntivi. Nella seconda metà del XIX secolo Cesati (1872) in un suo saggio citò alcune specie presenti nel territorio tarantolese, tra cui *Daphne mezereum* L. e *Laburnum anagyroides* Medik ssp. *anagyroides*. All'inizio del nuovo secolo Abbate (1903) segnalò altri ritrovamenti e alcuni decenni dopo fu seguito da Villani (1921) e Grande (1925).

Alla fine degli anni 70 del secolo scorso, Tammaro, Veri & Chichiriccò (1978) segnalarono due nuovi ritrovamenti: *Aurinia sinuata* (L.) Griseb. e *Coronilla valentina* L. Nello stesso anno (10 luglio) la Società Botanica Italiana effettuò un'escursione nella parte bassa della valle e segnalò altri ritrovamenti. Tuttavia, le segnalazioni floristiche più consistenti si ebbero nella seconda metà degli anni 80 con Tammaro (1986) che in un suo saggio elencò 61 taxa presenti nell'ambito di studio e ad essi nel 1998 vi aggiunse nuove segnalazioni. Altre notizie recenti sulla flora tarantolese sono riportate nei saggi dei seguenti autori: Bortolotti & Pierantoni (1984), Conti (1988, 1998), Conti & Pellegrini (1990), Galetti (1995, 2008), Manzi (1999), Cutini *et al*. (2002), Blasi *et al*. (2005), Simeone *et al*. (2006), Stanisci *et al*. (2006), Conti *et al*. (2007), Di Pietro *et al*. (2008), Gottschlich (2009), Lancioni *et al*. (2011); Ciaschetti *et al*. (2015), Pirone (2015), Conti *et al*. (2019), Pezzetta (2019), Conti *et al*. (2020), Pezzetta *et al*. (2022) e negli Index seminum dei Giardini Botanici Michele Tenore di Lama dei Peligni e Daniela Brescia di Sant'Eufemia a Majella (Pe) che sono stati pubblicati in diversi anni.

MATERIALI E METODI

L'elenco floristico è stato realizzato considerando: le ricerche sul campo degli autori, i dati ricavati dal materiale bibliografico consultato e le segnalazioni inedite fornite da Nicola Centurione, Rodolfo Giancristofaro, Mario Pellegrini e Roberto Quarisa. Esso comprende le specie, le sottospecie e alcuni ibridi che sono stati riconosciuti. Non sono state considerate le varietà cromatiche e morfologiche.

La nomenclatura adottata e l'ordine di elencazione delle varie famiglie e specie seguono Conti *et al*. (2020) con l'eccezione di alcuni taxa per i quali essa è stata rivista più recentemente. Accanto a ogni taxon sono riportati: il tipo corologico, gli autori che l'hanno segnalato ed eventuali note o osservazioni.

Al fine di non ripetere troppe volte gli autori delle segnalazioni, si è deciso di utilizzare al loro posto delle sigle costituite da lettere maiuscole. Esse hanno il seguente significato: AK: Tenore, 1832; AX: Cesati, 1872; AY: Abbate, 1903; BH: Villani, 1921; BK: Grande, 1925; BW: Atti e resoconti sociali, 1978;

BX: Tammaro *et al.*, 1978; BY: Bortolotti & Pierantoni, 1984; CH: Tammaro, 1986; CK: Conti & Pellegrini, 1988; CX: Conti & Pellegrini, 1990; CY: Galetti, 1995; DK: Conti, 1998; DX: Tammaro, 1998; DY: Manzi, 1999; EK: Cutini *et al.*, 2002, EX: Blasi *et al.*, 2005; EY: Di Fabrizio, 2006; FH: Simeone *et al.*, 2006; FK: Stanisci *et al.*, 2006; FX: Conti *et al.*, 2007; FY: Di Pietro *et al.*, 2008; GH: Galetti, 2008; GK: Gottschlich, 2009; GM: Lancioni *et al.*, 2011; GX: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2011; GY: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2012; HK: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2013; HX: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2014; HY: Ciaschetti *et al.*, 2015; IK: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2015; IX: Pirone, 2015; IY: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2016; IW: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2018; LH: Pellegrini & Pinchera, 2018; LK: Conti *et al.*, 2019; LX: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2019; LY: Pezzetta, 2019; MH: Conti *et al.*, 2020; MK Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2020; MS: Index seminum Giardino Botanico Daniela Brescia di Sant'Eufemia a Majella, 2022; MX: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2022; MY: Paolucci, 2022; NH: Pezzetta *et al.*, 2022; NK: Ciaschetti & Di Cecco, 2023; NL: Index seminum Giardino Botanico Michele Tenore di Lama dei Peligni, 2023; NS: Index seminum Giardino Botanico Daniela Brescia di Sant'Eufemia a Majella, 2023; NH: Centurione, oss. pers.; NX: Giancristofaro, oss. pers.; NY: Paolucci, oss. pers.; OK: Pellegrini, oss. pers.; OX: Pezzetta, oss. pers.; OY: Quarisa, oss. pers.; PK: www.naturgucker.de.

Per l'assegnazione dei tipi corologici si è tenuto conto di quanto riportato nel sito internet di Acta Plantarum e in Pignatti *et al*. (2017-2019) tranne i seguenti tre casi:

- al corotipo avventizio sono stati assegnati i taxa d'origine ignota che si sono naturalizzati nell'ambito di studio;

- al corotipo Subendemico sono stati assegnati i taxa con un areale che comprende qualche regione italiana e altre di stati europei (Austria, Croazia, Francia, Slovenia e Svizzera);

- al corotipo Appennino-Balcanico sono stati assegnati i taxa presenti solo nel territorio delimitato dai seguenti confini fisici (Pezzetta, 2010): a) per la Penisola Italiana, le isole e l'arco appenninico dalla Liguria all'Aspromonte; b) per la Penisola Balcanica, Creta, le isole dell'Egeo e il territorio continentale posto a sud dell'asse fluviale che va dalle sorgenti della Sava alle foci del Danubio e dal Mar Nero all'Adriatico-Ionio.

Nella compilazione della Tabella 1 è stato utilizzato il concetto di "Contingente Geografico" che comprende più corotipi e in tale voce stati fatti dei raggruppamenti in base al seguente schema:

- nel contingente "Endemico e Subendemico" sono inclusi i corotipi con la stessa dicitura;

- nel contingente "Mediterraneo" sono inclusi i corotipi Eurimediterraneo, Mediterraneo-Macaronesico, Mediterraneo-Occidentale, Mediterraneo-Orientale, Mediterraneo-Montano, Nord-Mediterraneo, Nord-Est-Mediterraneo, Nord-Ovest-Mediterraneo, Stenomediterraneo, Sud-Mediterraneo e Sud-Ovest-Mediterraneo;

- nel contingente "Eurasiatico" sono inclusi i corotipi Europeo-Caucasico, Eurasiatico s.s., Eurosiberiano, Mediterraneo-Turaniano, Orofita Eurasiatico, Paleotemperato, Pontico e Sud-Europeo-Sud-Siberiano;

- nel contingente Nordico sono inclusi i corotipi Artico-Alpino e Circumboreale;

- nel contingente "Europeo" sono inclusi i corotipi Centro-Europeo, Europeo s.s., Orof. Centro-Europeo, Orof. Europeo, Orof. Sud- Europeo, Orof. Sud-Est-Europeo, Orof. Sud-Ovest-Europeo, Centro-Europeo, Sud-Est-Europeo, Sud-Europeo, Sud-Ovest-Europeo e Appennino-Balcanico;

- nel contingente "Atlantico" sono inclusi i corotipi Atlantico, Mediterraneo-Atlantico e Subatlantico;

- nel contingente Avventizio ed Extraeuropeo sono inclusi i corotipi Africano, Americano, Nord-Americano, Sud-Americano, Avventizio, Asiatico, Asiatico-Occidentale, Asiatico-Orientale, Neotropicale, Paleotropicale, Pantropicale e Subtropicale;

- nel contingente Cosmopolita sono inseriti i corotipi Cosmopolita e Subcosmopolita.

Al fine di ricavare altre importanti informazioni ecologiche e fitogeografiche, in accordo con Poldini (1991), sono stati fatti tre raggruppamenti di corotipi definiti: 1) macrotermico che è costituito da piante tipiche di ambienti caldo-temperati con temperature medie annue di oltre 20 °C; 2) mesotermico che comprende piante che per vivere hanno bisogno di una temperatura media annuale di 15-20 °C; 3) microtermico che a sua volta è costituito da piante che attecchiscono in territori con temperature medie annue comprese tra 0° e 15°.

La bibliografia comprende tutti i saggi consultati che riportano segnalazioni floristiche riguardanti il territorio in esame.

RISULTATI E DISCUSSIONE

L'elenco floristico è costituito da 1186 taxa ripartiti in 102 famiglie (Appendice 1). La prima considerazione da fare è che un'area che rappresenta solo lo 0,0067 % del territorio italiano ospita l'11,8% della flora

Tab. 1: Corotipi della flora di Taranta Peligna.
Tab. 1: Korotipi flore območja Taranta Peligna.

Contingenti geografici	Numero taxa	%	Contingenti geografici	Numero taxa	%
Endemico e Subendemico	**98**	**8,3**	Orof. Sud-Europeo	43	
Endemico	83		Orof. Sud-Est-Europeo	11	
Subendemico	15		Orof. Sud-Ovest-Europeo	5	
Mediterraneo	**404**	**34,1**	Ovest-Europeo	4	
Eurimediterraneo	215		Sud-Est-Europeo	21	
Stenomediterraneo	104		Sud-Europeo	9	
Mediterraneo-Macaronesico	1		Sud-Ovest-Europeo	5	
Mediterraneo-Montano	52		Atlantico	19	1,6
Mediterraneo-Orientale	8		Atlantico	2	
Mediterraneo-Occidentale	11		Mediterraneo-Atlantico	8	
Nord-Mediterraneo	4		Subatlantico	9	
Nord-Est-Mediterraneo	1		Nordico	65	5,5
Nord-Ovest-Mediterraneo	3		Artico-Alpino	19	
Sud-Mediterraneo	4		Circumboreale	46	
Sud-Ovest-Mediterraneo	1		Cosmopolita	60	5,1
Eurasiatico	284	**23,9**	Cosmopolita	27	
Eurasiatico s. s.	99		Subcosmopolita	23	
Europeo-Caucasico	24		Avventizio ed Extraeuropeo	41	3,4
Eurosiberiano	27		Avventizio	13	
Mediterraneo-Turaniano	19		Asiatico	7	
Orof. Eurasiatico	4		Asiatico-Occidentale	1	
Paleotemperato	73		Asiatico-Orientale	2	
Pontico	33		Americano	4	
Sud-Europeo-Sud-Siberiano	5		Nord-Americano	5	
Europeo	**215**	**18,1**	Sud-Americano	3	
Appennino-Balcanico	55		Neotropicale	1	
Centro-Europeo	14		Paleotropicale	3	
Europeo s. s.	42		Pantropicale	1	
Orof. Centro-Europeo	4				
Orof. Europeo	2		Subtropicale	1	

nazionale che in base alle ricerche più recenti (Bartolucci *et al*. 2024, Galasso *et al*. 2024) raggiunge il valore di 10023 taxa.

La flora tarantolese costituisce anche il 50,9 % della flora del Comprensorio del Parco Nazionale della Majella che ammonta a 2331 taxa (Ciaschetti & Di Cecco, 2023) e il 32,6% della flora abruzzese, a sua volta costituita da 3634 entità (Bartolucci *et al*., 2022; Galasso *et al.,* 2024).

La densità floristica calcolata dividendo il totale dei taxa censiti per la superfice comunale è di circa 55 taxa per km², un valore molto alto, superiore a quello di vari Comuni vicini, come si può osservare dai seguenti dati: a Palena in cui sono censiti 1202 taxa (Pezzetta *et al.,* 2012) è uguale a 13, a Lama dei Peligni è di 44 (Pezzetta & Paolucci, 2023) e a Fara San Martino che annovera 1042 taxa è di 24 (Pezzetta *et al.,* 2013).

1051 taxa, corrispondenti a circa l'89% della flora tarantolese, sono condivisi con il Comune confinante di Lama dei Peligni che annovera complessivamente 1362 entità (Pezzetta & Paolucci, 2023). Sul totale dei taxa presenti nei due Comuni (1497), quelli non condivisi ammontano a 446 e di conseguenza l'indice di somiglianza tra le flore dei due Comuni è di circa 0,7 un valore anch'esso abbastanza alto.

Le famiglie vegetali più rappresentate sono le seguenti: *Asteraceae* (155 taxa). *Fabaceae* (117), *Poaceae* (89), *Brassicaceae* (62), *Apiaceae* (51), *Lamiaceae* (50), *Rosaceae* (48), *Caryophyllaceae* (47), *Orchidaceae* (42), *Plantaginaceae* (32), *Ranunculaceae* (30) e le altre con valori minori.

Sono nuove per il Parco Nazionale della Majella le seguenti entità: *Ervilia loiseleurii* (M.Bieb.) H.Schaef. che è stata rinvenuta il 10-5-2024 lungo il sentiero per Macchia di Taranta; *Medicago disciformis* DC che è stata rinvenuta l'11-5-2024 in Via Duca degli Abruzzi e lungo la strada statale 84; *Cymbalaria glutinosa* ssp. *glutinosa* rinvenuta alla Loggetta l'11-5-2024; *Datura wrightii* rinvenuto il 31-8-2024 nel centro abitato di Taranta, *Ophrys* ×*camusii* (Fig. 8) trovato in un prato lungo la strada provinciale n. 125 il 13-4-2024 e *Xanthium orientale* trovato il 9-7-2024 in via Rione Orientale.

L'elenco oltre comprende 50 taxa avventizi, invasivi, utilizzati a fini ornamentali, per le alberature stradali, i rimboschimenti e coltivati che si sono spontaneizzati e continuano a vegetare nei terreni abbandonati. Tale modesto valore dimostra la bassa contaminazione floristica del territorio in esame.

Nell'elenco sono riportati i seguenti taxa che raggiungono nel Parco della Majella il limite meridionale di distribuzione geografica in Italia e accrescono l'importanza naturalistica del territorio in esame: *Campanula sibirica* ssp. *divergentiformis*, *C. spicata*, *Centranthus angustifolius* ssp. *angustifolius*, *Hesperis laciniata* ssp. *laciniata, Hieracium bifidum* ssp. *caesiiflorum*, *H. dentatum* ssp. *subvillosum*, *H. murorum* ssp. *pleiotrichum*, *H. pictum*, *H. pilosum* ssp. *portae*, *H. pulchellum*, *H. tomentosum* ssp. *tomentosum Iberis saxatilis* ssp. *saxatilis*, *Isatis apennina* e *Linaria alpina*.

Dalla Tabella 1 si osserva come i taxa considerati si ripartiscono in 52 diversi corotipi raggruppati in 9 contingenti geografici, un dato confermativo che il massiccio della Majella e l'Abruzzo, essendo situati al centro della penisola italiana, costituiscono un importante crocevia di flussi floristici che ha ricevuto ondate migratorie di diversa origine geografica. A questa particolare configurazione arealica hanno contribuito: 1) le particolari vicende geologiche passate che hanno interessato l'ambito di studio poiché hanno concorso a formare i ponti terrestri che sono stati attraversati dalle correnti migratorie floristiche pluridirezionali; 2) le diverse condizioni ambientali causate dall'ampia escursione altitudinale; 3) la presenza di aree esposte ai venti freddi settentrionali e nord-orientali e di altre riparate e molto soleggiate che nel loro insieme consentono l'attecchimento di piante con esigenze ecologiche molto varie, 4) l'uomo che con la sua attività ha contribuito alla formazione di nuove nicchie e corridoi ecologici. In particolare, l'agricoltura e la pastorizia esercitate per millenni hanno favorito la diffusione delle archeofite, delle specie coltivate che si sono spontaneizzate e di quelle tipiche dei pascoli secondari presenti sul massiccio della Majella.

Nell'area di studio sono presenti taxa artico-alpini, eurosiberiani, circumboreali, subatlantici, europei, eurasiatici, etc. che sono tipici di ambiti mesofili e microtermici e altri soprattutto mediterranei e sud-europei che invece attecchiscono negli ambiti termofili del settore collinare e nelle isole di mediterraneità poste a quote più rilevanti della valle di Taranta.

La tabella 1 mostra come nell'ambito di studio sia dominante il contingente floristico Mediterraneo che nel suo complesso è caratterizzato da 404 taxa, corrispondenti al 34,2% delle entità censite ed è presente in tutti i piani di vegetazione. Gli altri contingenti sono caratterizzati da valori inferiori. Infatti, è seguito dai contingenti Eurasiatico con 284 taxa (23,8%), Europeo con 215 taxa (18,1%), Endemico con 98 taxa (8,3 %), Nordico con 65 taxa (5,5%), Cosmopolita con 60 taxa (5,1%), Avventizio ed Extraeuropeo con 41 (3,4%) e Atlantico con 19 taxa (1,6%).

L'alta presenza di taxa mediterranei, sud-europei, sud-est-europei e eurasiatici dimostra che l'area è dominata da una componente floristica a baricentro sud-orientale.

Un contingente floristico molto importante è quello endemico con l'8,3 % dei taxa censiti, un valore percentuale molto vicino a quello dell'intero comprensorio del Parco della Majella che conferma l'importanza naturalistica dell'area d'indagine.

Fig. 8: Ophrys ×camusii.
Sl. 8: Ophrys ×camusii.

La maggior parte degli endemiti è collocata in aree specializzate e con scarsa competizione vegetale della valle di Taranta quali le praterie alpine, subalpine e gli ambiti glareicoli e rupestri. Tuttavia, non mancano anche gli endemiti collinari presenti in gran parte nel versante destro della valle dell'Aventino.

Hanno una certa importanza anche i taxa dei corotipi Artico-Alpino e Appennino-Balcanico che nel complesso ammontano a 74. Essi appartengono a entità relittuali che documentano le migrazioni floristiche avvenute nel corso di diverse ere geologiche da nord in direzione sud e da est in direzione ovest.

Anche tra la flora mediterranea del luogo sono presenti entità relittuali, dette "xerotermiche", che attecchiscono in ambiti ristretti molto riparati e si diffusero durante le ere geologiche caratterizzate da un clima caldo e secco. Altre particolari entità relittuali presenti nel territorio tarantolese sono *Daphne laureola* e *Taxus baccata* che durante il Terziario erano presenti nelle antiche foreste tropicali a "laurifille".

I taxa dei corotipi Ovest-Europeo, Mediterraneo-Occidentale, Mediterraneo-Macaronesico e Atlantici nel loro complesso documentano le migrazioni floristiche avvenute in direzione orientale.

Alla flora tarantolese appartengono anche 121 taxa appartenenti ai corotipi strettamente orofili e mediterraneo-montano che nel complesso rappresentano il 10,3 % del patrimonio floristico locale. È comunque da rilevare che la componente orofila e montana della flora tarantolese è più consistente poiché a tali entità bisogna aggiungere quelle inserite negli altri corotipi.

I taxa del contingente Avventizio ed Extraeuropeo sono invece presenti solo nel settore collinare e alle basse quote di quello montuoso e la loro diffusione nel

territorio locale è stata favorita dalle attività umane.

I raggruppamenti dei taxa che tengono conto delle loro esigenze termiche dimostrano quanto segue. Il raggruppamento macrotermico che comprende i contingenti Mediterraneo (escluso il corotipo Mediterraneo-Montano), Avventizio Extra-Europeo e i corotipi Sud-Est-Europeo, Sud-Europeo, Sud-Ovest-Europeo e Pontico nell'area in esame è rappresentato da 462 taxa (38,9%). Questo raggruppamento comprende il maggior numero di taxa, a dimostrazione che nella flora tarantolese primeggia una componente termofila.

Il raggruppamento mesotermico con i corotipi Appennino-Balcanico, Atlantico, Centro-Europeo, Cosmopolita, Europeo, Eurasiatico, Eurosiberiano, Mediterraneo-Atlantico, Mediterraneo-Turaniano, Ovest-Europeo, Europeo-Caucasico, Paleotemperato, Sud-Europeo-Sud-Siberiano, Subcosmopolita e Subendemico comprende 446 taxa (37,6 %) ed è lievemente inferiore al precedente.

Il raggruppamento microtermico in cui sono stati inclusi i corotipi Subatlantico, Circumboreale, Artico-Alpino, Mediterraneo-Montano, Orofita Centro-Europeo, Orof. Orof. Europeo, Orof. Eurasiatico, O. Sud-Europeo, O. Sud-Est-Europeo e O. Sud-Ovest-Europeo è rappresentato da 195 taxa (16,4%). Questo raggruppamento è caratterizzato dal minor numero di taxa, a dimostrazione che nel territorio tarantolese ci sono limitate aree in cui attecchiscono entità vegetali che prediligono temperature medie molto basse.

Gli altri corotipi non sono stati considerati poiché di difficile collocazione in uno dei tre gruppi. In particolare, non sono stati considerati i taxa endemici poiché ci sono alcuni che prediligono gli ambiti microtermici delle alte quote, altri mesofili e/o spiccatamente termofili che si rinvengono più in basso.

La presenza contemporanea dei tre raggruppamenti conferma che il territorio in esame appartiene a un ambito di transizione fitogeografico caratterizzato da varie tipologie ambientali, climatiche e di corrispondenti fasce vegetazionali.

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Appendice 1: L'elenco floristico di Taranta Peligna. Legenda: °° Il taxon raggiunge nel Parco della Majella il limite meridionale di distribuzione geografica in Italia; ## Specie nuova per il Parco della Majella.
Priloga 1: Floristični seznam območja Taranta Peligna. Legenda: °° Takson doseže južno mejo geografske razširjenosti v Italiji v parku Majella; ## Nova vrsta za park Majella.

	Elenco floristico	**TIPO COROLOGICO**	**AUTORI E OSSERVAZIONI**
	PTERIDOPHYTA		
	EQUISETACEAE		
1	*Equisetum arvense* L. ssp. *arvense*	Circumboreale	NY, OX
2	*Equisetum palustre* L.	Circumboreale	NY
3	*Equisetum ramosissimum* Desf.	Circumboreale	NY
4	*Equisetum telmateia* Ehrh	Circumboreale	NY
	OPHIOGLOSSACEAE		
5	*Botrychium lunaria* (L.) Sw	Subcosmopolita	EY, FH
	PTERIDACEAE		
6	*Adiantum capillus-veneris* L	Pantropicale	OX
	CYSTOPTERIDACEAE		
7	*Cystopteris fragilis* (L.) Bernh.	Cosmopolita	EY, NY
	ASPLENIACEAE		
8	*Asplenium ceterach* L.	Eurasiatico	NY, OX
9	*Asplenium flssum* Kit. ex Willd.	Orof. Sud-Est-Europeo	OX
10	*Asplenium lepidum C*. Presl ssp. *lepidum*	Orof. Sud-Est-Europeo	OX
11	*Asplenium ruta-muraria* L. ssp. *ruta-muraria*	Circumboreale	MY, NY
12	*Asplenium trichomanes* L. ssp. *quadrivalens* D.E. Mey	Cosmopolita	NY, OX
13	*Asplenium viride* Huds.	Circumboreale	OX
	DRYOPTERIDACEAE		
14	*Dryopteris filix-mas* (L.) Schott	Cosmopolita	OX
15	*Polystichum lonchitis* (L.) Roth	Circumboreale	EY
	POLYPODIACEAE		
16	*Polypodium cambricum* L.	Eurimediterraneo	NY
17	*Polypodium vulgare* L.	Circumboreale	NY
	GYMNOSPERMAE		
	PINACEAE		
18	*Abies alba* Mill.	Orof. Sud-Europeo	LH, NH.
19	*Abies cephalonica* Loudon	Sud-Est-Europeo	LH, NY. Utilizzato per rimboschimenti.
20	*Cedrus deodara* (Roxb.) G.Don	Africano	LH. Utilizzato a fini ornamentali
21	*Larix decidua* Mill.	Orof. Centro-Europeo	LH. Utilizzato per rimboschimenti.
22	*Picea abies* (L.) H.Karst.	Eurosiberiano	LH. Utilizzato per rimboschimenti.
23	*Pinus halepensis* Mill.	Stenomediterraneo	NY, OX
24	*Pinus mugo* Turra ssp. *mugo*	Eurasiatico	NY, OX
25	*Pinus nigra* J. F. Arnold ssp. *nigra*	Sud-Europeo	LH, NY, OX
	CUPRESSACEAE		
26	*Cupressus sempervirens* L.	Mediterraneo-Orientale	NY, OX
27	*Hesperocyparis arizonica* (Greene) Bartel	Nord-Americano	NY, LH. Utilizzato a fini ornamentali
28	*Juniperus communis* L.	Circumboreale	EK, EY,LH, MS, NY, OX
29	*Juniperus deltoides* R. P. Adams	Eurimediterraneo	NY
30	*Juniperus macrocarpa* Sm.	Eurimediterraneo	HY, LK, MH
31	*Juniperus oxycedrus* L.	Eurimediterraneo	LH, EK
32	*Platycladus orientalis* (L.) Franco	Asiatico-Orientale	NY
	TAXACEAE		
33	*Taxus baccata* L.	Paleotemperato	CH, EK
	ANGIOSPERMAE		
	LAURACEAE		

34	*Laurus nobilis* L.	Stenomediterraneo	NY, OX
	ARACEAE		
35	*Arum italicum* Mill. ssp. *italicum*	Stenomediterraneo	NY, OX
	ALISMATACEAE		
36	*Alisma lanceolatum* With.	Subcosmopolita	OX
37	*Alisma plantago-aquatica* L.	Sucosmopolita	OX
	COLCHICACEAE		
38	*Colchicum lusitanum* Brot.	Mediterraneo-Occidentale	OX
	MELANTHIACEAE		
39	*Paris quadrifolia* L.	Eurasiatico	OX
40	*Veratrum album* L.	Eurasiatico	OX
	SMILACACEAE		
41	*Smilax aspera* L.	Stenomediterraneo	EX, NY
	LILIACEAE		
42	*Lilium bulbiferum* L. ssp. *croceum* (Chaix) Jan	Orof. Centro-Europeo	OK
43	*Lilium candidum* L.	Mediterraneo-Orientale	NY, OX. Coltivato e naturalizzato.
44	*Lilium martagon* L.	Eurasiatico	NY
	ORCHIDACEAE		
45	*Anacamptis morio* (L.) R.M. Bateman, Pridgeon & M.W. Chase	Europeo-Caucasico	LY, NH, NY
46	*Anacamptis pyramidalis* (L.) Rich.	Eurimediterraneo	LY, NH
47	*Cephalanthera damasonium* (Mill.) Druce	Eurimediterraneo	NH, NY
48	*Cephalanthera longifolia* (L.) Fritsch	Eurasiatico	NH, NY
49	*Cephalanthera rubra* (L.) Rich.	Eurasiatico	NH
50	*Dactylorhiza maculata ssp. saccifera* (Brongn.) Diklić	Paleotemperato	NH
51	*Dactylorhiza sambucina* (L.) Soó	Europeo	LY, NH
52	*Dactylorhiza viridis* (L.) R.M. Bateman, Pridgeon & M.W. Chase	Circumboreale	NH
53	*Epipactis atrorubens* (Hoffm.) Besser	Europeo	LY, MS, NH, NS
54	*Epipactis helleborine* ssp. *helleborine* (L.) Crantz	Paleotemperato	NH, NY
55	*Epipactis microphylla* (Ehrh.) Sw.	Europeo-Caucasico	NY, OK
56	*Gymnadenia conopsea* (L.) R. Br. in W.T. Aiton	Eurasiatico	NH
57	*Himantoglossum adriaticum* H. Baumann	Eurimediterraneo	LY, NH
58	*Limodorum abortivum* (L.) Sw.	Eurimediterraneo	NH
59	*Neotinea maculata* (Desf.) Stearn	Mediterraneo-Atlantico	NY
60	*Neotinea tridentata* (Scop.) R.M. Bateman, Pridgeon & M.W. Chase	Eurimediterraneo	LY, NH
61	*Neottia nidus-avis* (L.) Rich.	Eurasiatico	LY, NH
62	*Neottia ovata* (L.) Bluff & Fingerh.	Eurasiatico	NH
63	*Ophrys apifera* Huds.	Eurimediterraneo	NH
64	*Ophrys bertolonii* ssp. *bertolonii* Moretti	Appennino-Balcanico	NH, NY
65	*Ophrys bombyliflora* Link	Stenomediterraneo	CK, CX, DK, LK, LY, MH, NH
66	*Ophrys crabronifera* Mauri	Endemico	NY
67	*Ophrys fusca* subsp. *funerea* Link	Mediterraneo-Atlantico	NY
68	*Ophrys fusca* ssp. *lucana* (P. Delforge, Devillers-Tersch. & Devillers) Kreutz	Endemico	NH
69	*Ophrys holosericea* (Burm. f.) Greuter ssp. *appennina* (Romolini & Soca) Kreutz	Endemico	NY
70	*Ophrys holosericea* (Burm. f.) Greuter ssp. *dinarica* (Kranjcev & P. Delforge)	Appennino-Balcanico	NY
71	*Ophrys holosericea* (Burm. f.) Greuter ssp. *pinguis* (Romolini & Soca) Kreutz	Endemico	NH
72	*Ophrys incubacea* Bianca ssp. *incubacea*	Stenomediterraneo	NH
73	*Ophrys lutea* Cav.	Stenomediterraneo	NH, NY
74	*Ophrys molisana* Delforge	Endemico	NY
75	*Ophrys promontorii* O. Danesch & E. Danesch	Endemico	NY
76	*Ophrys sphegodes* ssp. *sphegodes* Mill.	Eurimediterraneo	LY, NH
77	*Ophrys xbilineata* Barla *(O. bertolonii ´O. sphegodes).*	Endemico	NY
78	*Ophrys xcamusii* Cortesi *(O. argolica* ssp. *crabronifera x O. sphegodes).*	Endemico	NY. Seconda segnalazione per l'Abruzzo e nuova segnalazione per il Parco Nazionale della Majella e la Provincia di Chieti.

79	*Ophrys xcouloniana* P. Delforge *(O. bertolonii ´O. promontorii)*.	Endemico	NY
80	*Orchis anthropophora* (L.) All.	Mediterraneo-Atlantico	LY, NH, NY
81	*Orchis italica* Poir.	Stenomediterraneo	NH
82	*Orchis mascula* L. ssp. *mascula*	Centro-Europeo	NY
83	*Orchis pauciflora* Ten.	Stenomediterraneo	NH, NY
84	*Orchis purpurea* Huds.	Eurasiatico	LY, NH, NY
85	*Serapias parviflora* Parl.	Stenomediterraneo	NY
86	*Serapias vomeracea* (Burm.f.) Briq. ssp. *vomeracea*	Eurimediterraneo	CH, LY, NH
	IRIDACEAE		
87	*Crocus neapolitanus* (Ker Gawl.) Loisel.	Eurimediterraneo	OX.
88	*Gladiolus italicus* Mill.	Eurimediterraneo	NY, OX
89	*Iris florentina* L.	Avventizio	OX. Alloctona naturalizzata
90	*Iris germanica* L.	Avventizio	OX. Alloctona naturalizzata
	ASPHODELACEAE		
91	*Asphodeline lutea* (L.) Rchb.	Mediterraneo-Orientale	CH, HX, IK, PK
	AMARYLLIDACEAE		
92	*Allium ampeloprasum* L.	Eurimediterraneo	CH
93	*Allium angulosum* L.	Eurosiberiano	AK
94	*Allium lusitanicum* Lam.	Sud-Europeo	MS, NL
95	*Allium neapolitanum* Cirillo	Stenomediterraneo	NY
96	*Allium pendulinum* Ten.	Mediterraneo-Occidentale	NY
97	*Allium polyanthum* Schult. & Schult.f.	Avventizio	NY
98	*Allium sphaerocephalon* L.	Paleotemperato	EX, NY
99	*Allium tenuiflorum* Ten.	Stenomediterraneo	AK
100	*Allium ursinum*	Eurasiatico	NY
101	*Galanthus nivalis* L.	Sud-Est-Europeo	NY, OX
102	*Stenbergia lutea* (L.) Ker Gawl. ex Spreng.	Mediterraneo-Montano	NY
	ASPARAGACEAE		
103	*Anthericum liliago* L.	Subatlantico	NY
104	*Asparagus acutifolius* L.	Stenomediterraneo	NY, OX
105	*Bellevalia romana* (L.) Sweet	Eurimediterraneo	NY, OX
106	*Loncomelos brevistylum* (Wolfner) Dostál	Sud-Est-Europeo	NY
107	*Loncomelos pyrenaicum* (L.) L. D. Hrouda	Eurimediterraneo	NY
108	*Ornithogalum comosum* L.	Mediterraneo-Montano	OX
109	*Muscari comosum* (L.) Mill.	Eurimediterraneo	NY, OX
110	*Muscari neglectum* Guss. Ex Ten.	Eurimediterraneo	NY, OX
111	*Polygonatum multiflorum* (L.) All.	Eurasiatico	GX, GY, HK
112	*Polygonatum odoratum* (Mill.) Druce	Circumboreale	EK, MS, NS, NY
113	*Ruscus aculeatus* L.	Eurimediterraneo	NY, OX
114	*Scilla bifolia* L.	Europeo	NY, OX
	TYPHACEAE		
115	*Typha latifolia* L.	Cosmopolita	NY, OX
	JUNCACEAE		
116	*Juncus articulatus* L.	Circumboreale	NY
117	*Juncus inflexus* L.	Paleotemperato	NY
118	*Luzula campestris* (L.) DC.	Europeo	OX
119	*Luzula forsteri* (Sm.) DC.	Eurimediterraneo	NY
120	*Luzula spicata* (L.) DC. ssp. *italica* (Parl.) Arcang.	Endemico	EY
121	*Luzula sylvatica* (Huds.) Gaudin ssp. *sieberi* (Tausch) K. Richt.	Orof. Sud-Europeo	NL, NY
122	*Oreojuncus monanthos (Jacq.) Záv.Drábk. & Kirschner*	Artico-Alpino	EY
	CYPERACEAE		
123	*Carex caryophyllea* Latourr.	Eurasiatico	OX
124	*Carex distans* L.	Eurimediterraneo	NY

125	*Carex divulsa* Stokes	Eurimediterraneo	NY
126	*Carex flacca* Schreb. ssp. *erythrostachys* (Hoppe) Holub	Europeo	NY
127	*Carex halleriana* Asso	Eurimediterraneo	NY, OX
128	*Carex humilis* Leyss.	Eurasiatico	EY
129	*Carex kitaibeliana* Degen ex Beck.	Appennino-Balcanico	EX, EY, FH, FY, GM, NY
130	*Carex macrolepis* DC.	Appennino-Balcanico	EY
131	*Carex myosuroides* Vill.	Artico-Alpino	EY
132	*Carex otrubae* Podp.	Atlantico	NY
133	*Carex parviflora Host*	Orof. Sud-Europeo	OX
134	*Carex pendula Huds.*	Eurasiatico	NY, OX
135	*Carex sylvatica* Huds.	Eurasiatico	NY
136	*Cyperus longus* L.	Paleotemperato	OX
137	*Scirpoides holoschoenus* (L.) Soják	Eurimediterraneo	NY
	POACEAE		
138	*Achnatherum bromoides* (L.) P.Beauv.	Stenomediterraneo	NY
139	*Agrostis capillaris* L. ssp. *capillaris*	Circumboreale	EY
140	*Alopecurus myosuroides* Huds. ssp. *myosuroides*	Paleotemperato	NY
141	*Anisantha diandra* (Roth) Tzvelev	Eurimediterraneo	NY
142	*Anisantha madritensis* (L.) Nevski ssp. *madritensis*	Eurimediterraneo	NY
143	*Anisantha sterilis* (L.) Nevski	Mediterraneo-Turaniano	CH, NY
144	*Anisantha tectorum* (L.) Nevski	Paleotemperato	NL, NY, OX
145	*Anthoxanthum odoratum* L.	Eurasiatico	NY
146	*Arrhenatherum elatius* (L.) P. Beauv. Ex J. & C. Presl ssp. *elatius*	Paleotemperato	NY, OX
147	*Arundo donax* L.	Subcosmopolita	NY, OX
148	*Arundo plinii* Turra	Stenomediterraneo	NY, OX
149	*Avena barbata* Pott ex Link	Eurimediterraneo	CH, NY
150	*Avena fatua* L. ssp. *fatua*	Eurasiatico	NY
151	*Avena sativa* L.	Avventizio	NY, OX. Coltivato e spontaneizzato
152	*Avena sterilis* L.	Mediterraneo-Turaniano	NY
153	*Bothriochloa ischaemum* (L.) Keng	Cosmopolita	NY
154	*Brachypodium distachyon* (L.) P. Beauv.	Mediterraneo-Turaniano	NY
155	*Brachypodium genuense* (DC.) Roem. & Schult.	Orof. Sud-Europeo	EK
156	*Brachypodium rupestre* (Host) Roem. & Schult.	Subatlantico	FY, NH
157	*Brachypodium sylvaticum* (Huds.) P.Beauv. ssp. *sylvaticum*	Paleotemperato	NY
158	*Briza media* L.	Eurosiberiano	NY, OX
159	*Bromopsis erecta* (Huds.) Fourr.	Paleotemperato	EK, NY
160	*Bromopsis ramosa* (Huds.) Holub ssp. *ramosa*	Cosmopolita	NY
161	*Bromus arvensis* L. ssp. *arvensis*	Eurosiberiano	NY
162	*Bromus commutatus* Schrad.	Europeo	NY
163	*Bromus hordeaceus* L. ssp. *hordeaceus*	Cosmopolita	NY
164	*Bromus lanceolatus* Roth	Paleotemperato	NY, OX
165	*Bromus squarrosus* L.	Paleotemperato	NY
166	*Catapodium rigidum* (L.) C.E. Hubb.	Eurimediterraneo	OX
167	*Cleistogenes serotina* (L.) Keng	Eurimediterraneo	NY
168	*Cynodon dactylon* (L.) Pers.	Cosmopolita	NY
169	*Cynosurus cristatus* L.	Eurasiatico	NY
170	*Cynosurus echinatus* L.	Eurimediterraneo	EX, NY
171	*Dactylis glomerata* L. ssp. *glomerata*	Paleotemperato	NY
172	*Dasypyrum villosum* (L.) P. Candargy	Mediterraneo-Turaniano	NY
173	*Digitaria sanguinalis* (L.) Scop.	Cosmopolita	NY, OX
174	*Echinaria capitata* (L.) Desf.	Stenomediterraneo	NY
175	*Echinochloa crus-galli* (L.) P.Beauv. ssp. *crus-galli*		
176	*Elymus caninus* (L.) L.	Circumboreale	CH, NY

177	*Elymus repens* (L.) Gould ssp. *repens*	Circumboreale	CH, NY
178	*Eragrostis minor* Host ssp. *minor*	Subcosmopolita	EK, GM
179	*Festuca alfrediana* Foggi & Signorini ssp. *ferrariniana* Foggi, Parolo & Gr. Rossi	Endemico	NY
180	*Festuca circummediterranea* Patzke	Eurimediterraneo	NY
181	*Festuca danthonii* Asch. & Graebn. spp. *danthonii*	Subcosmopolita	OX
182	*Festuca inops* De Not.	Subendemico	OX
183	*Festuca laevigata* Gaudin	Orof. Sud-Ovest-Europeo	OX
184	*Festuca myuros* L. ssp. *myuros*	Subcosmopolita	EX, EY , FH, FY
185	*Festuca rubra* L. ssp. *commutata* (Gaudin) Markgr. -Dann.	Orof. Sud-Europeo	DX
186	*Festuca violacea* Ser. ex Gaudin ssp. *italica* Foggi, Gr. Rossi & Signorini	Endemico	OX
187	*Glyceria notata* Chevall.	Subcosmopolita	EX, EY, FY
188	*Helictochloa praetutiana* (Parl. ex Arcang.) Bartolucci, F. Conti, Peruzzi & Banfi ssp. *praetutiana*	Endemico	OX
189	*Holcus lanatus* L.	Circumboreale	NY
190	*Hordeum murinum* L. ssp. *murinum*	Circumboreale	OX
191	*Hyparrhenia hirta* (L.) Stapf ssp. *hirta*	Paleotropicale	NY, OX
192	*Koeleria splendens* C. Presl	Eurasiatico	HX, IK
193	*Lagurus ovatus* L.	Eurimediterraneo	CK, EK, IK, MS, NS.
194	*Leucopoa dimorpha* (Guss.) H. Scholz & Foggi	Subendemico	OX
195	*Lolium multiflorum* Lam.	Eurimediterraneo	NY
196	*Lolium perenne* L.	Circumboreale	NY
197	*Macrobriza maxima* (L.) Tzvelev	Paleotropicale	NY
198	*Melica ciliata* L.	Mediterraneo-Turaniano	NY
199	*Melica uniflora Retz*	Paleotemperato	NY
200	*Oloptum miliaceum (L.) Röser & H.R. Hamasha*	Mediterraneo-Turaniano	NY
201	*Oloptum thomasii* (Duby) Banfi & Galasso	Stenomediterraneo	OX
202	*Parapholis cylindrica* (Willd.) Romero Zarco	Eurimediterraneo	NY
203	*Phalaris brachystachys* Link	Stenomediterraneo	NY
204	*Phalaris coerulescens* Desf.	Stenomediterraneo	NY, OX
205	*Phalaris paradoxa* L.	Stenomediterraneo	NY, OX
206	*Phleum hirsutum* Honck. ssp. *ambiguum* (Ten.) Tzvelev	Mediterraneo-Montano	EY
207	*Phleum pratense* L. subsp. *pratense*	Centro-Europeo	EX, EY, FH, FY
208	*Phleum rhaeticum* (Humphries) Rauschert	Sud-Europeo	EY, FY
209	*Phragmites australis* (Cav.) Trin. ex Steud. ssp. *australis*	Cosmopolita	EY, FY, NY
210	*Poa alpina* L. ssp. *alpina*	Circumboreale	EY
211	*Poa angustifolia* L.	Cosmopolita	OX
212	*Poa annua* L.	Cosmopolita	EX, EY, FY
213	*Poa badensis* Haenke ex Willd.	Mediterraneo-Montano	FY
214	*Poa bulbosa* L. ssp. *bulbosa*	Paleotemperato	NY
215	*Poa molinerii* Balb.	Orof. Sud-Est-Europeo	EK, FH, MY
216	*Poa pratensis* L. ssp. *pratensis*	Circumboreale	NY
217	*Poa trivialis* L.	Eurasiatico	EY, GM, NY
218	*Polypogon viridis* (Gouan) Breistr. ssp. *viridis*	Paleotropicale	NY
219	*Rostraria cristata* (L.) Tzvelev	Paleotemperato	EK, NY
220	*Sesleria juncifolia* Suffren ssp. *juncifolia*	Appennino-Balcanico	CH, EY, NY
221	*Sesleria nitida* ssp. *nitida* Ten.	Endemico	NY
222	*Setaria italica* (L.) P. Beauv. ssp. *viridis* (L.) Thell.	Subcosmopolita	NY
223	*Setaria verticillata* (L.) P. Beauv.	Cosmopolita	NY
224	*Sorghum halepense* (L.) Pers.	Cosmopolita	NY
225	*Stipa dasyvaginata* Martinovsky ssp. *apenninicola* Martinovsky & Moraldo	Endemico	NY
226	*Triticum vagans* (Jord. & Fourr.) Greuter	Mediterraneo-Turaniano	NY
	BERBERIDACEAE		
227	*Berberis vulgaris* L. ssp. *vulgaris*	Eurasiatico	EK, MX, MY, NL

	RANUNCULACEAE		
228	*Adonis annua* L.	Eurimediterraneo	NY, OX
229	*Adonis distorta* Ten.	Endemico	FY
230	*Anemonastrum narcissiflorum* (L.) Holub, ssp. *narcissiflorum*	Artico-Alpino	EX
231	*Anemone hortensis* L. ssp. *hortensis*	Nord-Mediterraneo	NY, OX
232	*Anemonoides nemorosa* (L.) Holub	Circumboreale	NY
233	*Anemonoides ranunculoides* (L.) Holub	Europeo-Caucasico	NY
234	*Clematis flammula* L.	Eurimediterraneo	NY
235	*Clematis vitalba* L.	Europeo	LH, NY, OX
236	*Delphinium consolida* L.	Eurimediterraneo	NY
237	*Delphinium fissum* Waldst. & Kit. ssp. *fissum*	Eurasiatico	NY
238	*Delphinium halteratum* Sm. ssp. *halteratum*	Stenomediterraneo	NY
239	*Ficaria verna* Huds. s.l	Orof. Eurasiatico	NY
240	*Helleborus foetidus* L. ssp. *foetidus*	Subatlantico	NY, OX, OY
241	*Hepatica nobilis Mill.*	Circumboreale	NY
242	*Nigella damascena* L.	Eurimediterraneo	NY
243	*Pulsatilla alpina* (L.) Delarbre ssp. *millefoliata* (Bertol.) D.M. Moser	Circumboreale	FH, EY
244	*Ranunculus acris* L. ssp. *acris*	Cosmopolita	OX
245	*Ranunculus apenninus*. (Chiov.) Pignatti	Endemico	EY
246	*Ranunculus arvensis* L.	Paleotemperato	OX
247	*Ranunculus brevifolius* Ten.	Appennino-Balcanico	CH, EX, EY, FY
248	*Ranunculus breyninus* Crantz	Orof. Sud-Europeo	FH, GM
249	*Ranunculus bulbosus* L.	Eurasiatico	NY, OX
250	*Ranunculus illyricus* L.	Appennino-Balcanico	NY
251	*Ranunculus lanuginosus* L.	Europeo-Caucasico	NY
252	*Ranunculus millefoliatus* Vahl	Mediterraneo-Montano	NY
253	*Ranunculus pollinensis*. (N. Terracc.) Chiov.	Endemico	EX
254	*Ranunculus repens* L.	Eurasiatico	NY
255	*Ranunculus seguieri* Vill. ssp. *seguieri*	Mediterraneo-Montano °°	EY, FH, FY
256	*Thalictrum lucidum* L.	Sud-Est-Europeo	NY
257	*Trollius europaeus* L. ssp. *europaeus*	Artico-Alpino	EY
	PAPAVERACEAE		
258	*Chelidonium majus* L.	Eurasiatico	NY, OX
259	*Corydalis pumila* (Host) Rchb.	Centro-Europeo	NY
260	*Fumaria capreolata* L. ssp. *capreolata*	Eurimediterraneo	NY
261	*Fumaria officinalis* L. ssp. *officinalis*	Paleotemperato	NH, OX
262	*Fumaria vaillantii* Loisel.	Eurimediterraneo	IW, MK, NY
263	*Oreomecon alpina* (L.) Banfi, Bartolucci, J. M. Tison & Galasso ssp. *alpina*	Orof. Sud-Ovest-Europeo	EX, EY
264	*Papaver dubium* L. ssp. *dubium*	Eurimediterraneo	NY
265	*Papaver rhoeas*.L. ssp. *rhoeas*	Mediterraneo-Orientale	NY, OX
266	*Pseudofumaria alba* (Mill.) Lidén ssp. *alba*	Appennino-Balcanico	CH, NY
	CRASSULACEAE		
267	*Hylotelephium maximum* (L.) Holub	Centro-Europeo	NY, OX
268	*Petrosedum montanum* (Songeon & E.P. Perrier) Grulich	Mediterraneo-Montano	LK, MH, OX
269	*Petrosedum rupestre* (L.) P.V. Heath	Centro-Europeo	CY, EK, NY
270	*Sedum acre* L.	Europeo	FY, NY
271	*Sedum album* L. ssp. *micranthum* (Bast. ex DC.) Syme	Eurimediterraneo	NY, OX
272	*Sedum annuum* L.	Artico-Alpino	EY
273	*Sedum atratum* L.	Mediterraneo-Montano	EX, FH
274	*Sedum caespitosum* (Cav.) DC.	Stenomediterraneo	NY
275	*Sedum dasyphyllum* L. ssp. *dasyphyllum*	Eurimediterraneo	NY
276	*Sedum hispanicum* L.	Pontico	EX, NY
277	*Sedum rubens* L.	Eurimediterraneo	NY, OX

278	*Sedum sexangulare* L.	Europeo	EX, NY
279	*Sempervivum arachnoideum* L.	Orof. Sud-Europeo	AK, EY, FY, MS, MY
280	*Sempervivum riccii* Iberite & Anzal.	Endemico	NX
281	*Sempervivum tectorum* L.	Mediterraneo-Montano	AK, CY. MS. NL
282	*Umbilicus horizontalis* (Guss.) DC.	Stenomediterraneo	NY
	BERBERIDACEAE		
283	*Berberis vulgaris* L. ssp. *vulgaris*	Eurasiatico	NY
	SAXIFRAGACEAE		
284	*Saxifraga adscendens* L. ssp. *adscendens*	Mediterraneo-Montano	EX
285	*Saxifraga caesia* L.	Orof. Sud-Europeo	AK, AY, BH, CH
286	*Saxifraga callosa* Sm. ssp. *callosa*	Orof. Sud-Ovest-Europeo	GX, GY, HK, HX, LX, NY
287	*Saxifraga exarata* Vill. ssp. *ampullacea* (Ten.) D. A. Webb	Endemico	AK, EX, EY, FH
288	*Saxifraga granulata* L. ssp. *granulata*	Subatlantico	EX, NY
289	*Saxifraga italica* D. A. Webb	Endemico	EY
290	*Saxifraga oppositifolia* L. ssp. *oppositifolia*	Artico-Alpino	EY, FH, FY
291	*Saxifraga paniculata* Mill.	Artico-Alpino	EX
292	*Saxifraga porophylla* Bertol. ssp. *porophylla*	Endemico	MK, MS, NY
293	*Saxifraga rotundifolia* L. ssp. *rotundifolia*	Mediterraneo-Montano	NY
294	*Saxifraga speciosa* Dörfl. & Hayek	Endemico	EX
295	*Saxifraga tridactylites* L.	Eurimediterraneo	NY, OX
	VITACEAE		
296	*Parthenocissus quinquefolia (L.) Planch.*	Avventizio	NY
297	*Vitis vinifera* L. ssp. *vinifera*	Avventizio	NY, OX. Coltivato e spontaneizzato
	FABACEAE		
298	*Anthyllis montana* L.susbp. *jacquinii* (A Kern.) Rohlena	Orof. Sud-Est-Europeo	GY, HK, IK, MY
299	*Anthyllis vulneraria* L. ssp. *poliphylla* (DC.) Nyman	Sud-Est-Europeo	CH
300	*Anthyllis vulneraria* L. ssp. *pulchella* (Vis.) Bornm.	Sud-Est-Europeo	EX, FH, FY
301	*Anthyllis vulneraria* L. ssp. *rubiflora* (DC.) Arcang.	Eurimediterraneo	EY, HK. Sono state ricondotte al taxon le segnalazioni di A. vulneraria L. ssp. maura (Beck) Maire
302	*Anthyllis vulneraria* L. ssp. *weldeniana* (Rchb.) Cullen	Appennino-Balcanico	CH, GM
303	*Argyrolobium zanonii* (Turra) P.W. Ball ssp. *zanonii*	Mediterraneo-Occidentale	CH, EY, NY
304	*Astragalus australis* (L.) Lam.	Eurasiatico	EY, MS
305	*Astragalus depressus* L. ssp. *depressus*	Eurasiatico	BK, EX, NY
306	*Astragalus glycyphyllos* L.	Eurasiatico	NY
307	*Astragalus hamosus* L.	Mediterraneo-Turaniano	NY
308	*Astragalus monspessulanus* L. ssp. *monspessulanus*	Eurimediterraneo	FK, NH, OX
309	*Astragalus sempervirens* Lam.	Mediterraneo-Montano	EX, GM
310	*Astragalus sesameus* L.	Stenomediterraneo	NY
311	*Bituminaria bituminosa* (L.) C. H. Stirt	Eurimediterraneo	NY
312	*Cercis siliquastrum* L. ssp. *iliquastrum*	Pontico	LH, NY, OX
313	*Colutea arborescens* L.	Eurimediterraneo	NY
314	*Coronilla minima* L. ssp. *minima*	Mediterraneo-Occidentale	NY
315	*Coronilla scorpioides* (L.) W. D. J. Koch	Eurimediterraneo	NY
316	*Coronilla valentina* L.	Sud-Ovest-Mediterraneo	BW, BX, CH, DK, DX, GH, IK, IX, IW, LX, MK, MS, NS
317	*Cytisophyllum sessilifolius* (L.) O. Lang	Sud-Ovest-Europeo	AK, NY
318	*Cytisus hirsutus* L.	Eurosiberiano	OX
319	*Cytisus spinescens* Sieber ex Spreng.	Appennino-Balcanico	NY
320	*Emerus major* Mill. ssp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti	Pontico	BW, DX, IY, IW, LH, LX, MK
321	*Ervilia hirsuta* (L.) Opiz.	Paleotemperato	NY
322	*Ervilia loiseleurii* (M.Bieb.) H.Schaef.	Eurimediterraneo °°	NY. Specie nuova per la flora della Majella.
323	*Ervum gracile* DC.	Stenomediterraneo	NY

324	*Galega officinalis* L.	Pontico	NH, OX
325	*Genista tinctoria* L.	Eurasiatico	NY
326	*Hippocrepis biflora* Spreng.	Eurimediterraneo	NY
327	*Hippocrepis comosa* L. ssp. *comosa*	Europeo	NY, OX
328	*Laburnum anagyroides* Medik. ssp. *anagyroides*	Eurimediterraneo	AX, CH, EK, GY, LH, NY, OX
329	*Lathyrus annuus* L.	Eurimediterraneo	NY
330	*Lathyrus aphaca* L. ssp. *aphaca*	Eurimediterraneo	NY
331	*Lathyrus cicera* L.	Eurimediterraneo	NY
332	*Lathyrus hirsutus* L.	Eurimediterraneo	NY
333	*Lathyrus nissolia* L.	Eurimediterraneo	NY
334	*Lathyrus ochrus* (L.) DC.	Stenomediterraneo	NH, OX
335	*Lathyrus odoratus* L.	Endemico	OX
336	*Lathyrus pratensis* L.	Paleotemperato	NY, OX.
337	*Lathyrus sphaericus* Retz.	Eurimediterraneo	NY
338	*Lathyrus setifolius* L.	Europeo	NY
339	*Lathyrus sylvestris* L. ssp. *sylvestris*	Europeo	EX, NY
340	*Lathyrus venetus* (Mill.) Wohlf.	Eurasiatico	NY
341	*Lotus corniculatus* L. ssp. *alpinus* (DC.) Rothm.	Mediterraneo-Montano	OX
342	*Lotus corniculatus* L. ssp. *corniculatus*	Paleotemperato	NY
343	*Lotus herbaceus* (Vill.) Jauzein	Pontico	NY
344	*Lotus hirsutus* L.	Eurimediterraneo	NY
345	*Lotus ornithopodioides* L.	Stenomediterraneo	NY
346	*Lotus tenuis Waldst. & Kit. ex Willd.*	Paleotemperato	NY
347	*Lotus tetragonolobus* L.	Stenomediterraneo	NY
348	*Medicago arabica* (L.) Huds.	Eurimediterraneo	NY
349	*Medicago disciformis* DC.	Stenomediterraneo ##	NY
350	*Medicago falcata* L. ssp. *falcata*	Eurasiatico	OX
351	*Medicago lupulina* L.	Paleotemperato	NY, OX
352	*Medicago minima* (L.) L.	Eurimediterraneo	NY, OX
353	*Medicago orbicularis* (L.) Bartal.	Eurimediterraneo	NY
354	*Medicago polymorpha* L.	Subcosmopolita	NY
355	*Medicago prostrata* Jacq. ssp. *prostrata*	Pontico	EX
356	*Medicago sativa* L.	Eurasiatico	NY, OX
357	*Medicago scutellata* Mill.	Eurimediterraneo	NY
358	*Medicago truncatula* Gaertn.	Stenomediterraneo	NY
359	*Onobrychis alba* (Waldst. & Kit.) Desv. ssp. *alba*	Appennino-Balcanico	MS, MY
360	*Onobrychis caput-gallli* (L.) Lam.	Mediterraneo-Montano	OX
361	*Onobrychis viciifolia* Scop.	Mediterraneo-Montano	NY
362	*Ononis mitissima* L.	Stenomediterraneo	NY
363	*Ononis pusilla* L. ssp. *pusilla*	Eurimediterraneo	NY
364	*Ononis reclinata* L.	Mediterraneo-Occidentale	NY
365	*Ononis spinosa* L. ssp. *pinosa*	Eurimediterraneo	NY
366	*Ononis viscosa* L. ssp. *breviflora* (DC.) Nyman	Sud-Mediterraneo	NY
367	*Oxytropis campestris* (L.) DC. ssp. *campestris*	Circumboreale	CH, EY, FY
368	*Oxytropis neglecta* Ten.	Orof. Sud-Europeo	CH, EY, FH, FY, GK
369	*Pisum sativum* L. ssp. *biflorum* (Raf.) Soldano	Eurimediterraneo	NY.
370	*Pisum sativum* L. ssp. *ativum*	Subcosmopolita	NY, OX
371	*Robinia pseudacacia* L.	Nord-Americano	NY, OX
372	*Securigera securidaca* (L.) Degen & Dorf.	Eurimediterraneo	OX
373	*Securigera varia* (L.) Lassen	Circumboreale	CH, NY
374	*Spartium junceum* L.	Eurimediterraneo	NY, OX
375	*Sulla coronaria* (L.) Medik.	Mediterraneo-Occidentale	NY, OX
376	*Trifolium alexandrinum* L.	Eurimediterraneo	NY

377	*Trifolium alpestre* L.	Europeo	NY, OX
378	*Trifolium angustifolium* L.	Eurimediterraneo	NY
379	*Trifolium arvense* L. ssp. *arvense*	Paleotemperato	NY
380	*Trifolium campestre* Schreb.	Paleotemperato	CH, NY
381	*Trifolium echinatum* M. Bieb.	Mediterraneo-Turaniano	NY
382	*Trifolium incarnatum* L. ssp. *molinerii* (Balb. ex Hornem.) Ces.	Eurimediterraneo	NY
383	*Trifolium lappaceum* L.	Eurimediterraneo	NY
384	*Trifolium nigrescens* Viv. ssp. *nigrescens*	Eurimediterraneo	OX
385	*Trifolium noricum* Wulfen ssp. *praetutianum* (Savi) Arcang.	Appennino-Balcanico °°	EX, EY, FY
386	*Trifolium ochroleucon* Huds.	Pontico	NY
387	*Trifolium pratense* L. ssp. *pratense*	Eurasiatico	NY, OX
388	*Trifolium pratense* L. ssp. *emipurpureum* (Strobl) Pignatti	Endemico	EX, EY, MS
389	*Trifolium repens* L. ssp. *repens*	Paleotemperato	NH, OX
390	*Trifolium resupinatum* L.	Paleotemperato	NY
391	*Trifolium scabrum* L. ssp. *scabrum*	Eurimediterraneo	NY
392	*Trifolium squamosum* L.	Eurimediterraneo	NY
393	*Trifolium squarrosum* L.	Eurimediterraneo	NY
394	*Trifolium stellatum* L.	Eurimediterraneo	NY
395	*Trifolium thalii* Vill.	Mediterraneo-Montano	EX, EY
396	*Trigonella alba* (Medik.) Coulot & Rabaute	Eurasiatico	NY
397	*Trigonella sulcata* (Desf.) Coulot & Rabaute	Sud-Mediterraneo	NY
398	*Trigonella woijciechowskii.* Coulot & Rabaute	Stenomediterraneo	CK, NY
399	*Vicia angustifolia* L.	Stenomediterraneo	NY
400	*Vicia bithynica* (L.) L.	Eurimediterraneo	NY
401	*Vicia cracca* L.	Eurasiatico	OX
402	*Vicia dasycarpa* Ten.	Eurimediterraneo	OX
403	*Vicia ervoides* (Brign.) Hampe	Pontico	CH, NY
404	*Vicia hybrida* L.	Eurimediterraneo	NY
405	*Vicia incana* Gouan	Eurimediterraneo	NY
406	*Vicia johannis* Tammasch	Sud-Europeo-Sud-Siberiano	NY
407	*Vicia lathyroides* L.	Eurimediterraneo	NY
408	*Vicia lentoides* (Ten.) Coss. & Germ.	Stenomediterraneo	NY
409	*Vicia lutea* L.	Eurimediterraneo	NY
410	*Vicia peregrina* L.	Mediterraneo-Turaniano	NY
411	*Vicia sativa* L. ssp. s*ativa*	Eurimediterraneo	NY, OX
412	*Vicia sepium* L.	Eurosiberiano	NY
413	*Vicia tenuifolia* Roth ssp. *tenuifolia*	Eurasiatico	NY
414	*Vicia villosa* Roth	Stenomediterraneo	CH
	POLYGALACEAE		
415	*Polygala alpestris* Rchb. ssp. *angelisii* (Ten.) Nyman	Endemico	GM, OX
416	*Polygala major* Jacq.	Pontico	NY
417	*Polygala nicaensis* W. D. J. Koch ssp. *mediterranea* Chodat	Eurimediterraneo	NY
418	*Polygala monspeliaca* L.	Stenomediterraneo	NY
	ROSACEAE		
419	*Agrimonia eupatoria* L. ssp. *eupatoria*	Subcosmopolita	NY, OX
420	*Alchemilla alpina* L.	Artico-Alpino	OX
421	*Amelanchier ovalis* Medik. ssp. *ovalis*	Mediterraneo-Montano	EK, MY, MS, NL, NS, NY
422	*Aremonia agrimonoides (L.)* DC. ssp. *agrimonoides*	Sud-Europeo	NY, OX
423	*Cotoneaster integerrimus* Medik.	Pontico	EK, NY. E' stata riportata al taxon la segnalazione di *Cotoneaster nebrodensis* (Guss.) K.Koch
424	*Cotoneaster tomentosus* (Aiton) Lindl.	Pontico	EK
425	*Crataegus monogyna* Jacq.	Paleotemperato	IK, NY

426	*Cydonia oblonga* Mill.	Asiatico-Occidentale	NY. Coltivato e spontaneizzato
427	*Dryas octopetala* L. ssp. *octopetala*	Artico-Alpino	EY
428	*Filipendula vulgaris* Moench	Centro-Europeo	NY, OX
429	*Fragaria vesca* L. ssp. *vesca*	Eurosiberiano	NY
430	*Geum urbanum* L.	Circumboreale	NY
431	*Malus domestica* (Borkh.) Borkh.	Eurasiatico	NY
432	*Malus sylvestris* (L.) Mill.	Centro-Europeo	NY
433	*Mespilus germanica* L.	Pontico	OX. Coltivato e spontaneizzato
434	*Potentilla apennina* Ten. ssp. *apennina*	Appennino-Balcanico	CH, GM, NL, NY
435	*Potentilla caulescens* L. ssp. *caulescens*	Mediterraneo-Montano	MY, NL, NH, NY
436	*Potentilla crantzii* (Crantz) Beck ex Fritsch ssp. *crantzii*	Artico-Alpino	EX, EY, FH, FY
437	*Potentilla micrantha* Ramond ex DC.	Eurimediterraneo	NY
438	*Potentilla pedata* Willd. ex Hornem.	Eurimediterraneo	NY
439	*Potentilla reptans* L.	Paleotemperato	NH
440	*Potentilla rigoana* Th. Wolf	Endemico	NY
441	*Poterium sanguisorba* L. ssp. *balearica* (Bourg. Ex Nyman) Stace	Sud-Ovest-Europeo	NY
442	*Prunus armeniaca* L.	Europeo-Caucasico	OX. Coltivato e spontaneizzato
443	*Prunus avium* L. ssp. *avium*	Pontico	NY
444	*Prunus cerasifera* Ehrh.	Pontico	NY, OX. Coltivato e spontaneizzato
445	*Prunus cerasus* L.	Pontico	NY, OX. Coltivato e spontaneizzato
446	*Prunus domestica* L.	Europeo-Caucasico	NY, OX. Coltivato e spontaneizzato
447	*Prunus dulcis* (Mill.) D. A. Webb	Eurimediterraneo	OX. Coltivato e spontaneizzato
448	*Prunus mahaleb* L.	Pontico	LH, EK, NY, OX
449	*Prunus persica* (L.) Batsch	Asiatico	NY, OX. Coltivato e spontaneizzato
450	*Prunus spinosa* L. ssp. *pinosa*	Europeo	LH, NY, OX
451	*Pyracantha coccinea* M. Roem.	Stenomediterraneo	OX, PK
452	*Pyrus communis* L.L. ssp. *communis*	Avventizio	NY
453	*Rosa arvensis* Huds.	Mediterraneo-Atlantico	NY
454	*Rosa canina* L.	Paleotemperato	NY, OX
455	*Rosa montana* Chaix	Orof. Sud-Europeo	NK
456	*Rosa nitidula Besser*	Eurimediterraneo	CH, LK, MH
457	*Rosa sempervirens* L.	Stenomediterraneo	NY, OX
458	*Rubus caesius* L.	Eurasiatico	NY, 0X
459	*Rubus canescens* DC.	Eurimediterraneo	NY
460	*Rubus idaeus* L. ssp. *idaeus*	Circumboreale	EK, MY, NY
461	*Rubus saxatilis* L.	Circumboreale	OX
462	*Rubus ulmifolius* Schott	Mediterraneo-Atlantico	NY, OX
463	*Sibbaldia procumbens* L.	Artico-Alpino	EY
464	*Sorbus aria* (L.) Crantz ssp. *aria*	Paleotemperato	EK, LH, MS, MY, NS, NY
465	*Sorbus aucuparia* L. ssp. *aucuparia*	Europeo	EK
466	*Sorbus domestica* L.	Eurimediterraneo	NY, OX
	RHAMNACEAE		
467	*Atadinus alpinus* (L.) Raf.	Mediterraneo-Occidentale	AK, EK, LH, MS, NS
468	*Atadinus fallax* (Boiss.) Hauenschild	Orof. Sud-Est-Europeo	IK
469	*Atadinus pumilus* (Turra) Hauenschild ssp. *pumilus*	Mediterraneo-Montano	MY, NY
470	*Paliurus spina-christi* Mill.	Pontico	NY, OX
471	*Rhamnus alaternus* L. ssp. *alaternus*	Stenomediterraneo	CK
472	*Rhamnus saxatilis* Jacq. ssp. *infectorius* (L.) P. Fournier	Sud-Est-Europeo	NY
	ULMACEAE		
473	*Ulmus minor Mil*L. ssp. *minor*	Europeo-Caucasico	OX
	CANNABACEAE		
474	*Celtis australis* L.	Eurimediterraneo	OX

	MORACEAE		
475	*Ficus carica* L.	Eurimediterraneo	NY, OX. Coltivato e spontaneizzato
476	*Morus alba* L.	Asiatico	OX. Coltivato e spontaneizzato
477	*Morus nigra* L.	Asiatico	OX. Coltivato e spontaneizzato
	URTICACEAE		
478	*Parietaria judaica* L.	Eurimediterraneo	OX
479	*Parietaria officinalis* L.	Europeo	NY, OX
480	*Urtica dioica* L.	Cosmopolita	NY OX
	FAGACEAE		
481	*Fagus sylvatica* L.	Centro-Europeo	LH, NH, NY, OX
482	*Quercus ilex* L. ssp. *ilex*	Stenomediterraneo	BW, DX, FK, LH, NH, NY, OX
483	*Quercus cerris* L.	Eurimediterraneo	NY
484	*Quercus pubescens* Willd. ssp. *pubescens*	Pontico	CH, NH, OX
	JUGLANDACEAE		
485	*Juglans regia* L.	Asiatico	NY, OX
	BETULACEAE		
486	*Alnus cordata* (Loisel.) Duby	Sud-Est-Europeo	LH, MS, NS, NH, NY
487	*Alnus glutinosa* L. Gaertn.	Paleotemperato	NY, OX
488	*Carpinus orientalis* MilL. ssp. *orientalis*	Pontico	NY, OX
489	*Corylus avellana* L.	Europeo	NY, OX
490	*Ostrya carpinifolia* Scop.	Pontico	BW, LH, DX, NY, OX
	CUCURBITACEAE		
491	*Bryonia dioica* Jacq.	Eurimediterraneo	GY, HK
492	*Ecballium elaterium* (L.) A. Rich.	Eurimediterraneo	HK, HX, NY
	CELASTRACEAE		
493	*Euonymus europaeus* L.	Eurasiatico	NY, OX
494	*Euonymus latifolius* (L.) Mill	Mediterraneo-Montano	EK
	OXALIDACEAE		
495	*Oxalis articulata* Savigny	Sud-Americano	NY
496	*Oxalis corniculata* L.	Cosmopolita	NY
497	*Oxalis dillenii* Jacq.	Subcosmopolita	NY
	VIOLACEAE		
498	*Viola alba* Besser ssp. *dehnhardtii* (Ten.) W. Becker	Eurimediterraneo	NH, NY, OX
499	*Viola eugeniae* Parl. ssp. *eugeniae*	Endemico	EX, EY, FH, FY, LH, MY, NX
500	*Viola magellensis* Porta & Rigo ex Strobl	Appennino-Balcanico	EX, EY,FH, FY
501	*Viola odorata* L.	Eurimediterraneo	OX
502	*Viola riechenbachiana* Jord. ex Boreau	Eurosiberiano	NH, NY, OX
	SALICACEAE		
503	*Populus alba* L.	Paleotemperato	NY, OX
504	*Populus nigra* L.	Paleotemperato	NY, OX
505	*Populus tremula* L.	Eurosiberiano	OX
506	*Salix alba* L.	Paleotemperato	DX, OX
507	*Salix apennina* A.K.Skvortsov	Subendemico	NY
508	*Salix babylonica* L.	Subtropicale	NY
509	*Salix eleagnos* Scop. ssp. *eleagnos*	Mediterraneo-Montano	NY, OX
510	*Salix purpurea* L. ssp. *purpurea*	Eurasiatico	DX, NY, OX
511	*Salix retusa* L.	Orof. Europeo	EX, EY, FH, MY
512	*Salix triandra* L. ssp. *triandra*	Eurosiberiano	OX
	LINACEAE		
513	*Linum alpinum* Jacq.	Mediterraneo-Montano	GY, HK, HX, IK, NL , NY
514	*Linum bienne* Mill.	Subatlantico	NY, OX
515	*Linum capitatum* Kit. ex Schult. ssp. *serrulatum* (Bertol.) Hartvig	Appennino-Balcanico	GY, MS, MY, NY
516	*Linum corymbulosum* Rchb.	Stenomediterraneo	NY

517	*Linum strictum* L.	Stenomediterraneo	NY
518	*Linum tenuifolium* L.	Pontico	NY, OX
519	*Linum viscosum* L.	Orof. Sud-Europeo	NY
	HYPERICACEAE		
520	*Hypericum montanum* L.	Europeo-Caucasico	OX
521	*Hypericum perforatum* L.ssp. *perforatum*	Eurimediterraneo	NY, OX
522	*Hypericum richeri* Vill. ssp. *richeri*	Orof. Sud-Europeo	EX
523	*Hypericum tetrapterum* Fr.	Paleotemperato	NY
	EUPHORBIACEAE		
524	*Euphorbia amygdaloides* L.	Europeo	NY, OX
525	*Euphorbia characias* L.	Stenomediterraneo	BW, DX, LH, NY, OX, PK
526	*Euphorbia cyparissias* L.	Europeo	NH, OX
527	*Euphorbia dulcis* L.	Centro-Europeo	NY
528	*Euphorbia exigua* L.	Eurimediterraneo	NY
529	*Euphorbia falcata* L.	Mediterraneo-Turaniano	NY
530	*Euphorbia helioscopia* L. ssp. *helioscopia*	Cosmopolita	MY, NY, OX
531	*Euphorbia maculata* L.	Nord-Americano	NY
532	*Euphorbia nicaensis* All. ssp. *nicaensis*	Eurimediterraneo	OX
533	*Euphorbia peplus* L.	Cosmopolita	NY
534	*Euphorbia platyphyllos* L.	Eurimediterraneo	NY
535	*Euphorbia prostrata* Aiton	Nord-Americano	NY
536	*Mercurialis annua* L.	Paleotemperato	NY
537	*Mercurialis ovata* Sternb. & Hoppe	Pontico	EX, MY
538	*Mercurialis perennis* L.	Europeo	EK, NY
	GERANIACEAE		
539	*Erodium ciconium* (L.) L'Hér.	Eurimediterraneo	NY
540	*Erodium cicutarium* (L.) L'Hér.	Cosmopolita	NY
541	*Erodium malacoides* (L.) L'Her.	Eurimediterraneo	NY
542	*Geranium columbinum* L.	Subcosmopolita	NY
543	*Geranium dissectum* L.	Eurasiatico	NY
544	*Geranium lucidum* L.	Eurimediterraneo	NY
545	*Geranium molle* L.	Eurasiatico	NY
546	*Geranium nodosum* L.	Mediterraneo-Montano	NY
547	*Geranium purpureum* Vill.	Eurimediterraneo	NY
548	*Geranium pusillum* L.	Europeo	NY
549	*Geranium pyrenaicum* Burm.f. ssp. *pyrenaicum*	Eurimediterraneo	NY
550	*Geranium robertianum* L.	Cosmopolita	EK, NY
551	*Geranium rotundifolium* L.	Paleotemperato	NY
552	*Geranium sanguineum* L.	Europeo-Caucasico	NY
553	*Geranium versicolor* L.	Appennino-Balcanico	NY
	ONAGRACEAE		
554	*Chamaenerion angustifolium* (L.) Scop.	Circumboreale	MS, NH, NY
555	*Epilobium hirsutum* L.	Paleotemperato	NY
556	*Epilobium montanum* L.	Eurasiatico	OX
557	*Epilobium parviflorum* Schreb.	Paleotemperato	NY
	LYTHRACEAE		
558	*Lythrum hyssopifolia* L.	Subcosmopolita	NY
559	*Punica granatum* L.	Asiatico	OX
	ANACARDIACEAE		
560	*Pistacia terebinthus* L.ssp. *terebinthus*	Eurimediterraneo	HK, HX, IK, LH, LX, MK, NL
	SAPINDACEAE		
561	*Acer campestre* L.	Europeo-Caucasico	NY, OX
562	*Acer monspessulanum* L. ssp. *monspessulanum*	Eurimediterraneo	CH, FH, NY

563	*Acer opalus* Mill. ssp. *obtusatum* (Waldst. & Kit. ex Willd.) Gams	Appennino-Balcanico	AK, EK
564	*Acer platanoides* L.	Europeo-Caucasico	NY
565	*Acer pseudoplatanus* L.	Europeo-Caucasico	NY
566	*Aesculus hippocastanum* L.	Sud-Est-Europeo	OX. Utilizzato per le alberature stradali
	RUTACEAE		
567	*Ruta chalepensis* L.	Stenomediterraneo	NY
	THYMELACEAE		
568	*Daphne alpina* L.ssp. *alpina*	Orof. Sud-Europeo	LK, MH
569	*Daphne laureola* L.	Eurasiatico	NY
570	*Daphne mezereum* L.	Eurosiberiano	AK, AX, EK, NY
571	*Daphne oleoides* Schreb.	Orof. Eurasiatico	AK, AY, CH, EK, EY, MY, NY
572	*Thymelaea passerina* (L.) Coss. & Germ	Eurimediterraneo	NY
	CISTACEAE		
573	*Cistus creticus* L. ssp. *creticus*	Stenomediterraneo	CH, CY, GY, HK, HX, IK, LX, MK, PK
574	*Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter & Burdet	Stenomediterraneo	NY
575	*Fumana ericifolia* Wallr.	Stenomediterraneo	GY, HK
576	*Fumana procumbens* (Dunal) Gren. & Godr.	Pontico	OX
577	*Fumana thymifolia* (L.) Spach ex Webb	Stenomediterraneo	NY, OX
578	*Helianthemum appeninum* (L.) Mill. ssp. *apenninum*	Sud-Ovest-Europeo	NH, NY, OX
579	*Helianthemum nummularium* (L.) Mill. ssp. *glabrum* (W.D.J.Koch) Wilczek	Europeo-Caucasico	GY
580	*Helianthemum nummularium* (L.) Mill. ssp. *grandiflorum* (Scop.) Schinz & Thell.	Europeo-Caucasico	NY
581	*Helianthemum oleandicum* (L.) Dum. Cours. ssp. *alpestre* (Jacq.) Ces.	Orof. Sud-Europeo	EY, FH, FY, MY, NY
582	*Helianthemum oleandicum* (L.) Dum. Cours. ssp. *incanum* (Willk.) G. Lopez	Europeo-Caucasico	IW, LX, MK, NY
583	*Helianthemum oelandicum* (L.) Dum. Cours. ssp. *italicum* (L.) Ces.	Orof. Sud-Ovest-Europeo	EX
584	*Helianthemum salicifolium* (L.) Mill.	Eurimediterraneo	NY
	SIMABOURACEAE		
585	*Ailanthus altissima* (Mill.) Swingle	Avventizio	NY, OX
	MALVACEAE		
586	*Alcea rosea* L.	Avventizio	OX. Coltivato e spontaneizzato.
587	*Malope malacoides* L.	Eurimediterraneo	NY
588	*Malva neglecta* Wallr.	Paleotemperato	NY
589	*Malva setigera* K.F. Schimp. & Spenn.	Eurimediterraneo	NY
590	*Malva sylvestris* L.ssp. sylvestris	Eurosiberiano	NY, OX
591	*Malva thuringiaca* (L.) Vis.	Sud-Europeo-Sud-Siberiano	NY
592	*Malva trimestris* (L.) Salisb.	Stenomediterraneo	NY
593	*Tilia xeuropaea* L.	Europeo-Caucasico	OX. Utilizzato a fini ornamentali.
	RESEDACEAE		
594	*Reseda lutea* L.ssp. *lutea*	Europeo	NY
595	*Reseda luteola* L.	Circumboreale	OX
596	*Reseda phyteuma* L.	Eurimediterraneo	NY
	BRASSICACEAE		
597	*Aethionema saxatile* (L.) R. Br. ssp. *saxatile*	Mediterraneo-Montano	AH, BK, EX, IK, NY
598	*Alliaria petiolata* (M. Bieb.) Cavara & Grande	Eurasiatico	NY
599	*Alyssum alyssoides* (L.) L.	Eurimediterraneo	NY
600	*Alyssum cuneifolium* Ten.	Endemico	CH, EX, EY, FH
601	*Alyssum diffusum Ten. ssp. diffusum*	Mediterraneo-Montano	EX, NY
602	*Alyssum montanun* L. ssp. *montanum*	Pontico	OX
603	*Alyssum strigosum (Banks & Sol.) Jalas*	Mediterraneo-Orientale	NY
604	*Arabidopsis thaliana (L.) Heynh.*	Paleotemperato	NY
605	*Arabis alpina* L. ssp. *alpina*	Artico-Alpino	OX
606	*Arabis alpina* L. ssp. *caucasica (Willd.) Briq.*	Mediterraneo-Montano	EY, NY
607	*Arabis auriculata Lam.*	Orof. Sud-Europeo	NY
608	*Arabis collina Ten. ssp. collina*	Mediterraneo-Montano	NY

609	*Arabis hirsuta* (L.) Scop.	Orof. Sud-Europeo	NY
610	*Arabis surculosa N. Terracc.*	Appennino-Balcanico	EX
611	*Aubrieta columnae Guss. ssp. columnae*	Endemico	MY, NY
612	*Aurinia sinuata* (L.) Griseb.	Appennino-Balcanico	BW, BX, CH, DK, DX, LK, MH
613	*Barbarea vulgaris* W.T. Aiton	Eurosiberiano	NY
614	*Biscutella laevigata* L. ssp. *australis Raffaelli & Baldoin*	Endemico	AK, EK,LX, MK, NL, NY. Sono state riferite al taxon tutte le segnalazioni di *Biscutella laevigata* s.l.
615	*Brassica gravinae Ten.*	Subendemico	MY, MS, NS, NY
616	*Brassica nigra (L.) W. D. J. Koch*	Eurimediterraneo	NY
617	*Brassica oleracea (L.)*	Ovest-Europeo	NY
618	*Bunias erucago* L.	Eurimediterraneo	NY
619	*Capsella bursa-pastoris (L.) Medik. ssp. bursa-pastoris*	Cosmopolita	NY, OX
620	*Capsella rubella Reut.*	Cosmopolita	NY
621	*Cardamine amporitana Sennen & Pau*	Subendemico	NY
622	*Cardamine bulbifera (L.) Crantz*	Centro-Europeo	NY
623	*Cardamine chelidonia* L.	Appennino-Balcanico	NY
624	*Cardamine graeca* L.	Sud-Est-Europeo	NY
625	*Cardamine hirsuta* L.	Cosmopolita	NY
626	*Cardamine kitaibelii Bech.*	Orof. Sud-Europeo	OX
627	*Clypeola jonthlaspi* L. ssp. *jonthlaspi*	Stenomediterraneo	HX, IK, NY
628	*Diplotaxis erucoides* (L.) DC. ssp. *erucoides*	Stenomediterraneo	NY
629	*Diplotaxis tenuifolia* (L.) DC.	Subatlantico	NY, OX
630	*Draba aizoides* L. ssp. aizoides	Orof. Centro-Europeo	EX, EY, FH, FY
631	*Draba aspera Bertol.*	Orof. Sud-Europeo	OX
632	*Draba verna* L. ssp. *praecox (Steven) Rouy & Foucaud*	Stenomediterraneo	NY
633	*Draba verna* L. ssp. verna	Circumboreale	NY
634	*Drabella muralis* (L.) Fourr.	Circumboreale	NY
635	*Erysimum majellense Polatscheck*	Endemico	CH, CY, EY, LH
636	*Erysimum pseudorhaeticum Polatscheck*	Endemico	NY
637	*Fibigia clypeata (L.) Medik*	Orof. Sud-Est-Europeo	NY
638	*Hesperis laciniata* All. ssp. *laciniata*	Orof. Sud-Europeo °°	NY
639	*Hornungia petraea* (L.) Rchb. ssp. *petraea*	Eurimediterraneo	NY
640	*Iberis saxatilis* L. ssp. *saxatilis*	Mediterraneo-Montano °°	AK, EX, FH, FY, IW, LX, NY
641	*Isatis apennina* Ten. ex Grande	Subendemico °°	AK, CH, CY, HX, IK, IW, LX, MK, MY, NY
642	*Isatis tinctoria* L. ssp. *tinctoria*	Eurasiatico	NY, PK
643	*Lepidium campestre* (L.) W.T. Aiton	Europeo-Caucasico	NY
644	*Lepidium draba* L. ssp. *draba*	Mediterraneo-Turaniano	NY
645	*Lepidium graminifolium* L.	Eurimediterraneo	NY
646	*Microthlaspi perfoliatum* (L.) F. K. Mey	Paleotemperato	NY
647	*Mummenhoffia alliacea* (L.) Esmailbegi & Al-Shehbaz	Mediterraneo-Atlantico	NY
648	*Nasturtium officinale* W.T. Aiton	Cosmopolita	NY
649	*Noccaea stylosa* (Ten.) Rchb.	Endemico	EX, EY
650	*Phyllolepidum rupestre* (Sweet) Trinajstić	Stenomediterraneo	IK
651	*Pseudoturritis turrita* (L.) Al-Shehbaz.	Stenomediterraneo	NY
652	*Rapistrum rugosum (L.) Arcang.*	Eurimediterraneo	NY
653	*Sinapis alba* L. ssp. *alba*	Eurimediterraneo	NY
654	*Sinapis arvensis* L. . *ssp. arvensis*	Stenomediterraneo	NY
655	*Sisymbrium irio L.*	Paleotemperato	NH
656	*Sisymbrium officinale* (L.) Scop.	Eurasiatico	NY
657	*Sisymbrium orientale* L.	Eurimediterraneo	NY
658	*Turritis glabra* L.	Artico-Alpino	NY
	LORANTHACEAE		
659	*Loranthus europaeus* Jacq.	Europeo	NY

	SANTALACEAE		
660	*Osyris alba* L.	Eurimediterraneo	GY, HK, IK, LX, MX
661	*Thesium humifusum* DC.	Eurimediterraneo	NY, OX
662	*Thesium linophyllon* L.	Sud-Est-Europeo	CH, NY
663	*Thesium parnassii* A. DC.	Appennino-Balcanico	EY
664	*Viscum album* L. ssp. *album*	Eurasiatico	NY
	PLUMBAGINACEAE		
665	*Armeria gracilis* Ten. ssp. *gracilis*	Endemico	NH
666	*Armeria gracilis* Ten. ssp. *majellensis* (Boiss.) Arrigoni	Endemico	EY, FY, NY
667	*Plumbago europaea* L.	Stenomediterraneo	NY, OX
	POLYGONACEAE		
668	*Bistorta officinalis* Delarbre	Circumboreale	OX
669	*Bistorta vivipara* (L.) Delarbre	Artico-Alpino	EX, EY,FH, FY
670	*Fallopia convolvulus* (L.) Á.Löve	Circumboreale	NY
671	*Polygonum aviculare* L. ssp. *aviculare*	Cosmopolita	NY
672	*Rumex acetosa* L. ssp. *acetosa*	Circumboreale	BK, EX
673	*Rumex conglomeratus* Murray	Eurasiatico	NY
674	*Rumex crispus* L.	Cosmopolita	NY
675	*Rumex nebroides* Campd.	Appennino-Balcanico	0X
676	*Rumex pulcher* L. ssp. *pulcher*	Eurimediterraneo	NY
677	*Rumex scutatus* L. ssp. *cutatus*	Mediterraneo-Montano	BW, DX, EK, MS, MY, NY
	TAMARICACEAE		
678	*Tamarix africana* Poir.	Mediterraneo-Occidentale	NY
	CARYOPHYLLACEAE		
679	*Agrostemma githago* L. ssp. *githago*	Europeo-Caucasico	OX
680	*Arenaria bertolonii* Fiori	Endemico	AK, AY, BH, CH, EX, EY, FY, NY
681	*Arenaria grandifora* L. ssp. *grandifora*	Mediterraneo-Montano	EX, FH, FY, LX, NY
682	*Arenaria serpyllifolia* L. ssp. *erpyllifolia*	Subcosmopolita	NY
683	*Cerastium arvense* L. ssp. *arvense*	Paleotemperato	OX
684	*Cerastium arvense* L. ssp. *trictum* (W.D.J.Koch) Gremli	Orof. Sud-Europeo	CH, FY
685	*Cerastium glomeratum* Thuill.	Cosmopolita	NY
686	*Cerastium thomasii* Ten.	Endemico	EX, EY, FH, FY
687	*Cerastium tomentosum* L.	Ovest-Europeo	CY, DX, EK, MS, NS
688	*Cherleria capillacea* (All.) A.J.Moore & Dillenb.	Orof. Sud- Europeo	AK, AY, BH, BK, CH, MS, NS
689	*Cherleria laricifolia* (L.) Iamonico	Orof. Europeo	AK, BK
690	*Dianthus brachycalyx* A.Huet & É.Huet ex Bacch., Brullo, Casti & Giusso	Endemico	NH
691	*Dianthus ciliatus* Guss. ssp. *ciliatus*	Appennino-Balcanico	AK, HX, IK, LX, MS, NS
692	*Dianthus hyssopifolius* L.	Mediterraneo-Montano	GY, HK, NY
693	*Dianthus virgineus* L.	Stenomediterraneo	GM, GY, HK. HX, NY. Sono state ricondotte al taxon le segnalazioni di *Dianthus sylvestris* Wulfen
694	*Drypis spinosa* L. ssp. *pinosa*	Appennino-Balcanico	BW, CH, DX, EK, GY, HK, IK,LX, MY, MS, NS
695	*Heliosperma pusillum* (Waldst. & Kit.) Rchb.	Mediterraneo-Montano	OX
696	*Herniaria glabra* L.	Paleotemperato	NY
697	*Herniaria incana* Lam.	Eurimediterraneo	NY
698	*Holosteum umbellatum* L. ssp. *umbellatum*	Paleotemperato	NY
699	*Mcneillia rosanoi* (Ten.) F.Conti & Del Guacchio	Appennino-Balcanico	AK, MY, NY
700	*Moehringia muscosa* L.	Orof. Sud-Europeo	CH
701	*Moehringia trinervia* (L.) Clairv.	Eurasiatico	EK, EX, NY
702	*Paronychia capitata* (L.) Lam. ssp. *capitata*	Eurimediterraneo	AK, IK
703	*Paronykia kapela* (Hacq.) A. Kern. ssp. *kapela*	Appennino-Balcanico	CK, NY
704	*Pethroragia prolifera* (L.) P. W. Ball & Heywood	Eurimediterraneo	NY
705	*Pethroragia saxifraga* (L.) Link ssp. *saxifraga*	Eurimediterraneo	NY, OX

706	*Polycarpon tetraphyllum* L.	Eurimediterraneo	NY
707	*Sabulina tenuifolia* (L.) Rchb.ssp. *tenuifolia*	Paleotemperato	NY
708	*Sabulina verna* (L.) Rchb. ssp. *verna*	Eurasiatico	AY, EX, FH, EY, FY
709	*Sagina apetala* Ard.	Eurimediterraneo	NY
710	*Sagina saginoides* (L.) H. Karst. ssp. *saginoides*	Artico-Alpino	EY
711	*Saponaria officinalis* L.	Eurosiberiano	NY
712	*Silene acaulis* (L.) Jacq. ssp. *bryoides* (Jord.) Nyman	Artico-Alpino	EX, EY, FH, FY
713	*Silene conica* L.	Appennino-Balcanico	NY
714	*Silene italica* L.) Pers. ssp. *italica*	Eurimediterraneo	NY
715	*Silene latifolia* Poir.	Paleotemperato	CY, NY
716	*Silene multicaulis* Guss. ssp. *multicaulis*	Appennino-Balcanico	EY, GY, HK, MS, NY
717	*Silene nocturna* L. ssp. *nocturna*	Mediterraneo-Macaronesico	NY
718	*Silene otites* (L.) Wibel ssp. *otites*	Eurasiatico	EX, NY
719	*Silene viridiflora* L.	Eurasiatico	NY
720	*Silene vulgaris* (Moench) Garcke ssp. *glareosa* (Jord.) Marsden-Jones & Turrill	Orof. Sud-Est-Europeo	GY, HK
721	*Silene vulgaris* (Moench) Garcke ssp. *prostrata* (Gaudin) Schinz & Thell.	Orof. Sud-Ovest-Europeo	MK, MS, MY, NS, NY
722	*Silene vulgaris* (Moench) Garcke ssp. *vulgaris*	Eurasiatico	NY
723	*Spergularia rubra* (L.) J.Presl & C.Presl	Cosmopolita	NY
724	*Stellaria media* (L.) Vill. ssp. *media*	Cosmopolita	OX
725	*Stellaria pallida* (Dumort.) Crép.	Paleotemperato	NY
	AMARANTHACEAE		
726	*Amaranthus deflexus* L.	Sud-Americano	NY
727	*Amaranthus retroflexus* L.	Cosmopolita	NY
728	*Atriplex patula* L.	Circumboreale	NY
729	*Atriplex prostrata* Boucher ex DC.	Circumboreale	NY
730	*Beta vulgaris* L. ssp. *vulgaris*	Eurimediterraneo	OX
731	*Blitum bonus-henricus* (L.) Rchb.	Circumboreale	DY, MS, NS, NX, NY, OX
732	*Chenopodium album* L. ssp. *album*	Cosmopolita	NY
733	*Chenopodium opulifolium* Schrad. ex W.D.J.Koch & Ziz	Paleotemperato	NY
734	*Chenopodium vulvaria* L.	Eurimediterraneo	NY
	PORTULACACEAE		
735	*Portulaca trituberculata* Danin, Domina & Raimondo	Subcosmopolita	NY
	CACTACEAE		
736	*Opuntia stricta* (Haw.) Haw.	Americano	NY
	CORNACEAE		
737	*Cornus mas* L.	Pontico	OX
738	*Cornus sanguinea* ssp. *hungarica* (Kàrpàti) Soò	Eurasiatico	NY, OX
	PRIMULACEAE		
739	*Androsace villosa* L. ssp. *villosa*	Orof. Eurasiatico	EX, EY, FH, FY, NX
740	*Androsace vitaliana* (L.) Lapeyr. ssp. *praetutiana* (Buser ex Sünd.) Kress	Endemico	EX, EY, FH
741	*Cyclamen hederifolium* Aiton ssp. *hederifolium*	Stenomediterraneo	NY, OX
742	*Cyclamen repandum* Sm. ssp. *repandum*	Nord-Mediterraneo	NY, OX
743	*Lysimachia arvensis* (L.) U. Manns & Anderb. ssp. *arvensis*	Eurimediterraneo	NY, PK
744	*Primula auricula* L. ssp. *ciliata* (Moretti) Ludi	Orof. Sud-Europeo	AK, NX, NY
745	*Primula intricata* Gren. & Godr.	Eurimediterraneo	GY, HK, HX
746	*Primula veris* L. ssp. *columnae* (Ten.) Maire & Petitm.	Eurimediterraneo	NY
747	*Primula vulgaris* Huds. ssp. *vulgaris*	Europeo	NY, OX
	ERICACEAE		
748	*Arctostaphylos uva-ursi* (L.) Spreng.	Artico-Alpino	AK, EK, GY, MY, NY
749	*Orthilia secunda* (L.) House	Circumboreale	EK, NL, NY
	RUBIACEAE		
750	*Asperula aristata* L. s.l.	Mediterraneo-Montano	NY, OX
751	*Asperula cynanchica* L. s.l.	Mediterraneo-Montano	NY, OX

752	*Asperula purpurea* (L.) Ehrend. ssp. *purpurea*	Mediterraneo-Montano	EK, NY
753	*Cruciata laevipes* Opiz	Mediterraneo-Montano	NY
754	*Cruciata pedemontana* (Bellardi) Ehrend.	Eurimediterraneo	NY
755	*Galium anisophyllon* Vill.	Orof. Centro-Europeo	OX
756	*Galium aparine* L.	Eurasiatico	NY
757	*Galium corrudifolium* Vill.	Stenomediterraneo	EK, IY, NY
758	*Galium lucidum* All. ssp. *venustum* (Jord.) Arcang.	Endemico	NY
759	*Galium magellense* Ten.	Endemico	EX, EY, FH
760	*Galium mollugo* L.	Eurasiatico	OX
761	*Galium murale* (L.) All.	Stenomediterraneo	NY
762	*Galium odoratum* (L.) Scop.	Eurasiatico	OY
763	*Galium parisiense* L.	Eurimediterraneo	NY
764	*Galium tricornutum* Dandy	Eurimediterraneo	NY
765	*Galium verum* L. ssp. *verum*	Eurasiatico	EX, NY
766	*Rubia peregrina* L. ssp. *peregrina*	Stenomediterraneo	NH
767	*Rubia tinctorium* L.	Eurasiatico	OX
768	*Sherardia arvensis* L.	Eurimediterraneo	NY
769	*Theligonum cynocrambe* L.	Stenomediterraneo	NY
770	*Thliphthisa purpurea* (L.) P.Caputo & Del Guacchio ssp. *purpurea*	Orof. Sud-Est-Europeo	NL
	GENTIANACEAE		
771	*Blackstonia perfoliata* (L.) Huds. ssp. *perfoliata*	Eurimediterraneo	NY
772	*Centaurium erythraea* Rafn ssp. *erythraea*	Paleotemperato	CH, NY
773	*Centaurium pulchellum* (Sw.) Druce	Paleotemperato	
774	*Centaurium tenuiflorum* (Hoffmanns. & Link) Fritsch ssp. *acutiflorum* (Schott) Zeltner	Paleotemperato	NY
775	*Gentiana cruciata* L. ssp. *cruciata*	Eurasiatico	NH
776	*Gentiana dinarica* Beck	Appennino-Balcanico	BY, CY, GY, HK, NL, NY
777	*Gentiana lutea* L. ssp. *lutea*	Orof. Sud-Europeo	BY, EK, NX, NY
778	*Gentiana nivalis* L.	Artico-Alpino	EY
779	*Gentiana verna* L. ssp. *verna*	Eurasiatico	EK, EX, FH
780	*Gentianella columnae* (Ten.) Holub	Endemico	EY, FY
781	*Gentianopsis ciliata* (L.) Ma ssp. *ciliata*	Mediterraneo-Montano	NX
	APOCYNACEAE		
782	*Vinca major* L. ssp. *major*	Eurimediterraneo	NY
783	*Vinca minor* L.	Europeo	NY
784	*Vincetoxicum hirundinaria* Medik. ssp. *hirundinaria*	Eurasiatico	EK, MS, NH, NY
	CONVOLVULACEAE		
785	*Convolvulus arvensis* L.	Paleotemperato	NY
786	*Convolvulus cantabrica* L.	Eurimediterraneo	CK , NY
787	*Convolvulus sepium* L.	Eurasiatico	OX
788	*Convolvulus silvaticus* Kit.	Sud-Est-Europeo	NY
789	*Cuscuta europaea* L.	Paleotemperato	NY
790	*Cuscuta planiflora* Ten.	Eurimediterraneo	NY
	SOLANACEAE		
791	*Datura wrightii* Regel	Avventizio	NY
792	*Solanum dulcamara* L.	Paleotemperato	CK, NY
793	*Solanum villosum* Mill.	Eurimediterraneo	NY, OX
	NYCTAGINACEAE		
794	*Mirabilis jalapa* L.	Avventizio	NY
	BORAGINACEAE		
795	*Aegonychon purpurocaeruleum* (L.) Holub.	Pontico	NY
796	*Anchusa azurea* Mill.	Pontico	NY, OX
797	*Asperugo procumbens* L.	Paleotemperato	CH
798	*Borago officinalis* L.	Eurimediterraneo	CH, NY

799	*Buglossoides arvensis* (L.) I. M. Johnst.	Eurimediterraneo	NY, OX
800	*Cerinthe major* L. ssp. *major*	Stenomediterraneo	NY
801	*Cynoglossum magellense* Ten.	Endemico	BK
802	*Cynoglottiss barrellieri* (All.) Vural & Kit Tan. ssp. *barrellieri*	Appennino-Balcanico	EK, NY
803	*Echium italicum* L. ssp. *italicum*	Eurimediterraneo	NY
804	*Echium plantagineum* L.	Eurimediterraneo	NY
805	*Echium vulgare* L. ssp. *vulgare*	Europeo	NY
806	*Lithospermum offcinale* L.	Eurosiberiano	OX
807	*Myosotis arvensis* (L.) Hill ssp. *arvensis*	Eurasiatico	NY, OX
808	*Myosotis graui* Selvi.	Endemico	EX, EY, FH, FY. Sono state ricondotte al taxon le segnalazioni di *Myosotis alpestris* F. W. Schmidt e *M. ambigens* (Bég.) Grau.
809	*Myosotis ramosissima* Rochel ssp. *ramosissima*	Paleotemperato	NY
810	*Onosma echioides* (L.) L.	Appennino-Balcanico	LX, MK, NL, NY, PK
811	*Pulmonaria vallarsae* A.Kern. ssp. *apennina* (Cristof. & Puppi) L. Cecchi & Selvi	Endemico	NY
	HELIOTROPIACEAE		
812	*Heliotropium europaeum* L.	Eurimediterraneo	NY, OX
	OLEACEAE		
813	*Fraxinus excelsior* L. ssp. *excelsior*	Europeo-Caucasico	NY
814	*Fraxinus ornus* L. ssp. *ornus*	Pontico	BW, CH, DX, EK, LH, NY, OX
815	*Ligustrum lucidum* W.T. Aiton	Asiatico-Orientale	NY
816	*Ligustrum vulgare* L.	Europeo	CH, DX, EK, NY
817	*Olea europaea* L.	Stenomediterraneo	NY, OX
818	*Phillyrea latifolia* L.	Stenomediterraneo	NY
	PLANTAGINACEAE		
819	*Antirrhinum majus* L.	Avventizio	DX, HX, LX, NY
820	*Chaenorhinum minus* (L.) Lange ssp. *minus*	Eurimediterraneo	NY, OX
821	*Cymbalaria glutinosa* Bigazzi & Raffaelli ssp. *glutinosa*	Endemico ##	NY
822	*Cymbalaria muralis* Gaertn., B. Mey & Scherb. subsp *muralis*	Subcosmopolita	CH, CY, NY
823	*Cymbalaria pallida* (Ten.) Wettst.	Endemico	AK, LH, MS, NY
824	*Digitalis ferruginea* L.	Nord-Est-Mediterraneo	AK, GY, MS, NY
825	*Digitalis micrantha* Roth ex Schweigg.	Endemico	CY, EK, NY, OX
826	*Globularia bisnagarica* L.	Sud-Europeo	CY, EK,NL, NH
827	*Globularia cordifolia* L. ssp. *bellidifolia* (Nyman) Wettst.	Appennino-Balcanico	AK, NY, OX
828	*Kickxia spuria* (L.) Dumort. ssp. *spuria*	Eurasiatico	NY
829	*Linaria alpina* (L.) Mill.	Mediterraneo-Montano	FH, MK
830	*Linaria purpurea* (L.) Mill.	Endemico	BW, DX, EY, PK
831	*Linaria simplex* (Willd.) Desf.	Eurimediterraneo	HX, IK, LX
832	*Linaria vulgaris* Mill. ssp. *vulgaris*	Eurasiatico	CH, NY
833	*Misopates orontium* Raf. ssp. *orontium*	Eurimediterraneo	CH, NY
834	*Plantago afra* L. ssp. *afra*	Stenomediterraneo	NY
835	*Plantago atrata* Hoppe ssp. *atrata*	Mediterraneo-Montano	EX, FY, NY
836	*Plantago atrata* Hoppe ssp. *fuscescens* (Jord.) Pilg.	Subendemico	
837	*Plantago coronopus* L.	Subcosmopolita	EX, FY, MY
838	*Plantago lanceolata* L.	Eurasiatico	NY, OX
839	*Plantago major* L.	Eurasiatico	NY, OX
840	*Plantago media* L. ssp. *media*	Eurasiatico	OX
841	*Plantago sempervirens Crantz*	Eurimediterraneo	NY, OX
842	*Veronica agrestis L.*	Europeo	NY
843	*Veronica anagallis-acquatica* L. ssp. *anagallis acquatica*	Cosmopolita.	NY
844	*Veronica arvensis* L.	Cosmopolita	NY, OX
845	*Veronica beccabunga* L. ssp. *beccabunga*	Eurasiatico	NY

846	*Veronica hederifolia* L. ssp. *hederifolia*	Eurasiatico	NY, OX
847	*Veronica orsiniana* Ten. ssp. *orsiniana*	Orof. Sud-Europeo	NY
848	*Veronica persica* Poir.	Eurasiatico	NY
849	*Veronica polita* Fr.	Subcosmopolita	MY, NY
850	*Veronica praecox* All.	Eurimediterraneo	MY, NY
	SCROPHULARIACEAE.		
851	*Scrophularia canina* L.	Eurimediterraneo	AK, NH
852	*Scrophularia juratensis* Schleicher	Orof. Sud-Europeo	GY, MY, NY
853	*Scrophularia peregrina* L.	Stenomediterraneo	NY
854	*Scrophularia scopolii* Hoppe ex Pers.	Orof. Eurasiatico	NY
855	*Scrophularia umbrosa* Dumort. . ssp. *umbrosa*	Subatlantico	NY
856	*Verbascum blattaria* L.	Paleotemperato	NY
857	*Verbascum longifolium* Ten.	Appennino-Balcanico	NY, OX
858	*Verbascum phlomoides* L.	Eurimediterraneo	OX
859	*Verbascum pulverulentum Vill.*	Centro-Europeo	OX
860	*Verbascum sinuatum* L.	Eurimediterraneo	NY
861	*Verbascum thapsus* L. ssp. *thapsus*	Europeo	OX
	LAMIACEAE		
862	*Ajuga chamaepitys* (L.) Schreb. ssp. *chamaepitys*	Stenomediterraneo	NY
863	*Ajuga reptans* L.	Europeo-Caucasico	NY
864	*Ballota nigra* L. ssp. *meridionalis* (Bég.) Bég.	Eurimediterraneo	NY
865	*Betonica alopecuros* L. ssp. *divulsa* (Ten.) Bartolucci & Peruzzi	Endemico	MY, NY
866	*Betonica officinalis* L.	Europeo-Caucasico	NY
867	*Clinopodium nepeta* (L.) Kuntze	Mediterraneo-Montano	NY
868	*Clinopodium vulgare* L. ssp. *vulgare*	Circumboreale	NY
869	*Galeopsis angustifolia* Hoffm. ssp. *angustifolia*	Eurimediterraneo	NY
870	*Galeopsis ladanum* L.	Eurasiatico	CH
871	*Lamium amplexicaule* L.	Eurasiatico	AX, EK, EY, NY
872	*Lamium bifidum* Cirillo ssp. *bifidum*	Stenomediterraneo	NY
873	*Lamium bifidum* Cirillo ssp. *balcanicum* Velen.	Orof. Sud-Est-Europeo *	NY
874	*Lamium garganicum* L. ssp. *longiflorum* (Ten.) Kerguélen	Mediterraneo-Montano	AK, NY
875	*Lamium maculatum* L.	Eurasiatico	NY
876	*Lamium purpureum* L.	Eurasiatico	NY
877	*Marrubium incanum* Desr.	Appennino-Balcanico	NY
878	*Marrubium peregrinum* L.	Sud-Est-Europeo	GY, HK
879	*Melissa officinalis* L. ssp. *altissima* (Sm.) Arcang.	Stenomediterraneo	NY
880	*Melittis melissophyllum* L. ssp. *melissophyllum*	Europeo	NY
881	*Mentha longifolia* (L.) Huds.	Paleotemperato	NY, OX
882	*Mentha pulegium* L. ssp. *pulegium*	Eurimediterraneo	NY
883	*Micromeria graeca* (L.) Benth. ex Rchb. ssp. *graeca*	Stenomediterraneo	NY
884	*Origanum vulgare* L. ssp. *vulgare*	Eurasiatico	NY, 0X, RK
885	*Prunella laciniata* (L.) L.	Eurimediterraneo	NY
886	*Prunella vulgaris* L.	Europeo	NY
887	*Pseudodictamnus mediterraneus* Salmaki & Siadati ssp. *mediterraneus*	Mediterraneo-Orientale	FX
888	*Salvia pratensis* L. ssp. *pratensis*	Eurimediterraneo	OX
889	*Salvia verbenaca* L.	Eurimediterraneo	NY
890	*Satureja hortensis* L.	Eurimediterraneo	NY
891	*Satureja montana* L. ssp. *montana*	Orof. Sud-Europeo	NY, OX
892	*Scorpiurus muricatus* L.	Eurimediterraneo	NY
893	*Scutellaria columnae* All. ssp. *columnae.*	Stenomediterraneo	NY
894	*Stachys annua* (L.) L. ssp. *annua*	Eurimediterraneo	NY
895	*Stachys heraclea* All.	Nord-Ovest-Mediterraneo	NY
896	*Stachys italica* Mill.	Endemico	NY

897	*Stachys germanica* L. ssp. *salviifolia* (Ten.) Gams.	Appennino-Balcanico	NY
898	*Stachys romana* (L.) E. H. L. Krause	Stenomediterraneo	NY
899	*Stachys recta* L. ssp. *recta*	Mediterraneo-Montano	NY
900	*Stachys thirkei* C. Koch	Appennino-Balcanico	NY
901	*Stachys thymphaea* Hausskn.	Appennino-Balcanico	NY
902	*Teucrium capitatum* L. ssp. *capitatum*	Stenomediterraneo	NY
903	*Teucrium chamaedrys* L. ssp. *chamaedrys*	Stenomediterraneo	NY
904	*Teucrium flavum* L. ssp. *flavum*	Stenomediterraneo	IK, IY, MS, NY, MS
905	*Teucrium montanum* L.	Orof. Sud-Europeo	HK, HX, IK, IY, LX. NY
906	*Thymus longicaulis* C. Presl. ssp. *longicaulis*	Mediterraneo-Montano	OX.
907	*Thymus praecox* Opiz ssp. *polytrichus* (Borbàs) Jalas	Orof. Sud-Europeo	EX, EY, FY
908	*Thymus striatus* Vahl	Sud-Est-Europeo	OX
909	*Thymus vulgaris* L. ssp. *vulgaris*	Stenomediterraneo	OX
910	*Ziziphora acinos* (L.) Melnikov	Eurimediterraneo	NY
911	*Ziziphora granatensis (Boiss. & Reut.) Melnikov ssp. alpina (L.) Bräuchler & Gutermann*	Orof. Sud-Europeo	EX, EY, FY, GY ,HK, HX, IK, NY
	OROBANCHACEAE		
912	*Bellardia trixago (L.) All.*	Eurimediterraneo	NY
913	*Euphrasia italica Wettst.*	Subendemico	OX
914	*Euphrasia salisburgensis Funck ex Hoppe*	Europeo	EX , EY
915	*Euphrasia stricta D. Wolff. Ex J. F. Lehm.*	Europeo	EY, NH
916	*Melampyrum arvense* L. ssp. *arvense*	Eurasiatico	OX
917	*Melampyrum barbatum Waldst. & Kit. ssp. carstiense Ronniger*	Appennino-Balcanico	NY
918	*Melampyrum italicum Soò*	Endemico	NY
919	*Odontites luteus (L.) Clairv.*	Eurimediterraneo	MS, NS, NY
920	*Odontites vernus (Bellardi) Dumort. ssp. serotinus Corb.*	Eurasiatico	NY
921	*Orobanche caryophyllacea Sm.*	Eurimediterraneo	OX
922	*Orobanche crenata Forssk.*	Mediterraneo-Turaniano	NY
923	*Orobanche gracilis Sm.*	Europeo-Caucasico	NY
924	*Orobanche hederae Vauchere ex Duby*	Eurimediterraneo	NY
925	*Orobanche minor Sm.*	Paleotemperato	NY
926	*Orobanche teucrii Holandre*	Orof. Sud-Europeo	NY
927	*Parentucellia latifolia (L.) Caruel*	Eurimediterraneo	NY, OX
928	*Pedicularis comosa* L. ssp. *comosa*	Mediterraneo-Montano	GY, HK
929	*Pedicularis elegans Ten.*	Endemico	EX, FH, FY, MS
930	*Pedicularis verticillata* L. ssp. *verticillata*	Artico-Alpino	GM
931	*Phelipanche nana (Reut.) Soják*	Paleotemperato	NY
932	*Rhinanthus alectorolophus (Scop.) Pollich ssp. alectorolophus*	Centro-Europeo	NY, OX
933	*Rhinanthus minor L.*	Circumboreale	NY
934	*Rhinanthus wettsteinii* (Sterneck) Soò	Endemico	OX
	VERBENACEAE		
935	*Verbena officinalis* L.	Paleotemperato	NY, OX
	CAMPANULACEAE		
936	*Campanula cochleariifolia* Lam.	Mediterraneo-Montano	NX
937	*Campanula erinus* L.	Stenomediterraneo	NY
938	*Campanula fragilis* Cirillo ssp. *cavolinii* Ten.	Endemico	AK, CH, CY, DK, NY, OX
939	*Campanula glomerata* L.	Eurasiatico	NH
940	*Campanula micrantha* Bertol.	Endemico	HK, HX, IK
941	*Campanula persicifolia* L. ssp. *persicifolia*	Eurasiatico	NY
942	*Campanula rapunculus* L.	Paleotemperato	AK, NY, PK
943	*Campanula scheuchzeri* Vill. ssp. *scheuchzeri*	Mediterraneo-Montano	EX, EY, FY
944	*Campanula sibirica* L. ssp. *divergentiformis* (Ják.) Domin	Sud-Europeo Sud-Siberiano °°	AK, AX, AY, CH, DK, GH. Sono state ricondotte al taxon le segnalazioni di *Campanula sibirica* L. ssp. sibirica.

945	*Campanula spicata* L.	Endemico °°	GH, GY, LX, NY
946	*Campanula tanfanii* Podlech	Endemico	EX, EY
947	*Campanula trachelium* L.	Eurasiatico	NY, OX
948	*Edraianthus graminifolius* (L.) A. DC. ssp. *graminifolius*	Appennino-Balcanico	EX, EY, FH, FY, GM, NY, OY
949	*Legousia falcata* (Ten.) Fritsch	Stenomediterraneo	NY
950	*Legousia hybrida* (L.) Delarbre.	Atlantico	NY
951	*Legousia speculum-veneris* (L.) Chaix	Eurimediterraneo	NY
952	*Phyteuma orbiculare* L.	Mediterraneo-Montano	EY, FY, MS, NY
	ASTERACEAE		
953	*Achillea barrellieri* Ten. ssp. *barellieri*	Endemico	EX, EY, FH, FY
954	*Achillea collina* Becker ex Rchb.	Sud-Est-Europeo.	LK, MH
955	*Achillea millefolium* L. ssp. *millefolium*	Eurosiberiano	NY, OX
956	*Adenostyles australis* (Ten.) Iamonico & Pignatti	Endemico	NY, OX
957	*Anthemis cretica* L. ssp. *petraea* (Ten.) Greuter	Endemico	EY
958	*Arctium lappa* L.	Eurasiatico	NY
959	*Artemisia absitnthium* L.	Subcosmopolita	OX
960	*Artemisia alba* Turra	Sud-Europeo	MS, NY
961	*Artemisia eriantha* Ten.	Orof. Sud-Europeo	AH, BK, EX
962	*Artemisia vulgaris* L.	Circumboreale	NY, OX
963	*Aster alpinus* L. ssp. *alpinus*	Circumboreale	AH, BK, EX, FH
964	*Bellis annua* L. ssp. *annua*	Stenomediterraneo	NY
965	*Bellis perennis* L.	Circumboreale	NY, OX
966	*Bellis sylvestris* Cirillo	Stenomediterraneo	NY, OX
967	*Bombycilaeana erecta* (L.) Smoljan	Eurosiberiano	NY, OX
968	*Calendula arvensis* L.	Eurimediterraneo	NY
969	*Calendula officinalis* L.	Eurimediterraneo	NY
970	*Carduus affinis* Guss. ssp. *affinis*	Appennino-Balcanico	OX
971	*Carduus carlinifolius* Lam. ssp. *carlinifolius*	Mediterraneo-Montano	0X
972	*Carduus chrysacanthus* Ten. ssp. *chrysacanthus*	Appennino-Balcanico	EX, EY
973	*Carduus corymbosus* Ten.	Endemico	NY
974	*Carduus nutans* L. ssp. *nutans*	Ovest-Europeo	NY, OX
975	*Carduus pycnocephalus* L. ssp. *pycnocephalus*	Eurimediterraneo	NY
976	*Carlina acanthifolia* All.	Orof. Sud-Europeo	DY, MY
977	*Carlina acaulis* L. ssp. *caulescens* (Lam.) Schubl. & G. Martens	Europeo	NX, NY
978	*Carlina corymbosa* L.	Stenomediterraneo	DY, NY
979	*Carlina vulgaris* L. ssp. *pinosa* (Velen.) Vandas	Nord-Mediterraneo	NY
980	*Carthamus lanatus* L. ssp. *lanatus*	Eurimediterraneo	NY
981	*Centaurea calcitrapa* L.	Eurimediterraneo	OX
982	*Centaurea diluta* Aiton	Mediterraneo-Occidentale	NY
983	*Centaurea jacea* L. ssp. *gaudinii* (Boiss. & Reut.) Gremli	Orof. Sud-Europeo	NY
984	*Centaurea solstitialis* L. ssp. *solstitialis*	Stenomediterraneo	NY, OX
985	*Centaurea tenoreana* Willk.	Endemico	CH, DX, HK, IK, LX
986	*Centaurea triumfetti* All.	Europeo	NY, OX
987	*Chondrilla juncea* L.	Eurosiberiano	NY
988	*Cichorium intybus* L.	Paleotemperato	NH, OX
989	*Cirsium arvense* (L.) Scop.	Eurasiatico	NY
990	*Cirsium creticum* (Lam.) d'Urv. ssp. *triumfettii* (Lacaita) K. Werner	Appennino-Balcanico	NY
991	*Cirsium tenoreanum* Petr.	Endemico	NY
992	*Cirsium vulgare* (Savi) Ten.	Paleotemperato	NY
993	*Cota tinctoria* (L.) J. Gaj ssp. *tinctoria*	Pontico	NY, OX
994	*Cota triumfettii* (L.) J.Gay	Sud-Europeo	NY
995	*Crepis aurea* (L.) Cass. ssp. *glabrescens* (Caruel) Arcang.	Appennino-Balcanico	EX
996	*Crepis lacera* Ten.	Appennino-Balcanico	OX

997	*Crepis magellensis* F. Conti & Uzunov	Endemico	LK, MH, NY
998	*Crepis neglecta* L. ssp. *neglecta*	Eurimediterraneo	NY
999	*Crepis pygmaea* L.	Orof. Sud-Ovest-Europeo	AK, BH, IW ,LX
1000	*Crepis pulchra* L.	Eurimediterraneo	NY
1001	*Crepis sancta* (L.) Babc. ssp. *nemausensis* (P. Fourn.) Babc.	Mediterraneo-Turaniano	NY, OX
1002	*Crepis setosa* Haller f.	Mediterraneo-Orientale	NY
1003	*Crepis vesicaria* (L.)	Subatlantico	NY
1004	*Crupina vulgaris* Cass.	Eurosiberiano	NY
1005	*Cynara cardunculus* L. ssp. *scolymus* (L.) Hegi	Stenomediterraneo	NY, NY
1006	*Dittrichia viscosa* (L.) Greuter	Eurimediterraneo	NY
1007	*Doronicum columnae* Ten.	Orof. Sud-Europeo	NY, OX
1008	*Echinops ritro* L. ssp. *ritro*	Orof. Sud-Europeo	OX
1009	*Erigeron bonariensis* L.	Americano	NY
1010	*Erigeron canadensis* L.	Nord-Americano	NY
1011	*Erigeron epiroticus* (Vier.) Halàcsy	Appennino-Balcanico	EX, EY, FY
1012	*Erigeron sumatrensis* Retz.	Americano	NY
1013	*Eupatorium cannabinum* L. ssp. *cannabinum*	Paleotemperato	NY
1014	*Filago pyramidata* L.	Eurimediterraneo	NY
1015	*Gaillardia x grandiflora* Van Houtte	Avventizio	CK
1016	*Geropogon hybridus* (L.) Sch.Bip.	Stenomediterraneo	NY
1017	*Hedypnois rhagadioloides* (L.) F.W. Schmidt	Stenomediterraneo	CK, NY
1018	*Helichrysum italicum* (Roth) G. Don ssp. *italicum*	Eurimediterraneo	LH, NY, OX
1019	*Helminthotheca echioides* (L.) Holub	Eurimediterraneo	NY
1020	*Hieracium acanthodontoides* Arv.-Touv. & Belli	Endemico	GK
1021	*Hieracium amplexicaule* L. ssp. *berardianum* (Arv.-Touv.) Zahn	Orof. Sud-Europeo	GK
1022	*Hieracium bifidum* Kit. ex Hornem. ssp. *caesiiflorum* (Almq. ex Norrl.) Zahn	Europeo °°	GK
1023	*Hieracium dentatum* Hoppe ssp. *subvillosum* Nägeli & Peter	Subendemico °°	GK
1024	*Hieracium dentatum* Hoppe ssp. *xanthostylophorum* Furrer & Zahn	Endemico	GK
1025	*Hieracium huetianum* Arv.-Touv.	Subendemico	GK
1026	*Hieracium humile* Jacq. ssp. *brachycaule* Vuk. ex Zahn	Orof. Sud-Europeo	EY
1027	*Hieracium murorum* L. ssp. *pleiotrichum* (Zahn) Zahn	Subendemico °°	GK
1028	*Hieracium naegelianum* Pančić	Appennino-Balcanico	GK
1029	*Hieracium neomalyi* Zahn	Appennino-Balcanico	GK
1030	*Hieracium pellitum* Fr.	Subendemico	GK
1031	*Hieracium pictum* Pers.	Nord-Ovest-Mediterraneo °°	GK
1032	*Hieracium pilosum* Schleich. ex Froel. ssp. *portae* (Nägeli & Peter) Gottschl.	Endemico °°	GK
1033	*Hieracium pulchellum* Gren. ex Griseb.	Subendemico °°	GK
1034	*Hieracium racemosum* Waldst. & Kit. ex Willd. ssp. *pulmonarifolium*	Endemico	GK
1035	*Hieracium scorzonerifolium* Vill. ssp. *flexuosum* Waldst. & Kit. ex Nägeli & Peter	Subendemico	CH, GK
1036	*Hieracium tomentosum* L. ssp. *tomentosum*	Subendemico °°	AK, AX, AY, BW, CH, GK, MY
1037	*Hieracium villosum* Jacq. ssp. *doratophyllum* Nägeli & Peter	Endemico	GK
1038	*Jacobaea erucifolia* (L.) G. Gaertn., B.Mey. & Scherb. ssp. *erucifolia*	Eurasiatico	NY
1039	*Hyoseris scabra* L.	Stenomediterraneo	NY
1040	*Hypochaeris achyrophorus* L.	Stenomediterraneo	NH, OX
1041	*Jurinea mollis* (L.) Rchb. ssp. *mollis*	Sud-Est-Europeo	GH, NY, OX
1042	*Lactuca perennis* L.	Europeo	NY
1043	*Lactuca saligna* L.	Mediterraneo-Turaniano	NY
1044	*Lactuca sativa ssp. serriola* (L.) Galasso, Banfi, Bartolucci & Ardenghi	Eurimediterraneo	NY
1045	*Lactuca viminea* (L.) J.& C. Presl. ssp. *viminea*	Eurimediterraneo	NY
1046	*Lapsana communis* L. ssp. *communis*	Paleotemperato	NY
1047	*Leontodon crispus* Vill.	Sud-Europeo-Sud-Siberiano	CH, MY, NY
1048	*Leontodon hispidus* L. ssp. *dubius* (Hoppe) Pawłowska	Orof. Sud-Europeo	CH, FY
1049	*Leontodon rosanoi* (Ten.) DC.	Nord-Ovest-Mediterraneo	FK, MY, NY

1050	*Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz.	Appennino-Balcanico	BY, EX, FH, FY, GM, HX, IK, LX, MK, MS
1051	*Leucanthemum pallens* (J.Gay ex Perreym.) DC.	Eurimediterraneo	NY
1052	*Leucanthemum tridactylites* (Kern. & Huter) Huter, Porta & Rigo	Endemico	EY, NY
1053	*Leucanthemum vulgare* Lam. ssp. *vulgare*	Eurimediterraneo	FY
1054	*Mantisalca duriaei* (Spach) Briq. & Cavill.	Stenomediterraneo	NY
1055	*Matricaria chamomilla* L.	Subcosmopolita	OX
1056	*Mycelis muralis* (L.) Dumort. ssp. *muralis*	Eurasiatico	NY, OX
1057	*Notobasis syriaca* (L.) Cass.	Stenomediterraneo	NY
1058	*Omalotheca diminuta* (Braun-Blanq.) Bartolucci & Galasso	Appennino-Balcanico	EX, EY
1059	*Pallenis spinosa* (L.) Cass. ssp. *spinosa*	Eurimediterraneo	NY
1060	*Pentanema montanum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort	Mediterraneo-Occidentale	NY
1061	*Pentanema salicinum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort.	Eurasiatico	NY
1062	*Pentanema squarrosum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort	Centro-Europeo	BK
1063	*Petasites albus* (L.) Gaertn.	Europeo	EX.NY
1064	*Petasites hybridus* (L.) P. Gaertn. B. Mey. & Scherb.	Eurasiatico	NY
1065	*Picnomon acarna* (L.) Cass.	Stenomediterraneo	AH, EX , NY
1066	*Picris hieracioides* L. ssp. *hieracioides*	Eurosiberiano	NY
1067	*Pilosella anchusoides Arv.-Touv.*	Europeo	GK
1068	*Pilosella lactucella (Wallr.) P.D. Sell & C.West*	Eurosiberiano	GK
1069	*Pilosella officinarum Vaill.*	Europeo-Caucasico	EX, FY, GK
1070	*Pilosella piloselloides (Vill.) Soják ssp. piloselloides*	Europeo-Caucasico	GK, GX, HK, HX, IK
1071	*Pilosella ziziana* (Tausch) F.W. Schultz & Sch.Bip.	Orof. Sud-Europeo	GK
1072	*Pseudopodospermum hispanicum* s. l. (L.) Zaika, Sukhor. & N. Kilian	Sud-Europeo-Sud-Siberiano	NY
1073	*Ptilostemon strictus* (Ten.) Greuter	Appennino-Balcanico	NY
1074	*Pulycaria dysenterica* (L.) Bernh.	Eurimediterraneo	NY
1075	*Reichardia picroides* (L.) Roth	Stenomediterraneo	NY
1076	*Rhagadiolus stellatus* (L.) Gaertn.	Eurimediterraneo	EX , NY
1077	*Robertia taraxacoides* (Loisel.) DC.	Endemico	NY
1078	*Scolymus hispanicus* L.	Eurimediterraneo	NY
1079	*Scorzoneroides montana* (Lam.) Holub ssp. *breviscapa* (DC.) Greuter.	Endemico	EY, FH, FY
1080	*Senecio apenninus* Tausch	Endemico	AK
1081	*Senecio doronicum* (L.) L. ssp. *orientalis* J. Calvo.	Appennino-Balcanico	EX
1082	*Senecio rupestris* Waldst. & Kit.	Orof. Sud-Est-Europeo	OX
1083	*Senecio scopolii* Hoppe & Hornsch. ssp. *floccosus* (Bertol.) Greuter	Appennino-Balcanico	OX
1084	*Senecio vulgaris* L.	Eurimediterraneo	NY
1085	*Silybum marianum* (L.) Gaertn.	Eurimediterraneo	NY
1086	*Solidago virgaurea* L. ssp. *virgaurea*	Circumboreale	BK, CH, CY, EK, CK, NY
1087	*Sonchus arvensis* L. ssp. *arvensis*	Eurosiberiano	MY, NL
1088	*Sonchus asper* (L.) Hill. ssp. *asper*	Cosmopolita	NY
1089	*Sonchus bulbosus* (L.) N. Kilian & Greuter	Stenomediterraneo	NY, OX
1090	*Sonchus oleraceus* L.	Eurasiatico	NY
1091	*Symphyotrichum squamatum* (Spreng.) G.L.Nesom	Neotropicale	NY
1092	*Tanacetum corymbosum* (L.) Sch.Bip. ssp. *achilleae* (L.) Greuter	Sud-Est-Europeo	NY
1093	*Tanacetum parthenium* (L.) Sch.Bip.	Eurasiatico	NY
1094	*Taraxacum apenninum* (Ten.) Ten.	Endemico	EX, EY, FY
1095	*Taraxacum glaciale* E. & A. Huet. ex Hand.-Mazz.	Endemico	EX, EY
1096	*Taraxacum officinale* Weber	Circumboreale	NH, OX
1097	*Tragopogon crocifolius* L. ssp. *crocifolius*	Stenomediterraneo	AY, BH
1098	*Tragopogon eriospermus* Ten.	Eurimediterraneo	NY
1099	*Tragopogon porrifolius* L. ssp. *porrifolius*	Eurimediterraneo	NY

1100	*Tragopogon pratensis* L.	Eurosiberiano	OX
1101	*Tussilago farfara* L.	Paleotemperato	NY
1102	*Urospermum dalechampii* (L.) F. W. Schmidt	Eurimediterraneo	NY, OX, PK
1103	*Urospermum picroides* (L.) Scop. ex F.W. Schmidt	Paleotemperato	NY
1104	*Xanthium orientale* L.	Americano	NY
1105	*Xanthium spinosum* L.	Sud-Americano	NY
1106	*Xeranthemum cylindraceum* Sm.	Eurasiatico	NY
1107	*Xeranthemum inapertum* (L.) Mill.	Pontico	NY
	VIBURNACEAE		
1108	*Adoxa moschatellina* L. ssp. *moschatellina*	Eurasiatico	NY
1109	*Sambucus ebulus* L.	Eurimediterraneo	NY
1110	*Sambucus nigra* L.	Europeo	NY, OX
1111	*Viburnum lantana* L.	Eurasiatico	AK, EK, IK, MS, MY, NL, NS
1112	*Viburnum tinus* L. ssp. *tinus*	Stenomediterraneo	NY
	CAPRIFOLIACEAE.		
1113	*Lonicera caprifolium* L.	Pontico	LH, NY, OX
1114	*Lonicera etrusca* Santi	Eurimediterraneo	NY, OX, PK
1115	*Lonicera implexa* Aiton ssp. *implexa*	Stenomediterraneo	NY
	DIPSACACEAE		
1116	*Cephalaria leucantha* (L.) Roem. & Schult.	Sud-Europeo	HX, MK , NY
1117	*Cephalaria transsylvanica* (L.) Roem. & Schult.	Pontico	NY
1118	*Dipsacus fullonum* L.	Eurimediterraneo	NY
1119	*Lomelosia crenata* (Cirillo) Greuter & Burdet ssp. *crenata*	Sud-Mediterraneo	EX, IK. Sono state assegnate al taxon le precedenti segnalazioni di *Knautia purpurea*
1120	*Lomelosia crenata* (Cirillo) Greuter & Burdet ssp. *pseudisetensis* (Lacaita) Greuter & Burdet	Endemico	OX
1121	*Lomelosia graminifolia* (L.) Greuter & Burdet ssp. *graminifolia*	Orof. Sud-Europeo	CK, MS, NH, NY
1122	*Scabiosa columbaria* L. ssp. *portae* (Huter) Hayek	Sud-Est-Europeo	OX
1123	*Scabiosa pyrenaica* All.	Sud-Ovest Europeo	GH, MS
1124	*Scabiosa uniseta* Savi	Endemico	OX
1125	*Sixalix atropurpurea* (L.) Greuter & Burdet	Stenomediterraneo	NY
	VALERIANACEAE		
1126	*Centranthus angustifolius* (Mill.) DC. ssp. *angustifolius*	Mediterraneo-Occidentale °°	DX, GY, HK, LK, MH, MY, NY
1127	*Centranthus ruber* (L.) DC. ssp. *ruber*	Stenomediterraneo	BW, NY, OX
1128	*Valeriana montana* L.	Orof. Sud-Europeo	EY
1129	*Valeriana saliunca* All.	Orof. Sud-Est-Europeo	EX, EY, FH, NY
1130	*Valeriana tripteris* L. ssp. *tripteris*	Mediterraneo-Montano	OX
1131	*Valeriana tuberosa* L.	Mediterraneo-Montano	EY
1132	*Valerianella coronata* (L.) DC.	Eurimediterraneo	NY
1133	*Valerianella locusta* (L.) Laterr.	Subcosmopolita	NY
	ARALIACEAE		
1134	*Hedera helix* L. ssp. *helix*	Mediterraneo-Atlantico	NY, OX
	APIACEAE		
1135	*Ammi majus* L.	Eurimediterraneo	NY
1136	*Anethum foeniculum* L.	Eurimediterraneo	NY
1137	*Anethum piperitum* Ucria	Sud-Mediterraneo	NY
1138	*Angelica sylvestris* L.	Eurosiberiano	NY
1139	*Apium graveolens* L.	Eurosiberiano	OX
1140	*Bunium bulbocastanum* L.	Ovest-Europeo	AK, NY
1141	*Bunium petraeum* Ten.	Endemico	EK
1142	*Bupleurum baldense* Turra	Eurimediterraneo	EX, IK, NL, NY
1143	*Bupleurum falcatum* L. ssp. *cernuum* (Ten.) Arcang.	Orof. Sud-Europeo	AK, EK, MY, NY
1144	*Buplerurum praealtum* L.	Pontico	OX

1145	*Bupleurum subovatum* Link ex Spreng.	Eurimediterraneo	NY
1146	*Carum carvifolium* (DC.) Arcang.	Endemico	NY, OX
1147	*Caucalis platycarpos* L.	Mediterraneo-Turaniano	NY
1148	*Cervaria rivini* Gaertn.	Eurosiberiano	NY
1149	*Chaerophyllum aureum* L.	Nord-Mediterraneo	AK, NY
1150	*Chaerophyllum temulum* L.	Eurasiatico	NY
1151	*Conium maculatum* L. ssp. *maculatum*	Eurasiatico	NL
1152	*Coristospermum cuneifolium* (Guss.) Bertol.	Endemico	AK, EK, MX, NY
1153	*Daucus carota* L. ssp. *carota*	Paleotemperato	NY, OX
1154	*Eryngium amethystinum* L.	Sud-Est-Europeo	CH, NY, OX
1155	*Eryngium campestre* L.	Eurimediterraneo	OX
1156	*Ferula communis* L. ssp. *communis*	Eurimediterraneo	OX
1157	*Ferula glauca* L.	Stenomediterraneo	NL
1158	*Grafia golaka* (Hacq.) Rchb.	Appennino-Balcanico	MY, NY
1159	*Helosciadium nodiflorum* (L.) W.D.J. Koch ssp. *nodiflorum*	Eurimediterraneo	GY, HK, NY
1160	*Heracleum orsinii* Guss.	Appennino-Balcanico	CH
1161	*Katapsuxis silaifolia* (Jacq.) Reduron, Charpin & Pimenov	Sud-Est-Europeo	NY
1162	*Laserpitium latifolium* L.	Europeo	MY
1163	*Oenanthe pimpinelloides* L	Mediterraneo-Atlantico	NY
1164	*Opopanax chironium* (L.) W.D.J.Koch	Stenomediterraneo	MY
1165	*Oreoselinum nigrum* Delarbre	Stenomediterraneo	EX ,NY
1166	*Orlaya grandiflora* (L.) Hoffm.	Centro-Europeo	LX, MK, NY
1167	*Orlaya platycarpos* W.D.J. Koch.	Stenomediterraneo	NY
1168	*Pastinaca sativa* L. ssp. *urens* (Req. ex Godr.) Celak.	Eurosiberiano	ny, OX
1169	*Petroselinum crispum* (Mill.) Fuss	Mediterraneo-Orientale	NY
1170	*Pimpinella anisum* L.	Asiatico	OX. Coltivato e spontaneizzato.
1171	*Pimpinella saxifraga* L. ssp. *axifraga*	Europeo	OX
1172	*Pimpinella tragium* Vill.	Mediterraneo-Turaniano	OX
1173	*Prangos ferulacea* (L.) Lindl.	Mediterraneo-Turaniano	HY, NY
1174	*Sanicula europea* L.	Mediterraneo-Montano	HY, IK, NY
1175	*Scandix pecten-veneris* L.	Eurimediterraneo	NY
1176	*Seseli montanum* L. ssp. *montanum*	Mediterraneo-Montano	EK, MY, NY
1177	*Siler montanum* Crantz ssp. *siculum* (Spreng.) Iamonico, Bartolucci & F. Conti	Endemico	NY
1178	*Seseli tommasinii* Rchb.	Sud-Est-Europeo	MY, NL
1179	*Sison amomum* L.	Subatlantico	NY
1180	*Thapsia asclepium* L.	Stenomediterraneo	NY
1181	*Tordylium apulum* L.	Stenomediterraneo	OX
1182	*Tordylium maximum* L.	Eurimediterraneo	NY
1183	*Torilis arvensis* (Huds.) Link	Subcosmopolita	NY
1184	*Torilis nodosa* (L.) Gaertn. ssp. *nodosa*	Mediterraneo-Turaniano	NY
1185	*Trinia dalechampii* (Ten.) Janch.	Appennino-Balcanico	EX, EY, FH, FY, GM
	ZYGOPHYLLACEAE		
1186	*Tribulus terrestris* L.	Cosmopolita	NY

FLORA TARANTA PELIGNA (ABRUCI, ITALIJA)

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POVZETEK

Občina Taranta Peligna, ki se nahaja v provinci Chieti (regija Abruci), je delno vključena v nacionalni park Majella in pokriva 21,65 km² površine. Avtorja poročata o floristični seznamu proučevanega območja, ki vključuje 1186 taksonov, vključno s 83 endemičnimi vrstami, ki povečujejo njegov fitogeografski pomen. Horološki spekter kaže, da ugotovljene vrste pripadajo 52 različnim korotipom, razdeljenim v 9 geografskih kontingentov.

Ključne besede: Taranta Peligna, Majella, Abruci, flora, reka Aventino

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KAZALO K SLIKAM NA OVITKU

SLIKA NA NASLOVNICI: Dve rdečezobi (*Odonus niger*) sta bili septembra 2024 ulovljeni v sirskih vodah. Gre za prvi zapis o pojavljanju te vrste v Sredozemskem morju, kamor je najverjetneje prišla skozi Sueški prekop kot lesepska selivka. (Foto: Borut Furlan)

Sl. 1: Rdečezoba balestra (*Odonus niger*) je grebenska riba s temno modrim trupom, ki meri do 50 cm v dolžino. Barvo lahko spreminja glede na razpoloženje in prehrano. (Foto: Borut Furlan)

Sl. 2: Plamenka (*Pterois miles*) se je prvič pojavila v vzhodnem Sredozemlju leta 1991 v Izraelu in se nato razširila na druga območja Sredozemskega morja. Povprečna zimska temperatura površinskega sloja vode je glavni omejevalni dejavnik, ki uravnava širjenje areala vrste. Njena razširjenost v Sredozemskem morju se bo verjetno še povečala, razen v najhladnejših severnih regijah. (Foto: Borut Furlan)

Sl. 3: Poročila o ugrizih navadnih, tipično neagresivnih ribjih vrst so v znanstveni literaturi redka oziroma nedokumentirana. Nepreverjeni primeri iz intervjujev v časopisih in na spletu pa kažejo, da so osebki *D. sargus* različnih velikosti v poletnih mesecih ugriznili več kopalcev na počitniških območjih Sredozemskega morja. (Foto: Borut Furlan)

Sl. 4: Polž zaškrgar *Tylodina perversa* je intenzivno rumene barve, ki jo pridobi iz spužve žveplenjače (*Aplysina aerophoba*), s katero se prehranjuje. Rumeni barvni vzorec ga učinkovito prikrije na spužvi, zaradi česar je polž neviden za plenilce. (Foto: Borut Furlan)

Sl. 5: Polža zaškrgarja vrste *Atalodoris camassae* so pred kratkim odkrili na območju Fiese (Tržaški zaliv, Slovenija) in ga opisali kot novo vrsto. Našli so ga na velikem leščurju, kjer se je prehranjeval s skorjastim mahovnjakom *Calpensia nobilis*. (Foto: I. Frkovič)

Sl. 6: 6: *Armina rubida* je tujerodna vrsta polžev zaškrgarjev, nedavno odkrita na območju Fiese (Tržaški zaliv, Slovenija). Zaradi nočnih navad vrste je bila njena prisotnost verjetno prej spregledana. (Foto: T. Knapič)

INDEX TO PICTURES ON THE COVER

FRONT COVER: Two red-toothed triggerfish (*Odonus niger*) were caught in Syrian waters in September 2024. This is the first recorded appearance of this species in the Mediterranean Sea, where it most likely arrived through the Suez Canal as a Lessepsian migrant (Photo: Borut Furlan).

Fig. 1: The red-toothed triggerfish (*Odonus niger*) is a dark blue reef fish that can grow up to 50 cm in length. Its colouration can change depending on its mood and diet. (Photo: Borut Furlan)

Fig. 2: The lionfish *Pterois miles* first appeared in the eastern Mediterranean Sea in 1991, in Israel, and subsequently spread to other areas in the Mediterranean Basin. The mean winter sea surface temperature is the primary limiting factor governing the species' range expansion, which is likely to continue throughout the Mediterranean, exception in the coolest northernmost regions. (Photo: Borut Furlan)

Fig. 3: Reports of bites by common, typically non-aggressive fish species are scarce or undocumented in scientific literature. However, anecdotal evidence from media interviews in newspapers and on the internet suggests that *D. sargus* specimens of various sizes have occasionally been involved in biting incidents with swimmers in summer vacation areas of the Mediterranean Sea. (Photo: Borut Furlan)

Fig. 4: The sea slug *Tylodina perversa* has an intense yellow colouration, which it acquires from the sponge *Aplysina aerophoba* it feeds on. This yellow pattern allows the sea slug to camouflage itself effectively on the sponge, rendering it nearly invisible to predators. (Photo: Borut Furlan)

Fig. 5: The sea slug species *Atalodoris camassae* was recently discovered in Fiesa (Gulf of Trieste, Slovenia) and described as a new species to science. It was found on a large noble pen shell, feeding on the encrusting bryozoan *Calpensia nobilis*. (Photo: I. Frkovič)

Fig. 6: *Armina rubida* is an alien heterobranch species recently discovered in the area of Fiesa (Gulf of Trieste, Slovenia). Its presence may have been previously overlooked due to the species' nocturnal habits. (Photo: T. Knapič)

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