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SQUALI E RAZZE MEDITERRANEE

MEDITERRANEAN SHARKS AND RAYS

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ANALYSIS OF CONFIRMED SHARK ATTACKS IN THE EASTERN MEDITERRANEAN SEA AND THE SEA OF MARMARA (1827–2025)

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ABSTRACT

This paper analyses data from 46 confirmed shark attacks recorded in the geographical subareas of the eastern Mediterranean Sea (GSAs 22–27) and the Sea of Marmara (GSA 28) from 1827 to 2025. The recent distribution of attacks shows the highest concentration in Turkish waters, followed by the Mediterranean waters of Egypt and Greece. Subarea-specific data reveal that the Aegean Sea (GSA 22) and the southern Levant (GSA 26) had the highest number of incidents. Temporal analysis shows an overall increasing trend in annual shark attacks throughout the study period. Since the large pelagic predatory sharks of the Mediterranean Sea are highly migratory, they can be encountered off any Mediterranean coast at any time. Considering the critical role of predatory sharks in marine ecosystems, a shark-safe eastern Mediterranean means creating safe environmental conditions for both humans and sharks.

Key words: Elasmobranchii, aggression, human, conservation, GSA22-28, shark attack

ANALISI DEGLI ATTACCHI DI SQUALI CONFERMATI NEL MEDITERRANEO ORIENTALE E NEL MAR DI MARMARA (1827-2025)

SINTESI

L'articolo analizza i dati relativi a 46 attacchi di squali confermati nelle sottozone geografiche del Mediterraneo orientale (GSA 22-27) e del Mar di Marmara (GSA 28) dal 1827 al 2025. La distribuzione recente degli attacchi mostra la più alta concentrazione nelle acque turche, seguite dalle acque mediterranee dell'Egitto e della Grecia. I dati specifici per sottozona rivelano che il Mar Egeo (GSA 22) e il Levante meridionale (GSA 26) hanno registrato il numero più elevato di incidenti. L'analisi temporale mostra una tendenza generale all'aumento degli attacchi di squali annuali durante tutto il periodo di studio. Poiché i grandi squali predatori pelagici del Mediterraneo sono altamente migratori, possono essere incontrati al largo di qualsiasi costa mediterranea in qualsiasi momento. Considerando il ruolo fondamentale degli squali predatori negli ecosistemi marini, un Mediterraneo orientale sicuro per gli squali significa creare condizioni ambientali sicure sia per gli esseri umani che per gli squali.

Parole chiave: Elasmobranchii, aggressività, esseri umani, conservazione, GSA22-28, attacchi di squali

INTRODUCTION

Sharks, a diverse group of cartilaginous fish belonging to the class Chondrichthyes (subclass Elasmobranchii), have inhabited the oceans for over 400 million years (Ebert *et al*., 2021). They play important roles as predators, competitors, facilitators, nutrient transporters, and prey across multiple ecosystem types (Dedman *et al*., 2024). Public perception, however, often demonises them as dangerous creatures or 'man eaters' (Kabasakal, 2010a; Peace, 2015), focusing more on their attacks on humans than on their benefits to the ecosystem. The narrative of shark attacks in the Mediterranean Sea has a profound historical background, dating back centuries before the birth of Christ. The epic writings of the Greco-Roman poet Oppian of Cilicia referenced the fear of sharks among sponge divers, describing their fear of being bitten and killed by these ferocious predators (Mair, 1968). Similarly, the Roman historian Claudius Aelianus recorded that divers, under constant pressure from shark threats, painted their hands and feet black to avoid detection by these fearsome creatures (Frost, 1968). According to the Greek historian Herodotus, sharks attacked survivors following the wreck of the Persian fleet off the coast of Thessaly in 493 BC. This incident, documented as case number 128 in the Global Shark Attack File (GSAF, 2025), is considered one of the earliest documented cases of a shark attack in the Mediterranean.

Midway *et al*. (2019) characterise shark attacks as a global phenomenon that attracts widespread attention and publicity, often with adverse implications for shark populations. As one of the few groups of animals with which humans have primarily negative interactions, sharks remain a perpetual source of public fascination. In fact, although the annual risk of dying from a shark attack is extremely low (1 in 4,332,817) – far lower than the likelihood of dying from heart disease (1 in 5), a car accident (1 in 84) or a bicycle accident (1 in 4,919) (International Shark Attack File [ISAF], 2025) – humans have meticulously documented such incidents for centuries. As of 3 July 2025, a total of 7,021 shark attacks had been recorded in the GSAF.

Several country-specific studies have analysed records of shark attacks in the eastern Mediterranean (Taklis, 2023, in Greek waters) and the Sea of Marmara (Kabasakal & Gedikoğlu, 2015). Researchers have also reported sporadic attacks near aquaculture cages (Ergüden *et al*., 2020) or power station cooling water discharges (Abd Rabou *et al*., 2025; Bigal *et al*., 2025), as well as historical cases from almost a century ago (Kabasakal & Gedikoğlu, 2015; Kabasakal & Bayrı, 2021). To date, however, recorded shark attacks in the eastern Mediterranean and the Sea of Marmara have not been analysed as a whole. Given the ongoing expansion of economic activities such as fishing, aquaculture, tourism, and hydrocarbon production in the eastern Mediterranean (Öztürk & Başeren, 2008), it is likely that human–shark encounters will increase as anthropogenic pressures on this marine region intensify. Due to the heterogeneous nature of the phenomenon (Chapman & McPhee, 2016), a better understanding of shark attacks requires an analysis of regional trends. Furthermore, a recent fatal shark attack in Israel in April 2025 (Abd Rabou *et al*., 2025; Bigal *et al*., 2025) and the subsequent spread of conflicting media reports highlight the necessity for a rigorous, data-based analysis of shark attacks in these marine regions. Therefore, this paper analyses recorded shark attacks in the eastern Mediterranean Sea and the Sea of Marmara since 1827, aiming to detect any potential increasing trend and identify the possible causes of the attacks.

MATERIAL AND METHODS

Study area

The eastern Mediterranean Sea, the easternmost part of the Mediterranean Basin (Fig. 1), is subdivided by the General Fisheries Commission for the Mediterranean (GFCM) into the following geographical subareas (GSAs): the Aegean Sea (GSA 22), Crete (GSA 23), the northern Levant Sea (GSA 24), Cyprus (GSA 25), the southern Levant Sea (GSA 26), and the eastern Levant Sea (GSA 27) (GFCM, 2018). The broader Levantine Basin is bounded by the Cretan archipelago and Anatolian peninsula to the north, the Middle East to the east, and northeastern Africa to the south. It has a total volume of 7.5 x 10^5 km^3 and reaches a maximum depth of ~4,300 m (Akpınar *et al*., 2016). Although the Sea of Marmara (GSA 28; Fig. 1) was once considered the northernmost extension of the Mediterranean ecosystem (Stanley & Blanpied, 1980), it is now classified as part of the larger Black Sea geographical subregion, with the exception of the Dardanelles Strait (GFCM, 2018). With a water volume of 11,500 km^3 and a maximum depth of ~1,390 m, the Sea of Marmara – together with the Dardanelles and Bosphorus straits (collectively known as the Turkish Straits System) – forms a transitional zone between the Mediterranean and Black Sea basins, functioning as a barrier, migration corridor, and acclimatisation zone for marine organisms (Öztürk & Öztürk, 1996). The topography of the Aegean Sea is characterised by hundreds of islands and thousands of islets, making it a highly archipelagic marine region (Onmuş, 2015), where several potential nurseries for top predatory lamniform sharks, such as the white shark, *Carcharodon carcharias*, and the shortfin mako shark, *Isurus oxyrinchus*, have been documented (Kabasakal, 2015, 2020).

Data acquisition

Shark attacks are defined as any forceful or aggressive contact between a living human and one or more sharks that results in injury or death to the person, or causes damage to equipment, such as surfboards, boats or diving fins (Baldridge, 1988; Taglioni *et al.*, 2019). In accordance with this definition, data were filtered from the Global Shark Attack File (GSAF, 2025), a long-running, comprehensive, scientific repository of global shark bite incidents. This initial search yielded 53 incidents from the study area. To identify recent unrecorded cases, a supplementary search was conducted on social media platforms (e.g., Facebook and Instagram), which are extensively used by spearfishers and commercial fishery communities. This search revealed four additional, provoked shark attacks, two of which were documented in published articles (Ergüden *et al.*, 2020; Kabasakal & Gedikoğlu, 2015; Kabasakal & Bayrı, 2021) but not catalogued in the GSAF. The final consolidated dataset – comprising GSAF records, incidents sourced from the literature, and those reported only on social media – thus consisted of 59 shark attacks. It is important to note that the GSAF database also includes two historical shark attacks from around 336 and 493 BC (GSAF case numbers 128 and 129, respectively; see Appendix 1), as well as one incident for which an accurate date is unavailable (GSAF case number 28; see Appendix 1); all three of these occurred in the Greek waters of the Aegean Sea. Furthermore, the GSAF curator has classified 10 records as "invalid or questionable" due to unconfirmed shark involvement prior to death. The distribution of these 10 incidents across countries is as follows: Türkiye (*n* = 1), Greece (*n* = 4), Israel (*n* = 1), Egypt (*n* = 3), and Syria (*n* = 1). In total, 13 incidents – comprising the 10 questionable reports, the two historical incidents, and the one undated incident – were excluded from the study. The analysis was therefore based on a final 'safe dataset' of 46 incidents identified as confirmed events of shark attack in the study area. Since the GSAF database lacks data on environmental factors (e.g., sea surface temperature, rainfall, lunar phases, wave height, water turbidity) for the confirmed shark attacks reported in the eastern Mediterranean and the Sea of

Tab. 1: Data collection and preparation protocol (adapted from Taglioni et al., 2019).
Tab. 1: Protokol zbiranja in priprave podatkov (prirejeno po Taglioni in sod., 2019).

Contextual factors	Date (day; month; year, of attack)
	Attack location (GSA, marine region)
	Shark species involved
Activity factors	Victim's activity at time of attack (spearfishing, fishing, swimming, sponge diving, recreational diving, aquaculture)
Type of attack	Provoked, unprovoked, on watercraft
Consequences of attack	Fatal, non-fatal

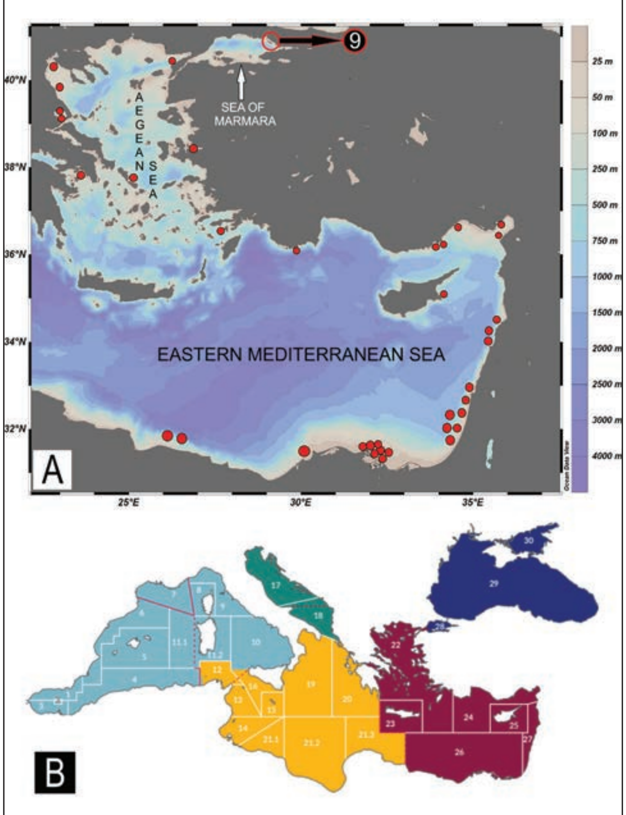

Fig. 1: (A) Approximate locations (red dots and a circle) of the 46 confirmed shark attacks reported in the eastern Mediterranean and Sea of Marmara between 1827 and 2025. The attacks in the Sea of Marmara (n = 9) are aggregated into a single circle, while the red dots represent individual incidents in the GSAs of the eastern Mediterranean. (B) Map of the GSAs of the eastern Mediterranean (GSA 22–27, shown in red) and the Sea of Marmara (GSA 28, shown in blue). Adapted from GFCM (2018).
Sl. 1: (A) Približne lokacije (rdeče pike in krog) 46 potrjenih napadov morskih psov, o katerih so poročali v vzhodnem Sredozemlju in Marmarskem morju med letoma 1827 in 2025. Napadi v Marmarskem morju (n = 9) so združeni v krog, rdeče pike pa predstavljajo posamezne incidente v območjih geografskega področja (GSA) vzhodnega Sredozemlja. (B) Zemljevid območij geografskega področja (GSA) vzhodnega Sredozemlja (GSA 22–27, prikazano z rdečo barvo) in Marmarskega morja (GSA 28, prikazano z modro barvo). Prirejeno po GFCM (2018).

Marmara, these parameters were not included in the analyses. The relevant available data for each attack were integrated into the present dataset to illustrate the conditions and consequences of the incidents (Tab. 1).

Data analysis

The collated data from the 46 confirmed shark attacks were analysed retrospectively using a set of statistical tests. A Kruskal–Wallis test was applied to assess for statistically significant differences between the distributions of the tested variable pairs (Parab & Bhalerao, 2010). Where a significant result was obtained, Dunn's post-hoc test was used for pairwise comparisons to identify which specific variable pairs (e.g., geographical subarea [GSA] vs. year, country vs. other countries, or country vs. year) differed significantly (Dinno, 2015). The Mann–Kendall test was used to detect annual trends in the GSA vs. year, country vs. year, and total study area vs. year data (Gilbert, 1987). The data were also disaggregated by country and GSA to calculate and plot the yearly incidence of attacks. Linear regression was applied to these annual counts to determine the overall trend in attack frequency over the study period (Chapman & McPhee, 2016). All analyses were performed using the statistical software PAST, version 4.03 (Hammer *et al.*, 2001), with a *p* value of 0.05 defined as statistical significance (Parab & Bhalerao, 2010). The data supporting the findings of this study are available from the author upon reasonable request.

RESULTS AND DISCUSSION

Spatiotemporal distribution of confirmed shark attacks

An analysis of collated data identified 46 confirmed shark attacks in the eastern Mediterranean Sea (GSAs 22–27) and the Sea of Marmara (GSA 28) (Fig. 1). The earliest recorded attack occurred in 1827 off the coast of Alexandria (Egypt, GSA 26), the most recent on 30 June 2025 off the coast of Mersin (Türkiye, GSA 24). Detailed information on all analysed attacks is provided in Appendix 1. The distribution of attacks by country showed the highest number in Turkish waters (*n* = 17, 39.96%), followed by the Mediterranean waters of Egypt (*n* = 10, 21.74%) and Greece (*n* = 8, 17.39%) (Fig. 2). Analysis by geographical subarea (GSA) indicated that the Aegean Sea (GSA 22; *n* = 11, 23.91%) and the southern Levant (GSA 26; *n* = 11, 23.91%) recorded the highest

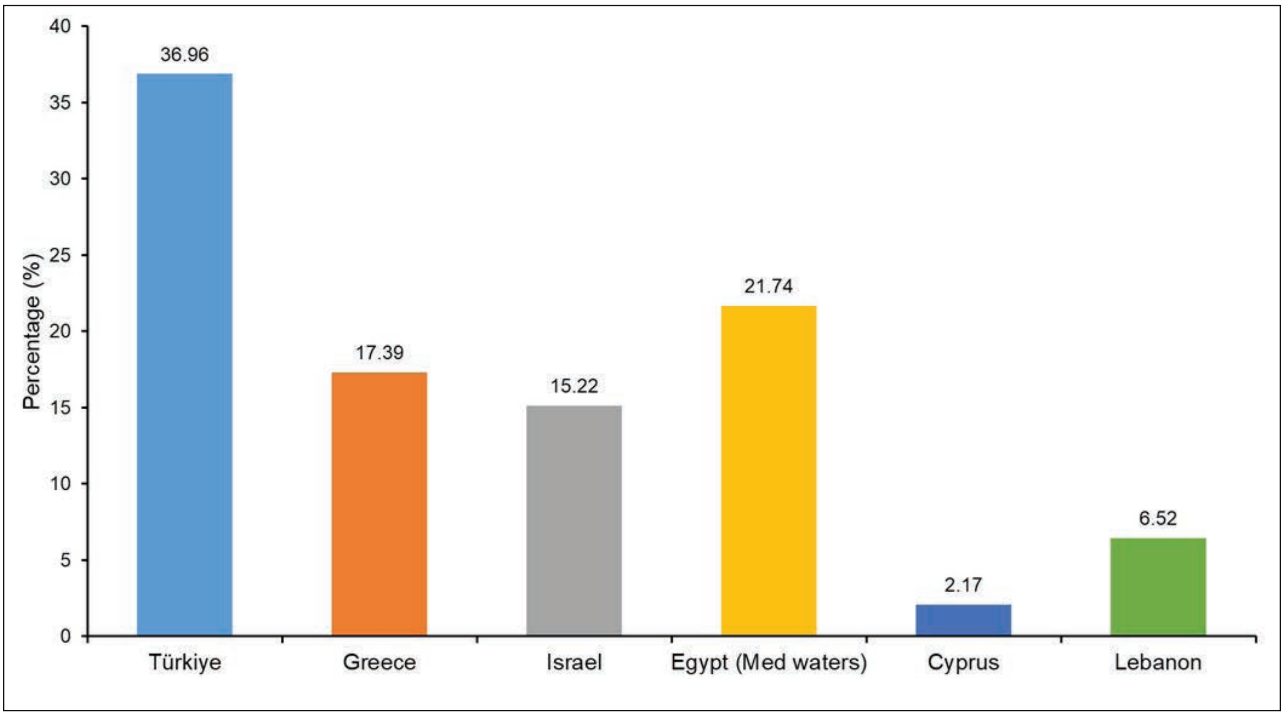

Fig. 2: Percentage distribution of confirmed shark attacks (n = 46) recorded in the eastern Mediterranean Sea (Türkiye, Greece, Israel, Egypt, Cyprus, Lebanon) and the Sea of Marmara (Türkiye) between 1827 and 2025.
Sl. 2: Odstotna porazdelitev potrjenih napadov morskih psov (n = 46), zabeleženih v vzhodnem Sredozemskem morju (Turčija, Grčija, Izrael, Egipt, Ciper, Libanon) in Marmarskem morju (Turčija) med letoma 1827 in 2025.

number of incidents, followed by the eastern Levant (GSA 27; *n* = 10, 21.73%), the Sea of Marmara (GSA 28; *n* = 7, 15.21%), the northern Levant (GSA 24; *n* = 6, 13.04%), and Cyprus (GSA 25; *n* = 1, 2.17%). A statistically significant difference was found in the number of confirmed attacks – whether provoked, unprovoked, fatal or non-fatal – across the GSAs (Kruskal–Wallis test, $p<0.05$, $p = 0.02$ for all GSAs). Significant differences were also identified when comparing the number of confirmed attacks among individual GSAs (Dunn's post-hoc test: $p = 0.008$ for the Aegean Sea, $p = 0.01$ for the southern Levant, and $p = 0.007$ for the eastern Levant). Although the GSAF database lists one alleged shark attack on a sponge diver in Syria from 1880 (case no. 484), the record was deemed invalid due to unconfirmed shark involvement and was consequently excluded from the study. This single exclusion accounts for the absence of any attack records from Syria.

Temporal distribution by year

Although the temporal distribution of confirmed shark attacks in the study area between 1827 and 2025 showed a slight upward annual trend (Fig. 3), no statistically significant trend was observed for

Tab. 2: Results of the Mann–Kendall trend test for individual countries and GSAs (z: normalised test statistic; p: p value; Y: yes; N: no).
Tab. 2: Rezultati Mann-Kendallovega trendnega testa za posamezne države in geografska podobmočja (GSA) (z: normalizirana statistika testa; p: vrednost p; Y: da; N: ne).

	z	p	Significant trend Y/N
Türkiye	1.86	0.06	N
Greece	1.19	0.23	N
Israel	2.08	0.04	N
Egypt (Med waters)	-1.77	0.08	N
Cyprus	0.25	0.80	N
Lebanon	-0.96	0.34	N
Aegean Sea (GSA 22)	1.76	0.08	N
Northern Levant (GSA 24)	2.42	0.02	**Y**
Cyprus (GSA 25)	-0.25	0.80	N
Southern Levant (GSA 26)	-1.00	0.32	N
Eastern Levant (GSA 27)	1.13	0.26	N
Sea of Marmara (GSA 28)	0.25	0.80	N
Total study area	**1.33**	**0.18**	N

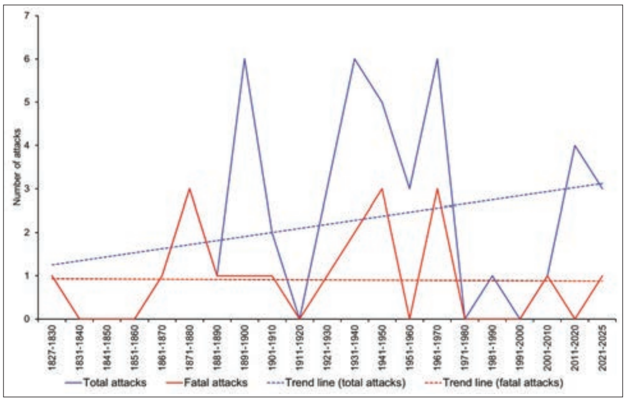

Fig. 3: Annual trend of confirmed shark attacks recorded in the entire study area between 1827 and 2025, showing total (n = 46) and fatal (n = 19) incidents.
Sl. 3: Letni trend potrjenih napadov morskih psov, zabeleženih na celotnem območju raziskave med letoma 1827 in 2025, ki prikazuje skupne primere (n = 46) in primere s smrtnim izzidom (n = 19).

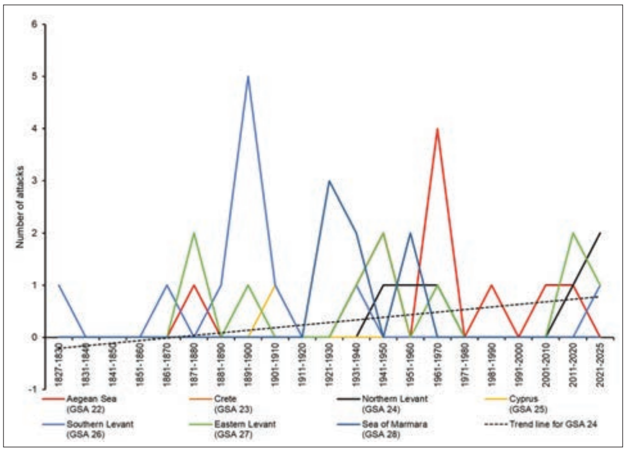

Fig. 4: Annual trend of confirmed shark attacks (1827–2025) by GSA. The dashed line indicates the increasing trend for GSA 24 (northern Levant). GSA 23 (Cretan waters) is omitted due to a lack of confirmed incidents.
Sl. 4: Letni trend potrjenih napadov morskih psov (1827–2025) po GSA. Črtkana črta označuje naraščajoči trend za GSA 24 (severni Levant). GSA 23 (kretske vode) je izpuščena zaradi pomanjkanja potrjenih primerov incidentov.

the entire study area (Mann–Kendall trend test: *z* = 1.33, *p* = 0.18) or for individual countries (Tab. 2). A statistically significant difference, however, was identified in the annual number of confirmed attacks with respect to countries (Kruskal–Wallis test, p<0.05, *p* = 0.03 for year vs. country). Although fewer attacks occurred in the northern Levant (GSA 24, *n* = 6) than other GSAs – except for Cyprus (GSA 25, *n* = 1) – the Mann–Kendall trend test indicated a statistically significant increasing trend for this geographical subarea (Tab. 2; Fig. 4).

With the exception of the eastern Levant (GSA 27), no more than one attack was recorded after 2010 in the other GSAs: the Aegean Sea (GSA 22), Cretan waters (GSA 23), Cypriot waters (GSA 25), the southern Levant (GSA 26) and the Sea of Marmara (GSA 28). Despite the overall low number of attacks in GSA 24 between 1827 and 2025, the relatively high number of incidents (*n* = 3) after 2010 likely contributed to the statistically significant upward trend observed for this area.

Temporal distribution by month and season

Of the 46 confirmed shark attacks, the month of occurrence was recorded for 45 (97.82%; Fig. 5). A significant difference was found in the number of attacks by month (Kruskal–Wallis test: p<0.05, *p* = 0.03). Seasonally, the highest number of attacks occurred in summer (*n* = 23, 51.11%). The greatest number of incidents (*n* = 10, 22.22%) was recorded in August, which showed a statistically significant difference compared to several other months of the year, and followed by September (*n* = 8, 17.39%). Seven or fewer attacks were recorded in each of the remaining months, with none in October (Fig. 5) and Dunn's post-hoc test confirmed no statistically significant differences between these months (p>0.05).

Victim activity during shark attacks

Information on the activities of the victims at the time of the attack was available for 45 incidents (97.83%). Most shark attacks occurred during swimming (*n* = 15, 33.3%), fishing (*n* = 12, 26.6%), or sponge diving (*n* = 10, 11.1%). Five shark attacks were recorded during spearfishing (*n* = 5, 11.1%), two during recreationally scuba diving (*n* = 2, 4.4%), and one during aquaculture cage maintenance (*n* = 1, 2.2%). Although no significant difference was found between activity type and the number of attacks (Kruskal–Wallis test: *p* > 0.05; *p* = 0.07), the Mann–Kendall trend test indicated a statistically significant increasing trend for spearfishing (*z* = 2.674; *p* = 0.008). The results of the Mann–Kendall trend test for victim activity at the time of confirmed shark attacks are presented in Tab. 3.

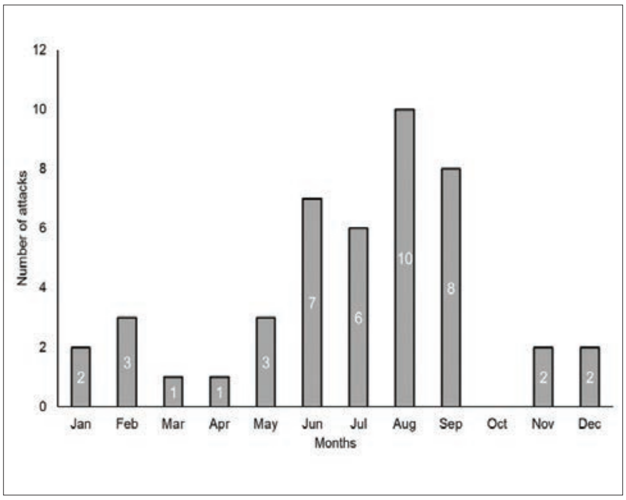

Fig. 5: Monthly distribution of confirmed shark attacks (n = 45), 1827–2025). Values above columns indicate the number of attacks per month. Results of Dunn's post-hoc test: August vs. January, p = 0.024; vs. March, p = 0.007; vs. April, p = 0.007; vs. October, p = 0.001; vs. November, p = 0.024; and vs. December, p = 0.024). September had the second highest number of attacks (n = 8, 17.77%, Dunn's post-hoc test: September vs. March, p = 0.025; vs. April, p = 0.025; and vs. October, p = 0.007), followed by June (n = 7, 15.55%, Dunn's post-hoc test: June vs. March, p = 0.029; vs. April, p = 0.029; and vs. October, p = 0.009).

Sl. 5: Mesečna porazdelitev potrjenih napadov morskih psov (n = 45), 1827–2025. Vrednosti nad stolpci označujejo število napadov na mesec. Rezultati Dunnovega post-hoc testa: avgust v primerjavi z januarjem, p = 0,024; v primerjavi z marcem, p = 0,007; v primerjavi z aprilom, p = 0,007; v primerjavi z oktobrom, p = 0,001; v primerjavi z novembrom, p = 0,024; in v primerjavi z decembrom, p = 0,024. V septembru je bilo drugo največje število napadov (n = 8, 17,77 %, Dunnov post-hoc test: september v primerjavi z marcem, p = 0,025; v primerjavi z aprilom, p = 0,025; in v primerjavi z oktobrom, p = 0,007), sledil mu je junij (n = 7, 15,55 %, Dunnov post-hoc test: junij v primerjavi z marcem, p = 0,029; v primerjavi z aprilom, p = 0,029; in v primerjavi z oktobrom, p = 0,009).

Type of shark attack

Of the 46 confirmed shark attacks, 44 (95.6%) were categorised by incident type (provoked, unprovoked, or involving watercraft). The majority were unprovoked attacks (*n* = 29, 65.9%), followed by attacks on watercraft (*n* = 8, 18.1%), and provoked attacks (*n* = 7, 15.9%). A statistically significant difference was found in the number of attacks by type (Kruskal–Wallis test: $p < 0.05$, $p = 0.0008$). Despite unprovoked attacks being most common, the Mann–Kendall trend test indicated a statistically significant increasing trend for provoked attacks ($z = 2.166$, $p = 0.03$; Tab. 3).

Consequences of a shark attack

Information on the outcome of shark attacks (fatal or non-fatal) was available for 43 of the 46 incidents (93.4%). Of these, 24 were non-fatal (55.8%) and 19 were fatal (44.1%). No statistically significant difference was found in the frequency of fatal and non-fatal attacks (Kruskal–Wallis test: $p>0.05$, $p = 0.81$), and the Mann–Kendall trend test detected no statistically significant temporal trend for either category (Tab. 3).

Shark species involved in attacks

The species of the shark involved in the attack was identified in 9 of the 46 incidents (19.56%). No statistically significant associations were found between shark species and victim activity, type of attack, or outcome (Kruskal–Wallis test: $p>0.05$, $p = 0.86$ for activity, $p = 0.27$ for type, and $p = 0.46$ for consequences), nor between species and the year of attack ($p = 0.13$). Nevertheless, a statistically significant increasing trend was observed for the involvement of *Isurus oxyrinchus* (Mann–Kendall trend test: $z = 2.272$, $p = 0.023$; Tab. 3).

In the vast marine environment, few phenomena evoke as much terror in humans as shark attacks – one of the most recognised examples of aggressive interactions between humans and nature. Due to this historic apprehension, humans have continually sought methods to fend off sharks and reduce the risk of attacks in coastal waters (Valenti, 2023), most notably through the use of shark nets (Valenti, 2023). However, these mitigation tools are known to have devastating environmental impacts (Cliff & Dudley, 2011). For example, based on the long-term observations by Queensland Shark Control Program in Australian waters, Sumpton *et al*. (2011) reported that higher numbers of marine mammals, teleost fish and rays have been unintentionally captured in protective nets, while the highest mortality of threatened loggerhead turtle *Caretta caretta* recorded in baited drumlines. Conversely, understanding the underlying causes of shark attacks has long been a major challenge for researchers. Over the years, numerous theories have been proposed to explain the occurrence of shark attacks globally. For instance, in a paper for the Taronga Conservation Society of Australia, West (2014) outlined 18 different theories regarding shark attack causation. While early explanations focused primarily on "hunger and feeding" as the motivating factors (Baldridge & Williams, 1969), contemporary perspectives are more varied and nuanced. Following the recent unprovoked fatal shark attack on a scuba diver off the coast of Hadera, Israel (GSA 27), Abd Rabou *et al.* (2025) proposed several potential contributing factors, ranging from the diver's sudden movements and loud noises to behavioural changes in the sharks due to human harassment. Given the complex behaviour of sharks, as emphasised by West (2014), the motivation for most attacks remains unclear, rendering the prediction of unprovoked incidents nearly impossible.

Whatever the underlying cause(s) of shark attacks, aggressive interactions with humans – particularly unprovoked shark bites – have increased

Tab. 3: Results of the Mann–Kendall trend test for victim activity, type of attack, outcome, and shark species involved (z: normalised test statistic; p: p value; Y: yes; N: no).

Tab. 3: Rezultati Mann-Kendallovega trendnega testa za aktivnost žrtve, vrsto napada, izid in vpletene vrste morskih psov (z: normalizirana statistika testa; p: vrednost p; Y: da; N: ne).

	z	*p*	**Significant trend Y/N**
Victim activity during shark attack (n=45)			
• Spearfishing	2.674	0.008	**Y**
• Fishing	0.268	0.789	N
• Swimming	0	1	N
• Sponge diving	0.659	0.510	N
• Recreational diving	2.217	0.027	N
• Aquaculture	1.404	0.160	N
Type of attack (n=44)			
• Provoked	2.166	0.030	**Y**
• Unprovoked	0	1	N
• Watercraft	0.533	0.594	N
Consequences of attack (n=43)			
• Fatal	0	1	N
• Non-fatal	1.911	0.056	N
Shark species involved (n=9)			
• *Carcharodon carcharias*	0.651	0.515	N
• *Isurus oxyrinchus*	2.272	0.023	**Y**
• *Carcharhinus plumbeus*	1.404	0.160	N
• *Carcharhinus obscurus*	1.569	0.117	N

worldwide over the past few decades (Chapman & McPhee, 2016; Taglioni *et al.*, 2019). In this context, the results of the present study are consistent with global findings (Chapman & McPhee, 2016; Taglioni *et al.*, 2019), revealing an increasing, though not statistically significant, annual trend in the eastern Mediterranean Sea (GSAs 22–27). This regional trend, however, masks a significant local shift. During the first half of the 20th century, the Sea of Marmara (GSA 28) was a seasonal hotspot for provoked attacks on handline fishing boats by white sharks pursuing Atlantic bluefin tuna (*Thunnus thynnus*), which migrated seasonally into this small inland sea (Kabasakal & Gedikoğlu, 2015; Kabasakal, 2016). However, with the extirpation of large pelagic predatory sharks such as *C. carcharias*, *Lamna nasus,* and *Prionace glauca* – with the exception of the common thresher shark (*Alopias vulpinus*) – from the Sea of Marmara decades ago (Kabasakal & Karakulak, 2024), the most recent confirmed shark attack in the region dates to 1983 (Kabasakal & Gedikoğlu, 2015). Consequently, the increasing annual trend observed in the wider eastern Mediterranean Sea is not applicable to the Sea of Marmara. However, ongoing severe deoxygenation and habitat deterioration in the region's deep bathyal and shelf waters have forced the large, deep-dwelling, demersal bluntnose sixgill shark (*Hexanchus griseus*) – which still inhabits the basin – to migrate to shallow coastal zones (Kabasakal *et al.*, 2024). Although this species is not known for unprovoked attacks (Compagno, 1984), its considerable size (total length up to 570 cm; Lipej *et al.*, 2022) and predatory capacity suggest it may still pose a potential danger to swimmers and divers along the coast.

In their analysis of global shark attack hotspots, Chapman and McPhee (2016) suggested that increases in shark bites are likely the result of a combination of factors beyond the shark-specific motivators proposed by West (2014) and Abd Rabou *et al.* (2025). They argued that a disruption to the natural balance of an area, whether at a local or regional level, can increase the likelihood of interactions between sharks and humans. The conditions underlying several provoked and unprovoked shark attacks in the northern Levant (GSA 24; Ergüden *et al.*, 2020) and the eastern Levant (GSA 27; Abd Rabou *et al.*, 2025) exemplify such ecological disruptions that may eventually trigger aggressive interactions. For example, the presence of excessive amounts of wounded and/or dead farmed fish in aquaculture cages anchored on the seabed nearly 4 km off the coast of Taşucu in Türkiye (GSA 24) caused a feeding frenzy among sandbar sharks (*Carcharhinus plumbeus*), resulting in non-fatal attacks and minor injuries to two commercial divers (Ergüden *et al.*, 2020). Under unstimulated and unprovoked conditions, *C. plumbeus* is not considered particularly dangerous and has never been implicated in attacks on humans (Compagno, 1984). In a second incident, the water discharged from the Orot Rabin power plant in Israel (GSA 27), which is 10 degrees warmer than the surrounding sea, attracts schools of two large coastal shark species – the dusky shark (*C. obscurus*) and the sandbar shark – to the coast of Hadera every year from November to May (Abd Rabou *et al.*, 2025; Bigal *et al.*, 2025). According to Barash *et al.* (2018), sharks are observed much more frequently near power plants, likely due to elevated water temperatures. Adventure-seeking divers, of which are trying to feed the sharks or touch them at designated aggregation spots – created by anthropogenic impacts – have been known to elicit stress-related behaviours in sharks. All of these factors confirm the role of provocation in the progression of a fatal attack (Abd Rabou *et al.*, 2025). Therefore, as coastal development can degrade habitat quality and induce environmental changes that disrupt shark behaviour (Chapman & McPhee, 2016), environmental impact assessments for projects such as coastal aquaculture facilities or power plants with hot water discharges should explicitly consider their potential impact on local shark populations in the eastern Mediterranean Sea and elsewhere.

Researchers have emphasised that in many marine areas worldwide, the dramatic increase in shark attack risk parallels the increase in time people spend in the sea, and the number of individuals engaging in water sports such as swimming, recreational scuba diving, and surfing (Taglioni *et al.*, 2019; Taklis, 2023). Supporting this, Ferretti *et al.* (2015) documented an increase in white shark attack records in California. However, the authors also emphasised that the individual attack risk for ocean users decreased by over 91% between 1950 and 2013. This apparent contradiction could be explained by an undetected long-term shark population decline and/or changes in behaviour and spatial distribution of both people and sharks. In the Sea of Marmara, historical fatal shark attacks during spearfishing and swimming have been attributed to *C. carcharias* (Kabasakal & Gedikoğlu, 2015). Similarly, in Greek waters, most shark attacks were directed at swimmers and divers, and predominantly involved *C. carcharias* (Taklis, 2023). In the present study, swimming was revealed as the most common activity at the time of attack (*n* = 15, 33.3%); however, there was also a statistically significant increasing trend for spearfishing (*n* = 5, 11.1%). The examined provoked shark attacks were predominantly caused by the shortfin mako (*Isurus oxyrinchus*), and the Mann–Kendall test also indicated an upward trend for this specific type of attack. The convergence of these trends is of particular importance, as three out of five provoked shark attacks occurred during spearfishing and were caused by shortfin mako sharks.

Spearfishing is a dangerous pastime that can result in shark attacks (Randall, 1986), particularly when carried out offshore or at dawn and dusk and has been associated with a global increase in bites (Duval *et al*., 2025). As of 10 June 2025, the GSAF database had recorded 410 spearfishing victims, accounting for 5.84% of its total incidents (GSAF, 2025). In Reunion Island, a global shark attack hotspot, attacks on spearfishers (*n* = 6, 17%) are considered a predominant form of human–shark interaction (Taglioni *et al*., 2019). Unlike events involving spearfishing, incidents linked to occupational or recreational diving (scuba or surface-supplied) showed no statistically significant trend, despite the remarkably high number of people practising these activities in the eastern Mediterranean Sea. A comparison of the numbers of attacks in occupational diving (surface-supplied sponge diving, *n* = 10) and recreational scuba diving (*n* = 2) reveals that all attacks on scuba divers occurred after 2010, while 90% (*n* = 9) of attacks on sponge divers occurred between 1871 and 1940 – a historical pattern also supported by Taklis (2023). Unlike freediving spearfishers, recreational scuba divers do not typically harpoon fish or carry dead catch. Therefore, as stated by Taglioni *et al*. (2019), they can be considered the least vulnerable to shark attacks. Also, occupational diving – whether surface-supplied ('Hookah') harvest diving or aquaculture cage maintenance diving – is a year-round activity and appears to carry a higher risk due to the time these divers spend in the water, which can be markedly longer than in recreational divers. As Lippman (2018) noted, diving for seafood collection is a major risk factor for shark attacks. Records of encounters involving occupational harvest divers are therefore important for improving our understanding of the factors that drive diver–shark interactions in the eastern Mediterranean Sea. Although not as common as in certain other regions of the world, hand-feeding or chumming of sharks – an activity known to facilitate agonistic behaviour in sharks (Clua, 2018) – has been initiated by professional underwater filmmakers in some localities of the eastern Mediterranean (Abd Rabou *et al*., 2025), possibly contributing to the region's increasing trend in shark attacks. Despite intensive chumming performed in the Italian waters of the Mediterranean and Adriatic seas for scientific research (Soldo & Peirce, 2005; Micarelli *et al*., 2023), the number of large predatory sharks attracted was extremely low, suggesting a drastic population decline. Ultimately, as the level of interaction between sharks and humans appears to be the most important driver of attacks (Clua, 2018), it is critical to remember that the likelihood of any single interaction resulting in a fatal, unprovoked attack – like the Hadera incident – remains exceedingly low (Abd Rabou *et al*., 2025; Bigal *et al*., 2025).

Identifying the species of shark involved in an attack is not always possible. This information typically relies on survivor accounts, which can be unreliable due to limited public knowledge of shark species. While some, such as the white and shortfin mako sharks, are easily recognisable, a significant knowledge gap exists for many other species. In a global analysis of 1,052 shark bites across six global shark attack hotspots, Chapman and McPhee (2016) found remarkable regional variations, yet the white shark was consistently responsible for most of the incidents. In South African waters, it alone accounted for 42.5% of bites. The predominance of white sharks is further emphasised by the GSAF data, in which they are implicated in 493 cases (7.02%), with only three of these classified as invalid or questionable (GSAF 25). De Maddalena and Heim (2012) documented 55 white shark attacks in the Mediterranean Sea but emphasised that 13 were doubtful due to uncertainties regarding the exact species involved. The predominance of white sharks contrasts with the minor role of mako sharks (*Isurus* spp.), which account for only 47 (0.66%) of the total shark bites in the GSAF database (GSAF, 2025). Since mako-related bites are uncommon worldwide (GSAF, 2025) – representing a mere 0.11% of bites in the six global shark attack hotspots (Chapman & McPhee, 2016) – the statistically significant increase in provoked attacks involving this species (*Isurus oxyrinchus*) in the northern Levant (GSA 24) is noteworthy.

In recent decades, predatory pelagic sharks have been repeatedly recorded in the very shallow coastal waters of the northern Levant (GSA 24) and the Aegean Sea (GSA 22) (Kabasakal, 2015; Filiz, 2019; Kabasakal *et al*., 2022). In rare cases, large predators such as the blue shark, *Prionace glauca*, have intentionally stranded themselves in pursuit of prey, remaining out of water for several seconds before returning (Kabasakal *et al*., 2021). Although several large pelagic predators, including *C. carcharias*, *I. oxyrinchus*, and *C. plumbeus*, have been observed in the shallows, these coastal occurrences predominantly involved *I. oxyrinchus*. According to Ebert *et al*. (2021), *I. oxyrinchus* prefers coastal and oceanic waters warmer than 16°C, and a recent study also showed that it displays transiting behaviour at sea surface temperatures (SSTs) exceeding 26°C (Banks *et al.*, 2025). Climate change is currently considered one of the four major global threats to sharks (Dulvy *et al.*, 2021); thus, warming marine waters could affect the spatial distribution of *I. oxyrinchus* in the eastern Mediterranean, as has been observed elsewhere in its distribution range (Abascal *et al.*, 2011; Banks *et al.*, 2025). The Mediterranean Basin is a recognised hotspot for climate change, having experienced a consistent warming trend for almost 40 years, with the highest values recorded precisely in the eastern Mediterranean (GSAs 22–27; Pastor *et al.*, 2020). During the summer months – when the highest number of shark attacks occurred in the studied region – the monthly averaged SSTs ranged from 24°C in June to 30°C in August and September in the eastern Mediterranean, and from 18°C in June to 24°C in August and September in the Aegean Sea (GSA 22) (Pastor *et al.*, 2020). All three attacks on freediving spearfishers involving *I. oxyrinchus* occurred in the northern Levant ($n = 2$) and the northern Aegean Sea ($n = 1$). Records of *I. oxyrinchus* in the waters of the northern Levant in the winter months – when SSTs average around 16°C (Pastor *et al.*, 2020) – followed by a northward shift into the northern Aegean Sea in late spring and summer (Kabasakal, 2015), suggest a seasonal, SST-dependent coastal occurrence pattern for the shortfin mako shark along the coast of Türkiye. A similar SST-linked pattern has been observed for *C. plumbeus*, whose annual aggregations peaked during summer, when SSTs averaged 29.4°C (Filiz, 2019). In contrast, coastal occurrences of the blue shark (*P. glauca*) appear to be a year-round phenomenon (Kabasakal, 2010b; Kabasakal *et al.*, 2021). An SST of 20–21°C has been suggested as a 'critical temperature' threshold for shark attacks (Baldridge, 1988), and the summer occurrence of confirmed shark attacks in the eastern Mediterranean (peaking in August) aligns with this threshold. Therefore, as marine water use increases during the summer, the safety of beachgoers in the warming eastern Mediterranean Basin should be insured by monitoring sea surface temperatures and implementing protective measures, based on the knowledge of the SST-associated patterns of coastal occurrence of large pelagic predatory sharks.

As Neff (2014) observed, though, the public and policymakers often focus on the question, 'What can sharks do for humans?' This perspective can cause the sharks' critical role in maintaining balanced marine ecosystems to be overlooked or underestimated. Governing sharks near coastlines is a complex public policy endeavour, creating a 'predator policy paradox' (Neff, 2014), which makes the objective management of human perceptions through news media critically important. In the Western world, few phrases evoke fear as instantly as 'shark attack' (Neff & Hueter, 2013). Such powerful terminology has been nurtured by the '*Jaws* effect', a legacy seeded decades ago that continues to frame our contemporary understanding of human–shark interaction. The fear of sharks is significantly shaped by environment and culture, with the media exerting a tremendous influence on public perception (Kabasakal, 2010a; Ostrovski *et al.*, 2021). As noted by Peschak (2006), the media perpetuate this fear because shark stories, especially sensational shark bite stories, sell well. Such stories used to be published only after editorial review and fact-checking, but the 'citizen journalism' enabled by instant widespread sharing on social media can now amplify a single incident virally, often with significant exaggeration. This dynamic was also observed in the recent unprovoked fatal attack off the coast of Hadera (Abd Rabou *et al.*, 2025). However, since not all human–shark interactions result in attack, a more refined language for reporting these incidents is needed. To address this issue, Neff and Hueter (2013) proposed a new classification system to be used by scientists, the media, policymakers, and the public to describe human–shark incidents. Regardless of the incident's severity, the authors strongly recommend avoiding the term 'shark attack' unless the shark's motivation and intent have been clearly established by experts.

In conclusion, the shark fauna of the Mediterranean Sea comprises 48 species, including 20 large pelagic predatory species (Barone *et al.*, 2022). Among these are the great white shark (*Carcharodon carcharias*) and the tiger shark (*Galeocerdo cuvier*) (Tobuni *et al.*, 2016; Kovačić *et al.*, 2021; Barone *et al.*, 2022), both of which are known for their involvement in provoked or unprovoked attacks on humans and watercraft (Ebert *et al.*, 2021). As the large pelagic predatory sharks of the Mediterranean Sea are highly migratory, they can be encountered off any Mediterranean coast at any time. The white shark, which once migrated seasonally to the Sea of Marmara in pursuit of schools of Atlantic bluefin tuna (*Thunnus thynnus*) (Kabasakal, 2016), has, on rare occasions, attacked fishing boats and people in this region (Kabasakal & Gedikoğlu, 2015). However, due to environmental deterioration and overfishing, the Atlantic bluefin tuna population no longer migrates to the region. Consequently, the white shark has also withdrawn following the decline of its prey. While this may suggest that the Sea of Marmara is now shark safe, new anthropogenic stimuli – such as tuna transport cages, the rapid growth of aquaculture farms, and the continuous discharge of warm water from coastal facilities – are increasing the potential for encounters with large sharks in coastal waters. Furthermore, the extirpation of the white shark points to severe environmental degradation and a loss of biodiversity in the region. These large sharks play a crucial balancing role in marine ecosystems, yet they are critically endangered in the Mediterranean Sea (as of 2021, these species constitute the 32.6% of the 1,199 species assessed; Dulvy *et al*., 2021), where their regional populations have declined by at least 90 per cent (Ferretti *et al*., 2008). Since the essential role of predatory sharks in the marine ecosystems and the decline of their populations are often overlooked, there is an urgent need to implement adaptive, science-based management measures to mitigate the risks of unregulated human–shark proximity in coastal environments (Bigal *et al*., 2025). Such policies are necessary not only for public safety but also for the survival of sharks in the eastern Mediterranean.

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Appendix 1: Dataset of 59 shark attacks reported from the eastern Mediterranean Sea (GSAs 22–27) and the Sea of Marmara (GSA 28). Unshaded rows represent the final 'safe dataset' of 46 confirmed shark attacks. Grey-shaded rows indicate unconfirmed records (invalid, questionable attack or unconfirmed shark involvement), historical or undated incidents that were excluded from the analysis (N/A: not applicable, unpublished, or not in the GSAF; Prv: provoked, Unprv: unprovoked; Wcrt: watercraft; Sea dis: Sea disaster). Victim names are anonymised.

Priloga 1: Nabor podatkov o 59 napadih morskih psov, zabeleženih v vzhodnem Sredozemskem morju (GSA 22–27) in Marmarskem morju (GSA 28). Ne osenčene vrstice predstavljajo končni „varen nabor podatkov" o 46 potrjenih napadih morskih psov. Sivo osenčene vrstice označujejo nepotrjene zapise (neveljaven, vprašljiv napad ali nepotrjena vpletenost morskih psov), zgodovinske ali nedatirane primere, ki so bili izključeni iz analize (N/A: ni relevantno, neobjavljeno ali ni v GSAF; Prv: izzvano, Unprv: neizzvano; Wcrt: plovilo; Sea dis: morska nesreča). Imena žrtev so anonimizirana.

GSAF Case No	Country	Date	Year	Type	Location	Activity	Sex	Age	Injury	Fatal Y/N	Time	Species
N/A	TURKEY	Reported 30-Jun-2025	2025	Prv	Mersin Taşucu Dana Island	Spearfishing	M		Not injuried	N	Early hours of the day	*Isurus oxyrinchus*
N/A	TURKEY	4-Jul-2023	2023	Prv	Antakya İskenderun	Spearfishing	M	>30	Non severe bruises on hands	N		*Isurus oxyrinchus*; *ca.* 2 m TL
N/A	TURKEY	21-Sep-2020	2020	Prv	Çanakkale Gulf of Saros, Three Islands; 40º34'23.8"N 26º47'38.8"E	Spearfishing	M	40	Severly hits the diver, grasp the fish on the weight belt	N	Early hours of the day	Probably *Isurus oxyrinchus*; ca. 1,8 m TL
N/A	TURKEY	26-Aug-2019	2019	Prv	Mersin Taşucu Dana Island	Aquaculture net contol	M		Non severe injuries on feet and ankles; lacerations on dive fins	N		*Carcharhinus plumbeus*; 7 to 8 specimens, ca. 2 m TL
2793	TURKEY	05-Jul-1967	1967	Unprv	İstanbul Off Tuzla coast	Spearfishing	M	36	Fatal	Y	13h40	
2520	TURKEY	30-Aug-1962	1962	Wcrt	Antalya Üçağız		M		No injury	N		
2427	TURKEY	16-Jul-1961	1961	Unprv	İzmir İnciralti Beach	Swimming	M	16	Left leg injured	N		
2226	TURKEY	Reported 26-Jun-1959	1959	Unprv	Mersin Off Mezitli		M		Leg injured	N		
2188	TURKEY	28-Dec-1958	1958	Wcrt	İstanbul Ahirkapi coast	Fishing			Boat damaged	N		White shark
N/A	TURKEY	1958	1958	Wcrt	İstanbul Ahırkapı	Fishing			Boat damaged	N		White shark
1773	TURKEY	Reported 17-Sep-1948	1948	Unprv	Adana Yumurtalik	Swimming	M		Fatal	Y		
1500	TURKEY	Reported 17-Jul-1938	1938	Prv	İstanbul	Fishing	M		Injured by harpooned shark	N		
1469	TURKEY	16-Aug-1937	1937	Invalid	İstanbul	Swimming	M		No injury, no attack			Invalid
1363	TURKEY	Reported 08-Feb-1934	1934	Wcrt	İstanbul Haydarpasa jetty	Fishing	M		No injury	N		
1290	TURKEY	16-Mar-1931	1931	Wcrt	İstanbul Bakırköy coast	Fishing			No injury to occupants, shark crushed boat	N		
1268	TURKEY	Reported 11-May-1930	1930	Wcrt	İstanbul Yeşilköy	Fishing	M		No injury but shark damaged boat	N		
1225	TURKEY	06-Jan-1929	1929	Wcrt	İstanbul Yeşilköy	Fishing boat	M		Fatal	Y		

N/A	TURKEY	Reported 2-Feb-1926	1926	Prv	İstanbul Prince Islands	Fishing	N/A		Fatal	Y		*Carcharodon carcharias*; ca. 5 m TL
92	GREECE	Before 2003	0000	Unprv	Dodecanese Islands near Symi Island	Free diving for sponges	M		Fatal	Y		
3414	GREECE	30-Dec-1983	1983	Invalid	Andikira Fokithes	Spearfishing	M	36	Coroner determined the man was killed by a boat propeller, not a tiger shark		02h45	Invalid
3274	GREECE	Summer of 1981	1981	Unprv	Pagasitikos Gulf	Free diving / spearfishing,	M		Minor injury	N		
3240	GREECE	1980s	1980	Invalid	Island of Kos	Surfing	M		Knee bitten			Said to involve a white shark but shark involvement not confirmed
72	GREECE	No date, Before 8-May-1965	0000	Unprv	Island of Volos	Swimming	F		Fatal	Y		
2567	GREECE	01-Jun-1963	1963	Unprv	Thessaly	Swimming	F	42	Fatal	Y	16h30	White shark, 3 m
2505	GREECE	Reported 03-Jul-1962	1962	Invalid	Cyclades				No injury			Questionable incident
1819	GREECE	Summer 1950	1950	Unprv		Swimming			Fatal	Y		
1776	GREECE	22-Sep-1948	1948	Unprv	Attica	Swimming	M	17	Fatal	Y	16h00	Said to be 6.4 m [21′] shark
1738	GREECE	Jul-1947	1947	Invalid	Carpathian Sea	Jumped overboard	M		Shark involvement unconfirmed			Questionable
1465	GREECE	Reported 28-Jun-1937	1937	Unprv	Salonika				Fatal	Y		
444	GREECE	Reported 07-Sep-1876	1876	Unprv	Cyclades archipelago between the islands of Tenos and Andros	Diving for sponges	M		Fatal	Y		
129	GREECE	Ca. 336.B.C..	0000	Unprv	Piraeus	Washing his pig in preparation for a religious ceremony	M		Fatal, shark "bit off all lower parts of him up to the belly"	Y		
128	GREECE	Ca. 493 B.C.	0000	Sea dis.	Off Thessaly	Shipwrecked Persian Fleet	M		Herodotus tells of sharks attacking men in the water	Y		
28	GREECE	No date	0000	Unprv	Dodecanese Islands Symi Island	Sponge diving	M		Head bitten	N		
	ISRAEL	21-Apr-2025	2025	Unprv	Hadera	Diving	M	45	Remains recovered several days after the attcks	Y	15h00	Dusky sharks
6501	ISRAEL	22-Nov-2019	2019	Unprv	Haifa	Snorkeling	M		No injury, swim fin bitten	N		
5710	ISRAEL	29-Sep-2013	2013	Unprv	Ashdod	Diving	M	27	Hand bitten	N	11h30	
2521	ISRAEL	Reported 31-Aug-1962	1962	Prv	Sharon	Fishing	M		Details unknown	?		2.5 m [8.25′] shark
1718	ISRAEL	24-Aug-1946	1946	Unprv	Gaza	Fishing	M	15	Laceration to back	N		

1686	ISRAEL	05-Feb-1945	1945	Unprv	Tel Aviv	Swimming	M		Survived. R.A.F. pilot, seeing commotion in the water, dived his plane to investigate and scared off shark	N		
1389	ISRAEL	Reported 21-Jan-1935	1935	Invalid	Herzliyah				human remains washed ahore			Shark involvement prior to death unconfirmed
1357	ISRAEL	Reported 27-Sep-1933	1933	Wcrt	Nabi Rubin	Fishing	M		One man bitten on thigh, another on arm	N		3 sharks
6708	EGYPT	10-Sep-2021	2021		Sidi Abdel Rahmen	Swimming	M		Laceration to arm caused by metal object			No shark invovlement
1486	EGYPT	Reported 1938	1938	Unprv	Mersa Matruh	Sponge diving	M		Fatal	Y		
987	EGYPT	Reported 15-May-1915	1915	Invalid	Alexandria	Fell overboard	M		Shark involvement not confirmed			Shark involvement prior to death unconfirmed
822	EGYPT	24-Aug-1905	1905	Invalid	Suez Canal Port Said	Human head found in shark caught by British steamer *Syria*	M		Probable drowning and scavenging.			Tiger shark, 3.9 m
775	EGYPT	Jun-1902	1902	Unprv	Tzortzou Reef, Marsa Matruh	Sponge diving	M		Bitten on hand and thigh	N		
739	EGYPT	08-Aug-1899	1899	Unprv	Port Said	Floating on his back	M	9	Back muscles torn away	N	11h30	
738	EGYPT	08-Aug-1899	1899	Unprv	Port Said	Bathing	M	19	Forearm, wrist and hand bitten	N	09h30	
737	EGYPT	08-Aug-1899	1899	Unprv	Port Said	Bathing	M	13	Left leg bitten	N	08h30	
695	EGYPT	1897	1897	Unprv	Port Said				No details	?		
636	EGYPT	1893	1893	Unprv	Port Said				No details	?		
607	EGYPT	Reported 02-Jun-1890	1890	Unprv	Port Said	Swimming	M		Fatal	Y		
382	EGYPT	Reported 22-Aug-1867	1867	Unprv	Port Said	Swimming	M		Fatal	Y		
209	EGYPT	1827	1827	Unprv	Alexandria		M		Remains of the men were recovered from a +17-foot shark	Y		
767	CYPRUS	Reported 23-Sep-1901	1901	Unprv	Southern Cyprus Larnaca	Swimming	M	Teen	Fatal, bitten on arms, chest and legs	Y		2 m shark
484	SYRIA	1880?	1880	Invalid		Diving for sponges	M		Fatal	Y		Shark involvement prior to death unconfirmed
644	LEBANON	22-Jun-1893	1893	Unprv	Off Tripoli	*HMS Victoria* collided with the *HMS Camperdown*	M		Fatal	Y		
440	LEBANON	1876	1876	Unprv	Batroun	Sponge diving	M		Fatal	Y		
107	LEBANON	Before 1876	0000	Unprv		Collecting fish	M		Posterior thigh bitten	N		

ANALIZA POTRJENIH NAPADOV MORSKIH PSOV V VZHODNEM SREDOZEMSKEM MORJU IN MARMARSKEM MORJU (1827–2025)

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POVZETEK

Avtor poroča o rezultatih analize podatkov o 46 potrjenih napadih morskih psov v geografskih podobmočjih vzhodnega Sredozemskega morja (GSAs 22–27) in Marmarskega morja (GSA 28) v obdobju med 1827 in 2025. Nedavna porazdelitev napadov kaže na največjo gostoto primerov v turških vodah, sledijo jim sredozemske vode Egipta in Grčije. Podatki po podobmočjih kažejo, da je bilo največ incidentov v Egejskem morju (GSA 22) in južnem Levantu (GSA 26). Časovna analiza kaže na splošno naraščajoč trend letnih napadov morskih psov v celotnem obdobju študije. Ker so veliki pelagični plenilski morski psi Sredozemskega morja selivci, jih je mogoče srečati ob kateri koli sredozemski obali kadar koli. Glede na ključno vlogo plenilskih morskih psov v morskih ekosistemih pomeni vzhodno Sredozemlje, varno pred morskimi psi, ustvarjanje varnih okoljskih pogojev tako za ljudi kot za morske pse.

Ključne besede: Elasmobranchii, agresivnost, človek, ohranjanje, GSA22-28, napadi morskih psov

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OBSERVATIONS OF A JUVENILE BASKING SHARK *CETORHINUS MAXIMUS* IN THE ADRIATIC SEA SUPPORT THE HYPOTHESIS OF A DISTINCT MEDITERRANEAN POPULATION

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ABSTRACT

The basking shark Cetorhinus maximus *is a large planktivorous shark which sightings in the Mediterranean Sea have increased in recent decades, particularly in the Adriatic Sea. This study reports the incidental capture and release of a juvenile basking shark (estimated total length ~2 m) in July 2015 near the island of Mljet, Eastern South Adriatic. The observation aligns with prior records indicating the appearance of juveniles and subadults during summer, after the departure of adults in late spring. When considered alongside global data on juvenile distribution, this finding strengthens the hypothesis that the Mediterranean Sea functions as a significant breeding and nursery area for basking sharks. Furthermore, the consistent regional presence and lack of evidence for migratory exchange with Atlantic populations suggest the possibility of a distinct Mediterranean population.*

Key words: basking shark, *Cetorhinus maximus,* juvenile, Adriatic Sea, Mediterranean Sea, nursery area

OSSERVAZIONI DI UN GIOVANE SQUALO ELEFANTE *CETORHINUS MAXIMUS* IN ADRIATICO CONFERMANO L'IPOTESI DI UNA POPOLAZIONE MEDITERRANEA DISTINTA

SINTESI

Lo squalo elefante Cetorhinus maximus *è un grande squalo planctivoro che negli ultimi decenni è stato avvistato sempre più spesso nel Mediterraneo, in particolare nell'Adriatico. Questo studio riporta la cattura accidentale e il rilascio di uno squalo elefante giovane (lunghezza totale stimata ~2 m) nel luglio 2015 vicino all'isola di Meleda (Mljet), nell'Adriatico sud-orientale. L'osservazione è in linea con precedenti registrazioni che indicano la comparsa di esemplari giovani e subadulti durante l'estate, dopo la partenza degli adulti alla fine della primavera. Se considerata insieme ai dati globali sulla distribuzione degli esemplari giovani, questa scoperta rafforza l'ipotesi che il Mediterraneo funga da importante area di riproduzione e crescita per gli squali elefante. Inoltre, la presenza costante nella regione e la mancanza di prove di scambi migratori con le popolazioni dell'Atlantico suggeriscono la possibilità di una popolazione mediterranea distinta.*

Parole chiave: squalo elefante, *Cetorhinus maximus*, giovane, Adriatico, Mediterraneo, area di crescita

INTRODUCTION

The basking shark, *Cetorhinus maximus* (Gunnerus, 1765), is a coastal-pelagic, semioceanic, or oceanic species inhabiting boreal to warm-temperate waters along continental and insular shelves. It is found both far offshore and near the coast, sometimes just beyond the surf zone or within enclosed bays (Compagno, 2001; Ebert *et al*., 2021). This species is highly seasonal, known for its periodic appearances and disappearances in specific locations (Ebert *et al*., 2021). The number of basking sharks observed in a given area can vary significantly from year to year, with unexplained fluctuations, including occasional population surges ('invasions'). In the Eastern Atlantic, its range extends from Iceland and Norway to North Africa and the Mediterranean (Compagno, 2001; Ebert *et al*., 2021). While basking shark sightings are widespread throughout the Mediterranean, they are most frequently reported in the Tyrrhenian, Balearic, and Adriatic regions (Mancusi *et al*., 2005; 2020; Soldo, 2022).

The first record of the basking shark in the Eastern Adriatic area, from where most of the Adriatic records are reported, dates back to 1822. Over the following two centuries, until 2022, 75 records have been documented, with a significant increase in sightings since the early 2000s (Soldo, 2022). In the beginning, the basking shark was relatively rare in the Adriatic, but its occurrence has substantially increased since the start of the 21st century. Records with known precise locations show the occurrence of the basking shark widespread along the Eastern Adriatic coast, with the highest numbers in the Northern Adriatic, particularly Kvarner Bay, known for its rich zooplankton biomass (Soldo *et al*., 2008; Soldo, 2022). After analyzing the occurrence of the basking sharks and comparing it to fluctuations in zooplankton structure and abundance it was evident that the basking sharks were found in the time of high density of large copepods, particularly *Calanus helgolandicus*, which is considered their major prey (Soldo *et al*., 2008). Thus, it was suggested that basking sharks migrate from the Mediterranean toward the Northern Adriatic, following water masses carrying specific copepod species that are sufficiently abundant for their feeding (Soldo *et al*., 2008). Soldo (2022) indicated that basking sharks predominantly appear in late winter and early spring, coinciding with peak copepod abundance. Fewer records exist for autumn and summer with most summer sightings involving juveniles and subadults (< 299 cm: juveniles, 300–499 cm: subadults), supporting the hypothesis of seasonal segregation, where younger sharks arrive after adults leave the Adriatic (Soldo, 2022). The only exception to this Adriatic seasonal pattern was a male juvenile (217 cm, 40 kg) caught in December 2014 in shallow Northern Adriatic waters (20 m depth) (Lipej & Mavrič, 2015). Records of juveniles in the Mediterranean are scarcer than for adults, but the majority corresponds to the summer season pattern (Mancusi *et al*., 2005). However, there are comparable cases of a juvenile basking shark reported during other periods, e.g. a recent report on a specimen of 259 cm TL that was accidentally captured by a gillnet on 27 February 2024 off the Syrian coast, Eastern Mediterranean (Ali *et al*., 2024). Even more interestingly, Ali *et al*. (2024) also report the statement from the fishermen that the caught specimen was part of a shoal that contained up to 40 young basking sharks of similar size. Kabasakal (2013) also reported several juvenile records from the Eastern Mediterranean out of the summer season which suggest a possible different behavior pattern of juvenile basking sharks in that area.

In the Mediterranean, which includes the Adriatic Sea, the basking shark is protected under various legislation. Additionally, in Croatian waters, which encompass most of the Eastern Adriatic Sea, the highest level of protection is given to the basking shark as it is declared as a Strictly protected species (Soldo & Lipej, 2022).

The aim of this paper is to contribute to the understanding of basking shark occurrence in the Adriatic by reporting a juvenile record and examining its relevance to the hypothesis of a Mediterranean population.

MATERIAL AND METHODS

On 4 July 2015, a commercial fisherman accidentally caught a juvenile basking shark, *Cetorhinus maximus*, during purse seining for Atlantic bonito, *Sarda sarda* (Bloch, 1793) near the island of Mljet in the Eastern south Adriatic Sea (Fig. 1). The shark was hauled onto the vessel's deck along with the rest of the catch and then promptly released unharmed back into the sea (Fig. 2). According to the fisherman's testimony, the shark immediately swam away vigorously, indicating that the brief period on the deck did not cause it any harm.

Based on visible characteristics of the vessel in the photograph where the juvenile shark is also visible, its size is estimated to be approximately 2 meters, which aligns with the initial information provided by the fisherman. The grey-dark brown shark was easily identified as a juvenile basking shark due to its pointed, hook-like snout, which is longer and more pointed than that of adults, its large subterminal mouth, and the enormous gill slits that nearly encircle the head (Matthews & Parker, 1950). Furthermore, the absence of visible claspers suggests that the shark was female.

Fig. 1: Location of a catch and release of the juvenile basking shark.
Sl. 1: Zemljevid z lokaliteto ulova in izpusta mladega morskega psa orjaka.

RESULTS AND DISCUSSION

This record aligns with previously documented patterns of basking shark occurrence in the Adriatic Sea, where individuals and even schools have been regularly observed since the beginning of the 21st century. What has also been noted is segregation between adults and young-of-the-year individuals (Soldo *et al.*, 2008; Soldo, 2022). Adult basking sharks typically arrive in the second half of winter and, in the following months are observed near the surface, feeding on dense patches of zooplankton. From mid-spring to late spring, as zooplankton abundance declines, adult basking sharks begin to leave the Adriatic, migrating along the eastern coastline but in deeper waters. Later, with the onset of summer, juvenile sharks emerge from deeper areas and move toward coastal feeding grounds (Soldo *et al.*, 2008; Soldo, 2022). Incorporating this new observation into the existing dataset of summer records (Soldo, 2022) further supports the temporal segregation of age classes. Of the seven summer records, three involved juveniles and three involved subadults (Soldo, 2022).

Notably, Katooka *et al*. (2022) compiled records of juvenile basking sharks worldwide and found that more than 90% originated from the Mediterranean Sea (84 out of a total of 93 records). Applying the three criteria outlined by Heupel *et al*. (2007) for identifying a nursery area: (1) sharks are more commonly encountered in the area than elsewhere; (2) individuals tend to remain in or return to the area for extended periods; and (3) the area is repeatedly used across years, it can be concluded that the Mediterranean Sea functions as both a breeding and nursery area for the basking shark. This does not necessarily imply that the Mediterranean is the only breeding and nursery ground globally, especially given the species' circumglobal distribution across both hemispheres and the existence of juvenile records from regions far beyond the Mediterranean. In the present study, we compiled an updated list of juvenile basking shark records in the Mediterranean Sea. After excluding duplicate entries from Katooka *et al*. (2022) and incorporating new data, the dataset comprises 83 Mediterranean records of individuals measuring up to 4 m in length (Tab. 1). This figure greatly exceeds the number of juvenile records from all other regions combined, highlighting the Mediterranean as a major breeding and nursery ground for the species. A report of the capture of an adult female carrying egg cases off the Syrian coast (Ali *et al*., 2012), as well as the recent catch of a 259 cm long basking shark in the same area, accompanied

Fig. 2: Photos of the juvenile basking shark on board of the fishing vessel and after the release.
Sl. 2: Fotografije mladega morskega psa orjaka na krovu ribiškega plovila in po izpustu.

by fishermen's reports that the specimen was part of a shoal of up to 40 similarly sized juveniles (Ali *et al*., 2024), lends further support to this hypothesis.

However, a crucial question remains unanswered: for which population does the Mediterranean serve as a breeding and nursery ground? Due to limited scientific understanding of basking shark biology and ecology, particularly regarding global migration routes, it is still unclear whether discrete local populations exist or how regional population structures relate to one another. Consequently, it remains unknown whether the basking sharks recorded in the Mediterranean belong to a distinct Mediterranean population or are part of a broader North/Northeast Atlantic population. Nevertheless, there is currently no evidence of migratory exchange between the Mediterranean and

Tab. 1: Records of juvenile and sub-adult (up to 4 m) basking sharks in the Mediterranean Sea.
Tab. 1: Zapisi o pojavljanju mladih in skoraj odraslih (do 4 m) primerkov morskih psov orjakov v Sredozemskem morju.

No	Date	Location	TL (m)	Sex	Reference
1	1795	Strait of Messina-Reggio Calabria	2.62	male	Barrull & Mate (1999)
2	1819	Island of Capri-Naples, Italy	2.76	male	Barrull & Mate (1999)
3	11/6/1870	Penzance, Italy	2.76	-	Cornish (1870)
4	25/4/1871	Gulf of Spezia-Liguria, Italy	2.95	male	Pavesi (1874), Barrull & Mate (1999)
5	25/4/1874	Lerici-Gulf of Spezia-Liguria, Italy	2.95	male	Carruccio (1906)
6	10/6/1877	Vado Ligure-Savona, Italy	3.25	male	Pavesi (1878)
7	1880	Messina-Sicily	2.85	female	Barrull & Mate (1999)
8	1880	Camogli – Liguria, Italy	3.58	-	Carruccio (1906)
9	18/6/1880	Messina - Sicily	3.1	female	Senna (1913)
10	3/6/1884	Naples – Campania, Italy	3.5	-	Barrull & Mate (1999)
11	1888	Camogli-Liguria, Italy	1.5	-	Carruccio (1906)
12	10/6/1903	Elba Island – Tuscany, Italy	3.9	male	Barrull & Mate (1999)
13	20/6/1903	Portoferraio - Elba Island – Tuscany, Italy	3.9	male	Barrull & Mate (1999)
14	15/3/1904	Gulf of Alghero-Sassari-Sardinia, Italy	3.37	female	Carazzi (1904)
15	7/3/1905	Naples – Campania, Italy	3.35	female	Barrull & Mate (1999)
16	23/3/1905	Cape Tres Forcas – Melilla, Spain	2.92	-	Escribano (1909)
17	12/5/1907	Faro - Messina – Sicily	2.55	female	Barrull & Mate (1999)
18	23/4/1908	Portulipe - Pozzallo - Ragusa - Sicily	3.6	male	Barrull & Mate (1999)
19	23/7/1908	Island Vis, Croatia	3.1	female	Soldo & Jardas (2002)
20	23/4/1910	Porto Conte – Cerdeña, Italy	2.6	-	Barrull & Mate (1999)
21	4/5/1910	Porto Conte – Cerdeña, Italy	3.3	-	Barrull & Mate (1999)
22	June 1912	Genoa-Liguria, Italy	3.16	male	Barrull & Mate (1999)
23	13/6/1912	Finale Ligure – Liguria, Italy	3.45	female	Vinciguerra (1923)
24	1913	Port of Paglio -Cardeña, Italy	1.5	-	Ariola (1913)
25	24/5/1913	Quercianella and Castiglioncello – Tuscany, Italy	2.7	male	Senna (1913)
26	1/6/1913	Port of Vado-Liguria, Italy	2.85	female	Ariola (1913)
27	19/6/1913	Port of Vado Ligure – Liguria, Italy	3.25	male	Ariola (1913)
28	24/7/1913	Portofino – Liguria	2.5	-	Ariola (1913)
29	27/6/1921	S. Michele Beach - Savona – Liguria, Italy	3	-	Vinciguerra (1923)
30	7/10/1921	Island Cres, Croatia	3.2	male	Soldo & Jardas (2002)
31	12/7/1922	Santa Margherita Ligure– Liguria, Italy	3	male	Vinciguerra (1923)
32	September 1922	Cornigliano, Italy	3.7	male	Vinciguerra (1923)
33	10/11/1922	Sesta Levante – Liguria, Italy	3	male	Vinciguerra (1923)
34	5/5/1923	Arebzabi Liguria, Italy	3.9	male	Vinciguerra (1923)
35	13/6/1923	Santa Margherita Ligure– Liguria, Italy	3.37	female	Vinciguerra (1923)
36	15/6/1923	Multedo Beach, Italy	2.68	male	Vinciguerra (1923)
37	7/6/1927	Ognina - Syracuse – Sicily	2	female	Monterosso (1931)
38	16/12/1929	Capo Zafferano - Palermo - Sicily	3.19	male	Barrull & Mate (1999)
39	27/12/1929	Ras Falcon, Tunisia	3.75	male	Capapé *et al.* (2003)
40	25/11/1930	Porticello - Palermo - Sicily	3.05	male	Barrull & Mate (1999)

41	25/5/1931	Balestrate - Palermo – Sicily	2.85	male	Barrull & Mate (1999)
42	6/2/1931	Plaia - Catania - Sicily	3.4	female	Monterosso (1931)
43	10/7/1937	Lumbarda-Korčula, Croatia	3.5	-	Soldo & Jardas (2002)
44	19/5/1939	Palma, Spain	3	male	Navarro (1943)
45	1942	Palma, Spain	2	-	Navarro (1943)
46	October 1957	Valencia, Spain	3.3	-	López (1963)
47	11/1/1965	Acre, Israel	2.67	-	Barrull & Mate (1999)
48	7/3/1965	Acre, Israel	2.59	-	Barrull & Mate (1999)
49	1968	Ston, Croatia	2.5	-	Lipej *et al.* (2000)
50	February 1969	Ses Caletes des Cap Pinar – Mallorca, Spain	3.4	female	Barrull & Mate (1999)
51	January-March 1971	Israel coast	259-261	-	
52	1974	Trieste, Italy	3.92	-	Lipej *et al.* (2000)
53	1979	Benicarló – Castellón, Spain	4	male	Barrull & Mate (1999)
54	1980	Gulf of Tunis	2.7	male	Capapé et al. (2003)
55	14/2/1981	Bar, Montenegro	4	-	Soldo & Jardas (2002)
56	18/6/1981	Ičići, Croatia	2.65	-	Soldo & Jardas (2002)
57	August 1981	Ras Fartas – Gulf of Tunis	3.5	male	Capapé *et al.* (2003)
58	18/4/1987	Antalya bay, Turkey	4	-	Kabasakal (2004)
59	7/2/1991	Haifa, Israel	2.5	-	Barrull & Mate (1999)
60	10/8/1992	Sant Pere Pescador – Girona, Spain	2.5	-	Barrull & Mate (1999)
61	19/3/1995	Gulf of Santa Eufemia – Calabria, Italy	3	male	Barrull & Mate (1999)
62	24/4/1997	Vittoria - Ragusa - Sicily	3.2	-	Barrull & Mate (1999)
63	11/5/1998	Lido Marza. Pozzallo - Ragusa – Sicily	2.48	male	Barrull & Mate (1999)
64	June 1998	Strait of Messina-Sicily	4	-	Barrull & Mate (1999)
65	4/3/2000	Offshore Annaba, Algeria	3.3	female	Capapé *et al.* (2003)
66	22/5/2000	Piran, Slovenia	2.99	male	Lipej *et al.* (2000)
67	10/6/2000	Camogli-Liguria, Italy	2.66	male	Barrull & Mate (1999)
68	19/7/2000	Piran, Slovenia	2.49	male	Lipej *et al.* (2000)
69	30/12/2006	Iskenderun Bay, Turkey	3	-	Bilecenoglu *et al.* (2013)
70	February 2007	Gulf of Gabès	2.42	female	Enajjar *et al.* (2019)
71	29/4/2007	Lumbarda-Korčula, Croatia	2.7	-	Soldo (2022)
72	11/7/2008	Port of Rijeka, Croatia	2.5	-	Soldo (2022)
73	11/6/2010	Ancona, Italy	3.65	male	This study
74	29/4/2011	Moščenička draga	3.7	-	Soldo (2022)
75	7/4/2012	Erdemli Coast, Turkey	2.36	male	Bilecenoglu *et al.* (2013)
76	12/5/2013	Famagusta harbour, Cyprus	4	-	Kabasakal (2013)
77	20/3/2014	Mersin Bay, Turkey	2.45	female	Ergüden *et al.* (2020)
78	25/12/2014	Piran, Slovenia	2.17	male	Tsiamis *et al.* (2015)
79	4/6/2015	Island Mljet, Croatia	2	female	This study
80	6/5/2017	Plage de Port Leucate, France	4	-	Carpaye-Taïlamée (2019)
81	7/5/2017	Banyuls sur Mer, France	4	-	Carpaye-Taïlamée (2019)
82	8/7/2017	Port des Embiez, France	2.5	-	Carpaye-Taïlamée (2019)
83	27/2/2024	South of Lattakia, Syria	2.59	-	Ali et al. (2024)

Atlantic populations. Basking sharks in the Mediterranean are observed during the same periods as those in the Northeast Atlantic, and the seasonal distribution patterns appear consistent across both regions (Soldo *et al*., 2008). This temporal overlap suggests the existence of regionally isolated populations. Likewise, studies in the Northeast Atlantic, particularly around Britain, have reported basking shark movements confined to the Atlantic, with no indications of individuals migrating into the Mediterranean Sea (Sims *et al*., 2005; Doherty *et al*., 2017, 2019; Dolton *et al*., 2020). Consequently, it can be assumed that basking sharks in the Mediterranean constitute a distinct regional population, but this hypothesis requires further verification through more focused and multidisciplinary studies. Comprehensive population genetic analyses should be prioritized as it is needed to determine whether Mediterranean basking sharks form a distinct genetic population. In parallel, long-term satellite tagging programs are essential to monitor movements of individual sharks, particularly to detect any connectivity between Mediterranean and Atlantic populations.

In conclusion, the high number of juvenile sightings in the Mediterranean, the apparent lack of migratory exchange with the Atlantic, and the consistent regional occurrence patterns all support the hypothesis of a distinct Mediterranean population of basking sharks. To validate this, an integrated research strategy combining genetic, ecological, and telemetry-based approaches is urgently needed. Such efforts are not only critical for advancing our understanding of basking shark population structure but also for producing effective regional conservation and management strategies.

OPAZOVANJA MLADEGA MORSKEGA PSA ORJAKA (*CETORHINUS MAXIMUS*) V JADRANSKEM MORJU PODPIRAJO HIPOTEZO O LOČENI SREDOZEMSKI POPULACIJI

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POVZETEK

*Morski pes orjak (*Cetorhinus maximus*) je velik planktivoren morski pes, katerega število opažanj v Sredozemskem morju se je v zadnjih desetletjih povečalo, zlasti v Jadranskem morju. Avtor poroča o naključnem ulovu in izpustu mladega morskega psa orjaka (ocenjene skupne dolžine ~2 m) julija 2015 v bližini otoka Mljet v vzhodnem južnem Jadranu. Opazovanje se ujema s prejšnjimi zapisi, ki kažejo na pojav mladih in skoraj odraslih primerkov poleti, po odhodu odraslih pozno spomladi. Če to ugotovitev obravnavamo skupaj z globalnimi podatki o razširjenosti mladih primerkov, to podpira hipotezo, da Sredozemsko morje deluje kot pomembno območje za razmnoževanje in odraščanje mladih primerkov morskih psov orjakov. Poleg tega dosledna regionalna prisotnost in pomanjkanje dokazov o migracijski izmenjavi z atlantskimi populacijami kažeta na možnost obstoja ločene sredozemske populacije.*

Ključne besede: morski pes orjak, *Cetorhinus maximus,* Jadransko morje, Sredozemsko morje, mladostni primerek, jaslice

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AN UNUSUAL ENCOUNTER WITH A JUVENILE KITEFIN SHARK, *DALATIAS LICHA*, IN SHALLOW COASTAL WATERS OF MONTENEGRO (ADRIATIC SEA)

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ABSTRACT

The aim of this study is to document the first confirmed report of the kitefin shark, Dalatias licha*, in Montenegrin waters (southern Adriatic Sea). On 5 May 2025, a juvenile specimen was observed near Miločer Beach (Budva) at 10 m depth, with an in situ average temperature of approximately 20 °C, as measured by the diver's computer. The encounter was recorded on high-resolution video, which allowed for unambiguous identification based on morphological characters. The shark, estimated at less than 50 cm total length, displayed calm swimming behavior, showed no visible injuries, and exhibited characteristics consistent with juvenile individuals. This record represents the first confirmation of the species in Montenegro and the shallowest recorded depth for* D. licha.

Key words: Mediterranean Sea, citizen science, deep-sea shark, Dalatiidae, *Dalatias licha*

INCONTRO INSOLITO CON UN GIOVANE SQUALO ZIGRINO, *DALATIAS LICHA*, IN ACQUE COSTIERE POCO PROFONDE DEL MONTENEGRO (MARE ADRIATICO)

SINTESI

Lo scopo di questo studio è documentare la prima segnalazione confermata dello squalo zigrino, Dalatias licha*, nelle acque montenegrine (Adriatico meridionale). Il 5 maggio 2025, un esemplare giovane è stato avvistato vicino alla spiaggia di Miločer (Budva) a 10 m di profondità, con una temperatura media in situ di circa 20 °C, misurata dal computer del subacqueo. L'incontro è stato registrato con un video ad alta risoluzione, che ha permesso un'identificazione inequivocabile sulla base delle caratteristiche morfologiche. Lo squalo, della lunghezza totale stimata inferiore a 50 cm, nuotava tranquillamente, non presentava ferite visibili e mostrava caratteristiche tipiche degli esemplari giovani. Questo avvistamento rappresenta la prima conferma della presenza della specie in Montenegro e la profondità più bassa mai registrata per il* D. licha.

Parole chiave: Mediterraneo, citizen science, squalo di acque profonde, Dalatiidae, *Dalatias licha*

INTRODUCTION

The kitefin shark, *Dalatias licha* (Bonnaterre, 1788) (Elasmobranchii: Squaliformes: Dalatiidae) (WoRMS Editorial Board, 2025), is a medium-sized demersal shark, reaching a maximum total length (TL) of 182 centimeters (Ebert *et al.*, 2021; Barone *et al.*, 2022).

D. licha is a deep-water species, occurring from 37 to at least 1800 m of depth, mainly deeper than 200 m), distributed across warm-temperate and tropical outer continental and insular shelves and upper slopes, usually on or near the bottom (Ebert *et al.*, 2021). It is geographically distributed in the Atlantic, Indian, Pacific Ocean, as well as in the Mediterranean Sea (Compagno, 1984; De Maddalena *et al.*, 2015; Ebert *et al.*, 2021). Kitefin shark was also reported from the Sea of Marmara, the northernmost extension of the Mediterranean Basin (Meriç, 1995).

Studies on stomach contents of the species have been carried out in sub-basins of the Mediterranean show that this species feeds mainly on cephalopods, crustaceans, tunicates, bony fishes and also small demersal sharks, such as velvet belly lanternshark, *Etmopterus spinax* (Linnaeus, 1758), blackmouth catshark, *Galeus melastomus* Rafinesque, 1810, and *Scyliorhinus* sp., Blainville, 1816 (Kabasakal & Kabasakal, 2002; Navarro *et al.,* 2014; Mulas *et* al., 2021; Bottaro *et al.*, 2023; Calabrò *et al.*, 2024).

The kitefin shark is an aplacental viviparous shark, and the known mating areas in the Mediterranean Sea occur in the Ligurian Sea, along the Maghreb coast and in the Tyrrhenian Sea (Capapé *et al.*, 2008; Mulas *et al.*, 2021; Bottaro *et al.*, 2023). In these sub-basins, males reach sexual maturity around 70.5 cm in TL and females around 98 cm (Capapé *et al.*, 2008; Mulas *et al.*, 2021; Bottaro *et al.*, 2023). The gestation period is unknown, while the litter size ranges between 3-16 pups, whose size at birth is 30-37 cm in TL (De Maddalena *et al.*, 2015; Ebert & Dando, 2021).

Based on the captures of new-borns with unhealed umbilical scars in bottom-trawl fishery, Kabasakal and Kabasakal (2002) proposed a nursery ground of *D. licha* in the northern Aegean Sea, and this nursery ground was further supported by the occurrence of gravid females in the same region (Kabasakal, 2023). Furthermore, Ergüden *et al.* (2022) also proposed another nursery of the kitefin shark in the northeastern Mediterranean Sea.

Although it is generally considered rare in the Adriatic Sea (Serena *et al.*, 2020; Soldo & Lipej, 2022), some studies suggest that it is frequently found in the deeper areas of the Southern Adriatic (Ungaro *et al.,* 1996; Follesa *et al.*, 2019; Dulčić & Kovačić 2020), particularly on its Italian side (D'Onghia *et al.*, 2015; D'Onghia *et al.*, 2015; Carluccio *et al.*, 2021). The species was also recorded during regional deep-sea surveys conducted in the framework of the MEDITS and FAO-AdriaMed projects (Isajlović 2012). However, documented records from the southeastern Adriatic are rare, with the species being only recently recorded in Albania (Hysolakoj *et al.*, 2020; Gajić, 2025), with no records from Montenegro (Ćetković *et al.*, 2024). This work reports the first confirmed record of *D. licha* in Montenegrin waters and the shallowest depth ever reported for this species, underlining the importance of the collaboration between citizen scientists and researchers.

MATERIAL AND METHODS

Data on the location, depth and water temperature were collected from the dive computer of spearfisherman Mr Dušan Vukčević. The authors were provided with two videos recorded in 4K resolution with a GoPro action camera, totaling 1 minute and 1 second. Still images of the observed kitefin shark were captured with the image software VLC Media Player. The species was identified based on morphological descriptions provided by Compagno (1984), De Maddalena *et al.* (2015), and Ebert *et al.* (2021) (Fig. 1). The geographical subarea (GSA) definition follows the GFCM (2018). The scientific name and taxonomy of the species follow the WoRMS Editorial Board (2025).

RESULTS AND DISCUSSION

On 5 May 2025, a shark was observed off Miločer Beach in the Municipality of Budva (42°15′38.6″N, 18°53′30.3″E; Montenegrin waters of the southern Adriatic Sea, GSA 18; Fig. 1) swimming over a mixed sand and gravel bottom at a depth of 10 m, with an average sea temperature about 20°C. The shark was sighted near to the sandy bottom displaying calm behaviour and normal swimming activity (Fig. 2). The following description is based on video footage of the observed shark: It can be easily distinguished from related species by its unique morphological features, including a cylindrical body, the absence of an anal fin, large eyes, large nostrils, large spiracles, and five pairs of short gill slits located anterior to the pectoral fin origin. It also has papillose thick lips and serrated lower teeth with erect, triangular, serrated cusps and distal blades. It has spineless dorsal fins, with the first dorsal fin originating behind the pectoral fin's free rear tips, with the base closer to the pectoral fin than the pelvic fin bases. The second dorsal fin is larger than the first. The lower caudal lobe is less developed than the upper lobe. It is brown to blackish in colour and juveniles

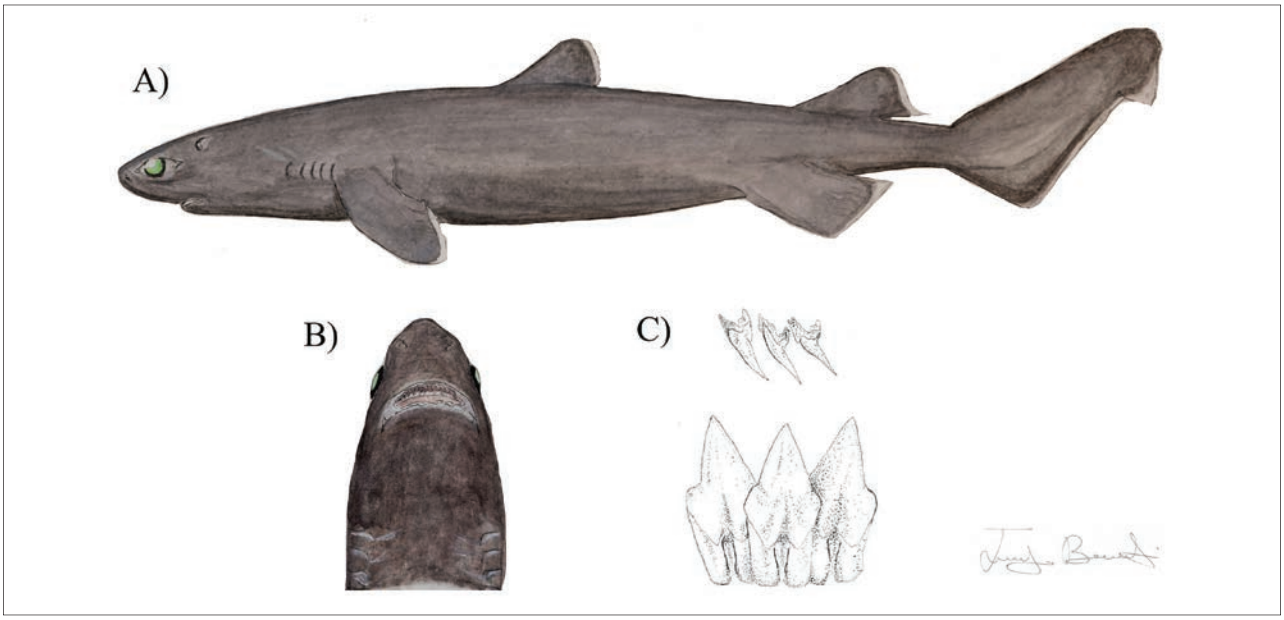

Fig. 1: Kitefin shark, *Dalatias licha* ***(Bonnaterre, 1788): A) lateral view, B) ventral view of the head, C) upper and lower teeth. Drawing by Jacopo Bernardi.***
Sl. 1: Klinoplavuti morski pes, *Dalatias licha* ***(Bonnaterre, 1788): A) stranski pogled, B) trebušni pogled na glavo, C) zgornji in spodnji zobje. Risba: Jacopo Bernardi.***

often show white posterior margins on their fins. The observed morphological characters are consistent with those given in Compagno (1984), De Maddalena *et al*. (2015) and Ebert *et al*. (2021), and the species is thus positively identified as *Dalatias licha* (Bonnaterre, 1788) (Fig. 2).

Based on the obtained video footage, the specimen showed no signs of visible injuries. The TL of the specimen is below 50 cm, showing also the fin posterior margins white, a clear diagnostic feature of juvenile individuals. In one of the frames from the available video footage, the specimen passed close to an individual of a red mullet *Mullus* sp. (Fig. 3), which further illustrates its small size. Additionally, this represents the first confirmed record of this species in the waters of Montenegro.

Given the fact that species is considered as a deep-sea species, whose abundance is highest at depths greater than 200 m (Compagno, 1984; Serena, 2005; Ebert *et al.,* 2022), the cause of its occurrence near the coastline remains a subject of discussion. Although the location of the observation is extremely close to the shore, it is relatively far away, 2.66 nautical miles from the nearby port of Budva, which hosts several fishing vessels. Montenegrin fishing fleet is considerably smaller than most of the fleets of the other Adriatic countries and operates mostly up to 100 m depth (Joksimović *et al*., 2019). This is reflected in the lack of records of the deep-sea sharks in general, and most of such species are known to be present in the country's territorial waters only from the earlier scientific surveys

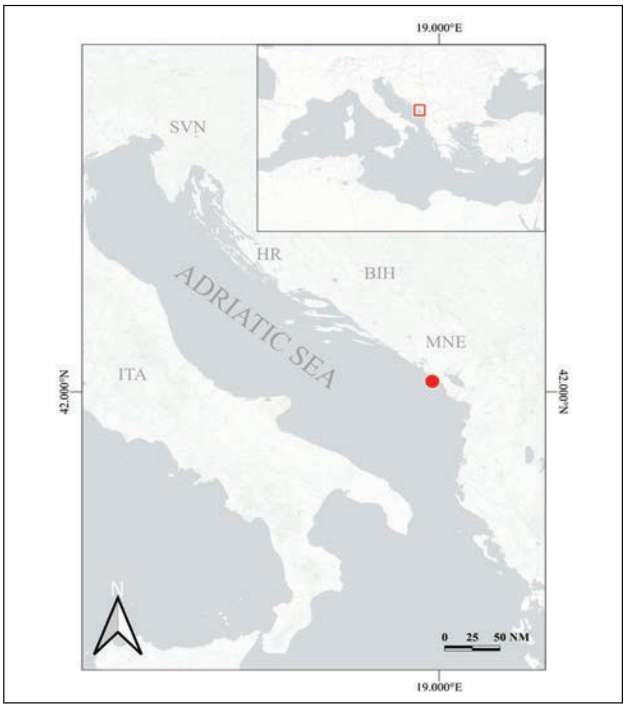

Fig. 2: Map of the Adriatic Sea, the study area in which the specimen of *Dalatias licha* ***was sighted is indicated by a red circle.***
Sl. 2: Zemljevid Jadranskega morja. Območje raziskave, na katerem je bil opažen primerek *Dalatias licha****, je označeno z rdečim krogom.***

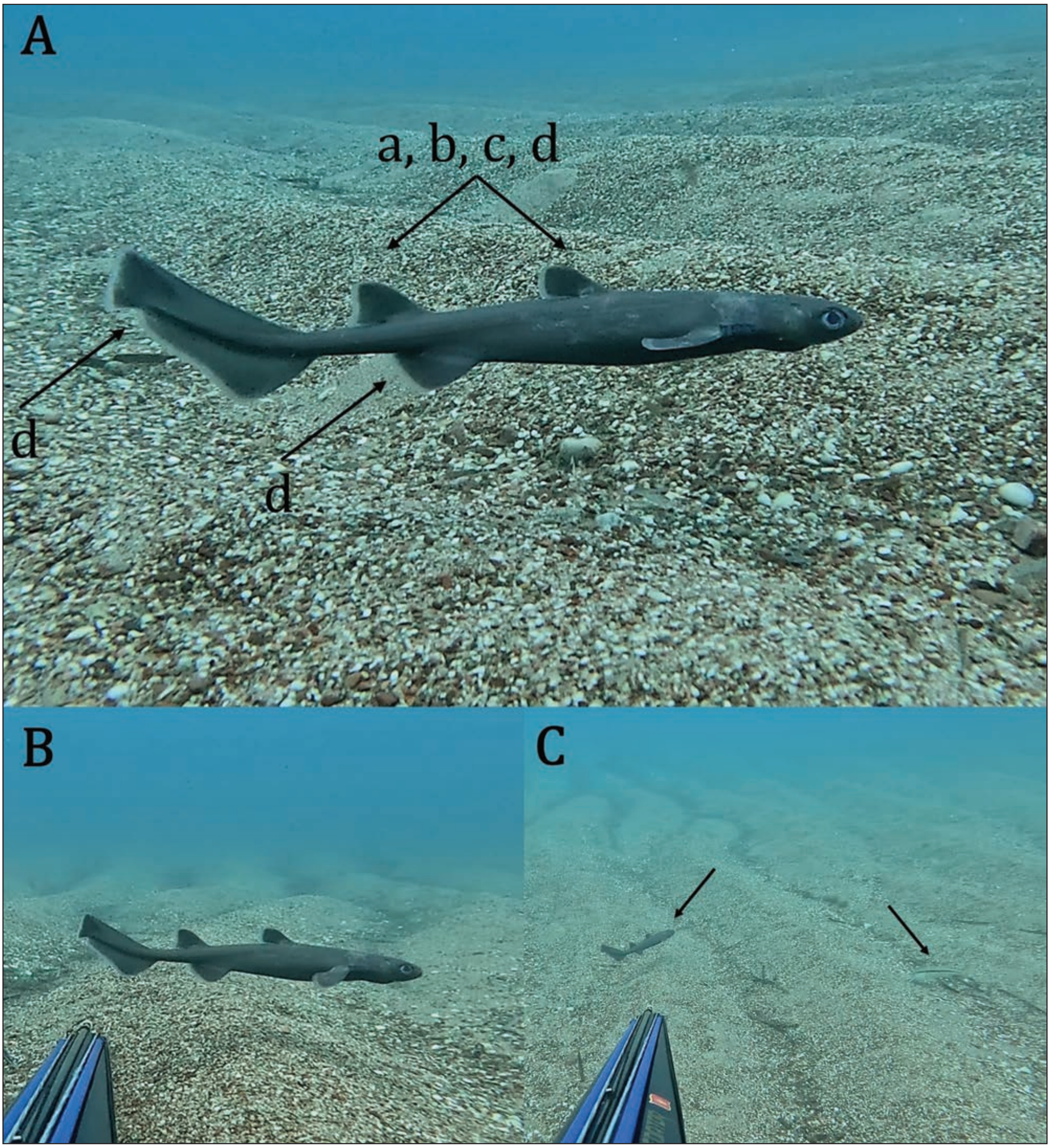

Fig. 3: A) Close lateral view of the described juvenile specimen of* Dalatias licha*, displaying taxonomic markers of the species, highlighted with arrows, such as: a) spineless dorsal fins; b) first dorsal fin originates behind free rear tip of the pectoral fin, with base closer to pectoral than pelvic fin bases; c) second dorsal fin larger; d) posterior margins of most fins are translucent (Ebert* et al.*, 2021); B) Lateral view of the specimen; C) The specimen next to the individual of* Mullus *sp., both highlighted with arrows, showing its small size (Photo: D. Vukčević).

Sl. 3: Bližnji stranski pogled (A) na opisani mladi primerek vrste* Dalatias licha*, ki prikazuje taksonomske značilnosti vrste, označene s puščicami, kot so: a) hrbtne plavuti brez trnov; b) prva hrbtna plavut izvira za prosto zadnjo konico prsne plavuti, pri čemer je osnova bližje prsni kot trebušni plavuti; c) druga hrbtna plavut je večja; d) zadnji robovi večine plavuti so prosojni (Ebert in sod., 2021); B) Stranski pogled na primerek; C) Primerek poleg primerka vrste* Mullus *sp., oba označena s puščicami, kar kaže na njegovo majhnost (Foto: D. Vukčević).

(Ćetković *et al.*, 2024). However, the possibility that the shark was caught and released by a fisherman cannot be excluded. A recent study on the movement ecology of *D. licha* documents that the species typically remains at depths of at least 100 m, although one of the tagged individuals descended to a depth of 33 m (Gandra *et al.*, 2025). In a previous report, Soto and Mincarone (2001) collected a newborn kitefin shark alive at the surface and considered this finding to be an expansion of the species' bathymetric range from 0 to 1800 m. The depths at which newborn kitefin sharks have been captured in the Mediterranean and south Atlantic raise the question of whether gravid females give birth in very shallow waters and then the newborns migrate to deep bathyal grounds, or whether encountering a newborn *D. licha* specimen at the surface was just a coincidence. Soto and Mincarone (2001) speculated that the unusual capture conditions of the South Atlantic specimen may have been caused by the kitefin shark attacking the luminous buoy of the fishing net in order to feed. If the present record of the kitefin shark was indeed free of anthropogenic influence, it would represent the shallowest depth documented for the species to date. Alternatively, the occurrence of *D. licha* in shallow waters may reflect environmental alterations in deep-water habitats, such as climate-driven deoxygenation events, which have recently been linked to the upward movement of deep-water species (Vedor *et al.*, 2021; Lipej & Mavrič, 2022; Lipej *et al.*, 2022; Kabasakal *et al.*, 2023).

Considering the facts that several previously mentioned studies contain contemporary records of *D. licha* along the Italian southwestern Adriatic coast and that this species is only recently recorded on the opposite side of the basin, there is a possibility that its abundance is higher in the southwestern area of the Adriatic Sea. This may be supported by its absence from earlier studies conducted in the southeastern Adriatic Sea, such as the HVAR expedition, which has also covered considerable depths (Jukić-Peladić *et al.*, 2001; Ikica *et al.*, 2021). However, given that this is a poorly studied deep-sea species inhabiting areas that are neither commercially exploited, nor routinely surveyed, it is difficult to accurately assess its true distribution and population abundance in the deep-sea regions of the southern Adriatic Sea.

In conclusion, the distribution of this species in the Adriatic is probably underestimated and as demonstrated in this study, integrating research with citizen science offers a valuable approach to improving our understanding of the distribution, ecology, and biology of threatened Mediterranean elasmobranch species.

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NENAVADNO SREČANJE Z MLADIM PRIMERKOM KLINOPLAVUTEGA MORSKEGA PSA, *DALATIAS LICHA*, V PLITVIH OBALNIH VODAH ČRNE GORE (JADRANSKO MORJE)

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POVZETEK

Avtorji poročajo o prvem potrjenem zapisu o pojavljanju klinoplavutega morskega psa Dalatias licha *v črnogorskih vodah (južno Jadransko morje). Petega maja 2025 je bil v bližini plaže Miločer (Budva) na globini 10 m opažen mladi primerek, pri čemer je bila povprečna temperatura na lokaliteti približno 20 °C, kot jo je izmeril potapljaški računalnik. Srečanje je bilo posneto na videozapis visoke ločljivosti, kar je omogočilo nedvoumno identifikacijo na podlagi morfoloških znakov. Morski pes, čigar skupna dolžina je bila ocenjena na manj kot 50 cm, je plaval mirno, ni kazal vidnih poškodb in je imel značilnosti, ki so značilne za mlade primerke. Gre za prvi potrjeni zapis o pojavljanju vrste v Črni gori in najnižjo zabeleženo globino za vrsto* D. licha.

Ključne besede: Sredozemsko morje, občanska znanost, globokomorski morski pes, Dalatiidae, *Dalatias licha*

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IDENTIFICATION OF A POTENTIAL NURSERY GROUND OF THE SPINY BUTTERFLY RAY, *GYMNURA ALTAVELA*, IN THE NORTHEASTERN MEDITERRANEAN SEA, TÜRKİYE

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ABSTRACT

This study reports the first identified potential nursery area for the critically endangered Gymnura altavela *off the coast of Samandağ in the northeastern Mediterranean. Two divers conducted seasonal surveys across a total area of 750 m² at three depth intervals (5–10 m, 11–20 m, 21–30 m) using the standard underwater visual census method. Additionally, bycatch data from nearby commercial trawling operations were collected. The highest individual density recorded was 0.051 n/m² in autumn, the lowest 0.02 n/m² in summer. The findings suggest that the area functions as a nursery habitat for the* G. altavela *population.*

Key words: *Gymnura altavela*, nursery site, breeding area, Samandağ coasts, northeastern Mediterranean

IDENTIFICAZIONE DI UN POTENZIALE LUOGO DI RIPRODUZIONE DI *GYMNURA ALTAVELA* NEL MAR MEDITERRANEO NORD-ORIENTALE, TURCHIA

SINTESI

Questo studio riporta la prima area potenziale identificata come zona di riproduzione per la specie Gymnura altavela, *gravemente minacciata di estinzione, al largo della costa di Samandağ, nel Mediterraneo nord-orientale. Due subacquei hanno condotto indagini stagionali su un'area totale di 750 m² a tre intervalli di profondità (5-10 m, 11-20 m, 21-30 m) utilizzando il metodo standard di censimento visivo subacqueo. Sono stati inoltre raccolti dati sulle catture accessorie delle vicine attività di pesca commerciale con reti a strascico. La densità individuale più alta registrata è stata di 0,051 n/m² in autunno, la più bassa di 0,02 n/m² in estate. I risultati suggeriscono che l'area funge da habitat di riproduzione per la popolazione di* G. altavela.

Parole chiave*:* *Gymnura altavela*, sito di nursery, area di riproduzione, coste di Samandağ, Mediterraneo nord-orientale

INTRODUCTION

Butterfly rays (Elasmobranchii: Myliobatiformes: Gymnuridae) are demersal batoids with a global distribution in the inshore coastal waters of tropical and temperate seas, typically found over soft sandy or muddy bottoms but also occurring over rocky reefs (Compagno & Last, 1999, McEachran & Carvalho, 2002; Ebert & Dando, 2020; Barone *et al.*, 2022).

The family is represented by a single genus, *Gymnura*, which comprises 16 species worldwide. *Gymnura altavela* (Linnaeus, 1758) is the only member of this family present in the Mediterranean Sea (Ebert & Dando, 2020; Barone *et al.*, 2022). The spiny butterfly ray *G. altavela* is the largest member of the Gymnuridae family, reaching a maximum disc width (DW) of approximately 2600 mm (Ebert & Dando, 2020). It is widely distributed in the western and eastern Atlantic Ocean, the Mediterranean Sea, and the Black Sea (Weigmann, 2016), inhabiting shallow inshore waters in the bathymetric range from 10 to 69 m (Ebert & Stehmann, 2013). Its diet consists of all kinds of benthic animals, but primarily fish and cephalopods (Bauchot, 1987). The species is aplacental viviparous, with an annual reproductive cycle that includes a six-month gestation period and results in a litter of 2–7 pups (McEachran & Capapé 1984; Bradai *et al.,* 2012). Although generally harmless to humans, *G. altavela* possesses a caudal spine capable of inflicting a painful wound if stepped on. It is also listed as a game fish in some regions (Conrath & Scarbrough, 2009).

G. altavela is caught as bycatch in trawl, trammel net, and longline fisheries (Bauchot 1987; Yağlıoğlu *et al.,* 2015). The wings are marketed fresh, chilled, or frozen in Sicily and Morocco, rarely elsewhere (Bauchot, 1987). The IUCN Red List of Threatened Species classifies the species as Endangered globally, and Critically Endangered in the Mediterranean, due to a suspected population decline exceeding 80% over the past three generations (Dulvy *et al.,* 2021). This drastic decline, documented in catch data (Abdul Malak *et al.,* 2011; Özbek *et al.,* 2016), is driven by intense fishing pressure and the species' slow reproductive rate.

The spiny butterfly ray was historically moderately abundant and commonly caught throughout the Mediterranean region. For much of the last century, up until the 1980s, it frequently appeared in the catches of demersal trawl and set net fisheries, particularly along the southern shores. In areas such as the Sicilian Channel, where it was once regularly captured, the species has now become very rare or is absent from local catch records (Bauchot, 1987). Its decline is further evidenced by its absence from the International Trawl Survey in the Mediterranean (MEDITS) records since 1994. The occasional contemporary reports of its presence are typically based on the incidental capture of individual specimens in demersal fisheries. An exception to this overall decline is the Levant coast, where the species remains relatively abundant and is regularly caught using bottom trawls, fixed nets, and longlines (Dulvy *et al.,* 2021).

Identification of critical habitats is an essential and well-established component of sustainable resource management (Gonçalves Silva and Vianna, 2018; Ergüden *et al.,* 2025; Turan *et al.,* 2025), and nursery sites are an important category of such habitats (Medeiros *et al.,* 2015; Rangel *et al.,* 2018). They can be used by many species, separated in space and time, and it is important to understand the mechanisms and drivers behind their use (Heithaus, 2007; Rosenfelder *et al.,* 2012; Cengiz *et al.,* 2024; Kabasakal *et al.*, 2024; Turan *et al.,* 2024). Heupel *et al*. (2007) established three key criteria for identifying an elasmobranch nursery habitat: (1) juvenile elasmobranchs are more commonly encountered there than in other areas, (2) they remain in the area for extended periods, and (3) the area is used repeatedly across years. Therefore, the main aim of this study is to evaluate a potential nursery ground

Fig. 1: Map of the study area.
Sl. 1: Zemljevid obravnavanega območja.

for the spiny butterfly ray *G. altavela* in the north-eastern Mediterranean. If confirmed, this site would represent the second identified critical habitat for this species along the Turkish Mediterranean coast (Bilgili & Kabasakal, 2023).

MATERIAL AND METHODS

This study, carried out over a one-year research period within the framework of a project supported by the Turquoise Coast Environment Fund–Turkey (ElasmoKAP-TCEF-2024), utilized a standardized underwater visual census (UVC) method (Whitfield *et al.,* 2007; Murphy *et al.*, 2010; Turan & Doğdu, 2022) to assess the density, abundance, distribution, and reproductive status–based on observed abdominal swellings–of *G. altavela* in the Ray field region of Hatay-Samandağ coast. Two divers monitored three depth ranges: shallow (5–10 m),

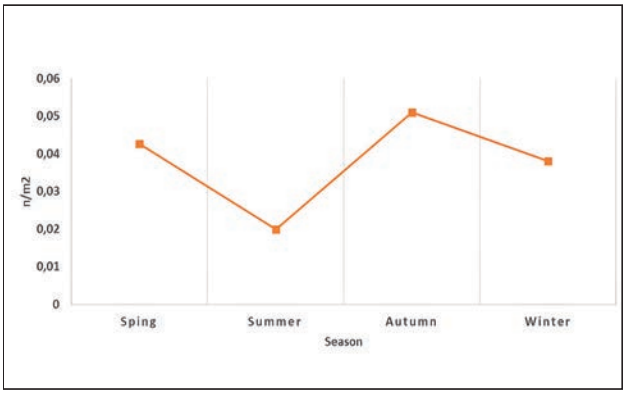

Fig. 2: Mean density of *G. altavela* ***across all depths and seasons within the identified nursery area.***
Sl. 2: Povprečna gostota primerkov vrste *G. altavela* ***v vseh globinah in letnih časih znotraj opredeljenega območja jaslic.***

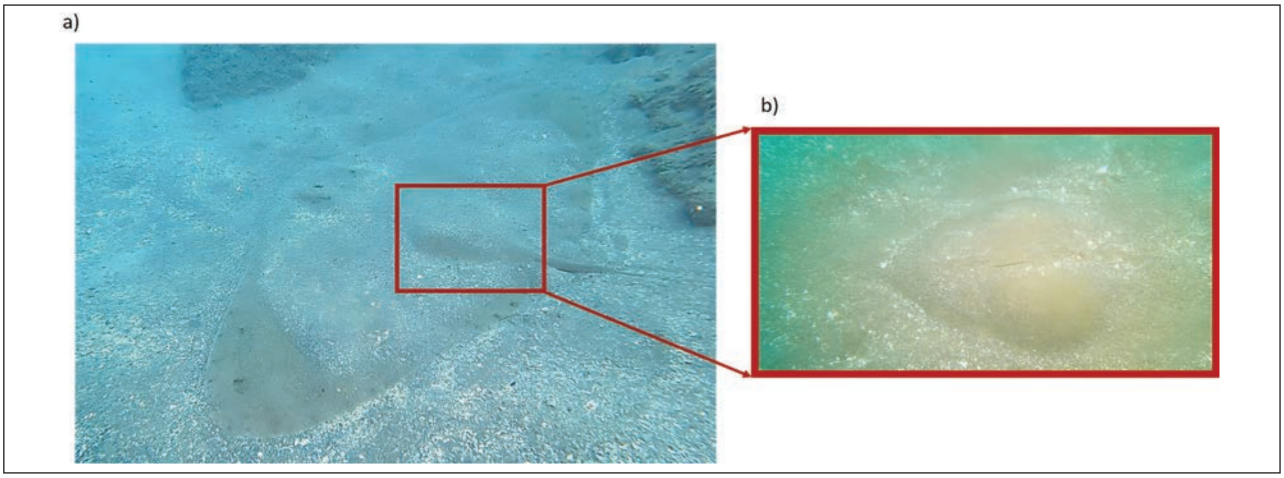

Fig. 3: Dorsal view of egg sacs from pregnant females *G. altavela* ***(A and B) (Photo: Cemal Turan).***
Sl. 3: Pogled na hrbtno stran jajčnih vrečk brejih samic vrste *G. altavela* ***(A in B) (Foto: Cemal Turan).***

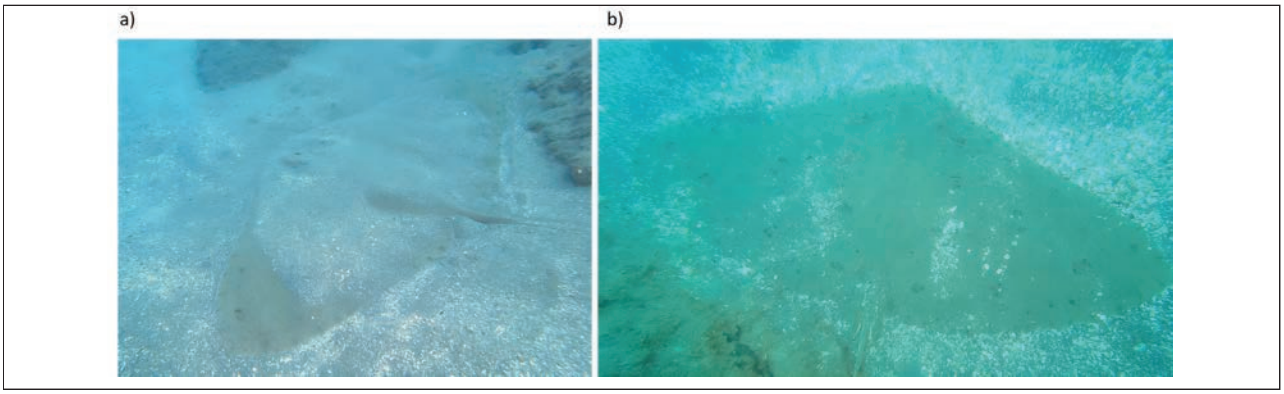

Fig. 4: Individuals of *G. altavela* ***in the investigating area: (A) a pregnant female and (B) an adult male (Photo: Cemal Turan).***
Sl. 4: Osebki vrste *G. altavela* ***na raziskovanem območju: (A) breja samica in (B) odrasel samec (Foto: Cemal Turan).***

intermediate (11–20 m), and deep (21–30 m). At each depth range, a 5 × 50 m transect was surveyed, resulting in a total examined area of 750 m² along the Samandağ coast (Fig. 1). Surveys were conducted four times over a year, once per season. The estimate of the mean density (*D*) on a transect is expressed as:

$$D = \frac{\sum_{i=1} n_i}{a}$$

where *n* is the number of *G. altavela* individuals observed, and *a* the census area (Whitfield *et al.,* 2007). In addition to UVC, data on *G. altavela* bycatch from commercial trawling activities near the study area were monitored for one year, and biological data were collected from captured individuals. All captured spiny butterfly rays were handled carefully and retained under appropriate conditions to minimize post-release mortality. All statistical analyses were performed using R-Studio.

RESULTS

G. altavela was observed on the Samandağ coast in all seasons, which suggests its regular occurrence in the area. The mean density across all depths and seasons was 0.038 n/m². Densities varied by depth range, with 0.0 n/m² at 5–10 m, 0.076 n/m² at 10.1–20 m, and 0.052 n/m² at 20.1–30 m. Seasonally, the highest density was recorded in autumn (0.051 n/m²), the lowest in summer (0.02 n/m²) (Fig. 2).

A single visual count in autumn along a 150 m transect in the 11–20 m depth range was documented. There were pregnant females and males were resting on the sandy seabed that a dorsal view of egg sacs from a pregnant females *G. altavela* was given in the Fig. 3A and 3B. Eight pregnant females and three males with long claspers resting on the sandy seabed (Fig. 4A and 4B). Conversely, during a summer survey in the same area and depth range, three non-pregnant females and one male were counted.

During the study, female butterfly ray–pregnant individuals in particular–were observed moving away from the area as divers approached (Fig. 5), a behavior not exhibited by males.

The UVC findings were further corroborated by trawl observations carried out in an adjacent area where commercial fishing is permitted. Trawl bycatch data collected during the local fishing season confirm that *G. altevera*–including mature individuals, juveniles, and newborns–are commonly encountered (Fig. 6) from September to May. The species is less frequently observed during the remaining, rest period.

DISCUSSION

The present study identifies a potential and rare nursery site for *Gymnura altavela* in the Mediterranean. The area is predominantly sandy, with a few small rocky structures, exhibiting similar oceanographic features as other known aggregation sites (Silva & Vianna, 2018; Castro & Meyers, 2022; Espino Ruano *et al.,* 2023).

Fig. 5: Ventral surface of a pregnant female* G. altavela*, showing the egg sac and open cloaca (Photo: Cemal Turan).
Sl. 5: Trebušna površina breje samice vrste* G. altavela*, na kateri je prikazana jajčna vrečka in odprta kloaka (Foto: Cemal Turan).

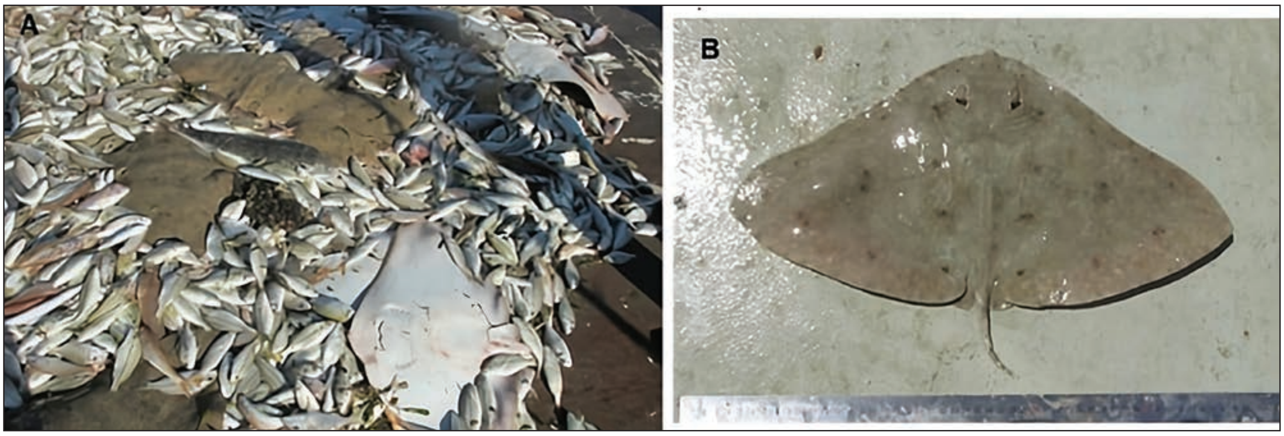

Fig. 6: Specimens of* G. altavela *on a trawler deck, captured as bycatch near the nursery area: (A) adult and (B) newborn individuals (Photo: Cemal Turan).
Sl. 6: Primerki vrste* G. altavela *na palubi vlečne mreže, ujeti kot prilov v bližini območja jaslic: (A) odrasli in (B) novoskoteni primerki (foto: Cemal Turan).

The average water temperature shows considerable seasonal variations: 30–32°C in summer (July), 20–24°C in autumn (November), 16–20°C in winter (February), and 20–22°C in spring (May). Salinity levels fluctuate between 33.6 and 37.1‰. Prior to this study, Bilgili and Kabasakal (2023) identified another aggregation site and potential breeding ground for *G. altavela* in Güllük Bay (SE Aegean Sea). Based on eight years of observation, the authors reported that aggregations of large pregnant females in that area peaked in mid-summer and were subsequently replaced by juveniles in the fall–a pattern consistent with a reproductive aggregation.

Applying the three established criteria for identifying nursery habitats (Heupel *et al.,* 2007) to our findings, we can confirm that the Samandağ Hırlavuk area functions as a nursery ground for *G. altavela*. The highest number of pregnant females was recorded in early autumn, aligning with the known fecundation period (Espino Ruano *et al.,* 2023). Furthermore, year-round observations suggest that this area serves multiple purposes, including feeding, mating, and parturition. The designation of a site as a nursery area is contingent on the presence of newborns, juveniles, and gravid females (Castro, 1993; Heupel *et al.,* 2007). Such areas typically support a higher proportion of juveniles, thereby contributing more significantly to adult recruitment compared to other habitats (Gunter, 1967; Beck *et al.,* 2001). Beck *et al.* (2001) further emphasized the essential role of juvenile survival in driving population growth. Also, in the spawning area they examined, females significantly outnumbered males among the adult population, a pattern consistent with our findings. Capapé *et al.* (2003) suggested that females migrate to shallow coastal waters to find suitable hydrobiological conditions for parturition, thereby minimizing risks to free-swimming neonates from both intra- and interspecific competition, including cannibalism. This behavior underscores the ecological importance of shallow nursery grounds in enhancing juvenile survival.

Given that *G. altavela* is classified as a critically endangered species in the Mediterranean, the identification and protection of its nursery habitats are crucial for effective conservation and population sustainability. However, research on its reproductive biology and life history remains limited, both in Türkiye and globally (Alkusairy *et al.,* 2014; Silva & Vianna, 2018; Yeldan *et al.,* 2018; Taylan *et al.,* 2019). The findings of this study contribute valuable insights into the species' reproductive ecology and habitat preferences, emphasizing the need for further research and conservation efforts.

In conclusion, the data presented in this study indicate that a sustainable population of *G. altavela* is established in the Samandağ Hırlavuk area, which serves as a critical nursery habitat. This finding adds Samandağ Hırlavuk to the list of other essential habitats for this species, alongside the Aegean coast of Türkiye (Taylan *et al.,* 2019) and Tunisian and Syrian waters (Alkusairy *et al.,* 2014; Capapé *et al.,* 1992; El Kamel *et al.,* 2009). Given the species' endangered status, it is imperative to implement conservation strategies that prioritize the protection of these nursery sites to support population recovery and long-term sustainability.

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IDENTIFIKACIJA POTENCIALNIH JASLIC ZA METULJASTEGA SKATA, *GYMNURA ALTAVELA*, V SEVEROVZHODNEM SREDOZEMSKEM MORJU, TURČIJA

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POVZETEK

Avtorji poročajo o prvem prepoznanem potencialnem območju za razmnoževanje kritično ogrožene vrste Gymnura altavela *ob obali Samandağa v severovzhodnem Sredozemlju. Dva potapljača sta izvedla sezonske raziskave na skupni površini 750 m² v treh globinskih intervalih (5–10 m, 11–20 m, 21–30 m) z uporabo standardne metode podvodnega opazovalnega popisa. Poleg tega so bili zbrani podatki o prilovu iz bližnjih komercialnih vlečnih mrež. Najvišja zabeležena gostota primerkov je bila 0,051 n/m² jeseni, najnižja pa 0,02 n/m² poleti. Ugotovitve kažejo, da območje deluje kot jaslice za populacijo vrste* G. altavela.

Ključne besede: metuljasti skat, *Gymnura altavela*, jaslice, razmnoževalno okolje, obale Samandağ, severovzhodno Sredozemlje

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RECENT RECORDS OF CRITICALLY ENDANGERED COMMON GUITARFISH *RHINOBATOS RHINOBATOS* (LINNAEUS, 1758) IN THE NORTHERN MEDITERRANEAN

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ABSTRACT

The Common Guitarfish, Rhinobatos rhinobatos*, a demersal elasmobranch listed as Critically Endangered on the IUCN Red List, has experienced severe population declines across its range, particularly in the northern Mediterranean, where it is widely considered locally extinct. This study reports two new records of* R. rhinobatos *from the Gulf of Taranto, on the Italian side of the Ionian Sea, representing the first confirmed sightings in this region in several decades. Given the species' vulnerability to unselective coastal fishing practices and the ongoing pressure in shallow marine habitats, these records are of considerable conservation significance. They highlight the urgent need to map critical habitats, refine bycatch mitigation measures, and reevaluate the species' regional conservation status. The detection of this species in areas previously thought to be devoid of it offers a rare opportunity to develop targeted management actions for its recovery.*

Key words: *Rhinobatos rhinobatos*, Critically Endangered, Mediterranean Sea, Elasmobranch conservation, Gulf of Taranto

RITROVAMENTI RECENTI DI PESCE CHITARRA *RHINOBATOS RHINOBATOS* (LINNAEUS, 1758), SPECIE IN PERICOLO CRITICO DI ESTINZIONE NEL MEDITERRANEO SETTENTRIONALE

SINTESI

Il pesce chitarra, Rhinobatos rhinobatos*, un elasmobranco demersale classificato come "in pericolo critico" nella Lista Rossa dell'IUCN, ha subito un grave declino della popolazione in tutto il suo areale, in particolare nel Mediterraneo settentrionale, dove è ampiamente considerato estinto a livello locale. Questo studio riporta due nuovi avvistamenti di* R. rhinobatos *nel Golfo di Taranto, sul versante italiano del Mar Ionio, che rappresentano i primi avvistamenti confermati in questa regione da diversi decenni. Data la vulnerabilità della specie alle pratiche di pesca costiera non selettiva e alla pressione continua sugli habitat marini poco profondi, questi avvistamenti rivestono una notevole importanza dal punto di vista della conservazione. Essi evidenziano l'urgente necessità di mappare gli habitat critici, perfezionare le misure di mitigazione delle catture accessorie e rivalutare lo stato di conservazione regionale della specie. Il ritrovamento di questa specie in aree che in precedenza si ritenevano prive di essa offre una rara opportunità per sviluppare azioni di gestione mirate al suo recupero.*

Parole chiave: *Rhinobatos rhinobatos*, in pericolo critico di estinzione, Mediterraneo, conservazione degli elasmobranchi, Golfo di Taranto

INTRODUCTION

Guitarfishes are cartilaginous fishes, members of the order Rhinopristiformes (Chondrichthyes: Elasmobranchii), which includes the families Rhinobathidae, Glaucostegidae and Pristidae (Barone *et al.*, 2022). Formerly included in a single family Rhinobatidae (Serena, 2005), guitarfishes have undergone major revisionary changes in classification over recent years: the giant guitarfishes (Glaucostegidae) have been placed into their own family and genus, and the remaining genus, *Rhinobatos*, split into three genera (*Acroteriobatus*, *Rhinobatos* and *Pseudobatos*) (Ebert and Dando, 2020; Barone *et al.*, 2022). These taxonomic revisions are critical for accurate species identification, historical data interpretation, and the application of conservation regulations. Globally, the family Rhinobatidae currently includes 39 species (Fricke *et al.*, 2024; Van der Laan *et al.*, 2024), but only Common Guitarfish *Rhinobatos rhinobatos* (Linnaeus, 1758) is present in the Mediterranean Sea (Barone *et al.*, 2022).

Guitarfishes have already been identified as being amongst the most vulnerable of elasmobranch families (Kyne *et al.*, 2024) as out of the 39 species belonging to the Family Rhinobatidae, 23 are assessed as threatened under the IUCN Red List of Threatened Species, including ten as Critically Endangered (CR). Common Guitarfish is targeted and caught as bycatch worldwide in a range of industrial and artisanal gears, including demersal trawl, longline, and gillnet. The meat is consumed locally and traded regionally as a dried or dried and smoked product, while the fins likely enter international trade (Bradai & Soldo, 2016). Severe population declines have been observed in many regions, and it is suspected that the Common Guitarfish has undergone severe population reduction. According to Bradai and Soldo (2016) the generation length of the common guitarfish is 13.5 years, and given evidence for local extinction in parts of the Mediterranean Sea and intense and continued fishing pressure in the region in the absence of any effective, enforced fisheries management that might protect the species or its habitat, it is suspected to have declined in the Mediterranean Sea by at least 50% over three generations (40.5 years).

Considering the aforementioned and considering that fishing pressure in shallow coastal habitats, which are the main habitats of the species, is unlikely to decrease, *R. rhinobatos* is assessed as Critically Endangered on a global level (Jabado *et al.*, 2021). In the Mediterranean, the common guitarfish is assessed as Endangered (Bradai & Soldo, 2016), which may suggest a relatively better status compared to other regions. However, this could be due to the regional assessment being older than the global one. Even at the time of the Mediterranean assessment, it was noted that with more accurate, species-specific data in the future, the species might require uplisting to a higher threat category as that assessment was a conservative estimate based on limited information (Bradai & Soldo, 2016).

R. rhinobatos is a medium-sized guitarfish that inhabits coastal, sandy bottom habitat from the intertidal zone to about 100 m throughout coastal subtropical waters in the entire Mediterranean Sea and the eastern Atlantic from the Bay of Biscay in France to Angola (Capapé *et al*. 1975; Bradai & Soldo, 2016; Newell, 2017). It is widespread in the Mediterranean Sea, but most common along the southern and eastern coasts. It is subjected to fishing pressure throughout most of its range in inshore coastal habitats, mainly by small scale and subsistence fisheries. In the northern Mediterranean Sea (in European countries bordering the Mediterranean Sea), guitarfishes were historically quite common, but the Common Guitarfish's absence during research trawl surveys conducted from the Alboran to Aegean Sea and absence from landings from other northern Mediterranean regions suggest that it is now possibly locally extinct (Bradai & Soldo, 2016). Soldo and Lipej (2022) reported Common Guitarfish as historically present in the Adriatic Sea but considered it as regionally extinct nowadays. Psomadakis *et al*. (2009) also consider *R. rhinobatos* as locally extinct from the Tyrrhenian Sea as well as around Sicily. A similar conclusion is reported for the French Mediterranean coast (Capape *et al*., 2006), while the last observation in Greek waters of the Ionian Sea was reported decades ago (Giovos *et al*., 2022). The long history of fishing in the Mediterranean has driven the extirpation of this species from European countries bordering the Mediterranean Sea and likely led to declines in abundance throughout much of its remaining Mediterranean range. In areas of the southern and eastern Mediterranean Sea guitarfishes are common in catches, even as species of high commercial value, e.g. in the Gulf of Gabes, southern Tunisia (Echwikhi *et al*., 2013). Common Guitarfish also has high commercial value in Lebanon where is directly targeted (Lteif *et al*., 2016). According to Bilecenoğlu (2024) *R. rhinobatos* occurs along the Turkish coasts of Aegean and Mediterranean Seas, which is protected according to National Legislation of Fisheries Act, however, the population status of the species throughout its' distribution range in Turkish waters is still unclarified, particularly in the Iskenderun Bay, where it is landed as a bycatch and used for human consumption but as less commercial species (Başusta *et al*. 2008; Çek *et al*., 2009).

In the present article, two recent records of *R. rhinobatos* from the Gulf of Taranto, on the Italian side of the Ionian Sea, representing the first confirmed sightings in this region in several decades, are reported.

MATERIAL AND METHODS

As part of the LIFE European Sharks project, which aims, among other objectives, to increase public awareness of the essential role that sharks and rays play in the Mediterranean ecosystem, various activities were carried out to collect data on elasmobranchs, with a particular focus on rare and threatened species.

As a result of these efforts, data were obtained on two recent records of *Rhinobatos rhinobatos* from the Gulf of Taranto, Italian side of the Ionian Sea. The first specimen was accidentally caught in gillnets on 18 May 2019 near Santa Maria al Bagno (Nardò, Lecce), while the second was captured on 26 August 2023 in the vicinity of Torre Colimena (Taranto) (Fig. 1).

Both records were documented with photographic evidence (Fig. 2), clearly displaying distinguishing morphological features characteristic of *R. rhinobatos*: a long, wedge-shaped snout; widely separated rostral ridges along their entire length; large anterior nasal lobes reaching the inner corners of the nostrils; spiracles with two moderately developed folds, the outer one being more prominent; a thick tail with two large, widely spaced dorsal fins; and a plain greenish to reddish-brown dorsal surface marked with light bluish-grey longitudinal stripes and blotches with a white underside (Ebert & Dando, 2020).

RESULTS AND DISCUSSION

These two recent records of *Rhinobatos rhinobatos* are particularly important, as they represent the first confirmed sightings of the species in the northern Mediterranean in several decades. Hence, these findings reinforce the urgency of region-specific conservation actions and suggest the possible existence of overlooked remnant populations that may benefit from targeted protective measures. Although *R. rhinobatos* was historically presumed to be common in the western and northern Mediterranean Sea, recent studies have reported it as locally extinct in those areas, specifically in the coastal waters of Spain, France, and Italy (Jabado *et al.*, 2021), as well as in the Adriatic Sea (Soldo & Lipej, 2022). MEDITS experimental trawl surveys (from the Alboran Sea to the Aegean Sea) conducted between 1994 and 1999, along with trawl surveys in the Adriatic Sea from 1948 to 2005, failed to record any individuals (Relini & Piccinetti, 1991; Baino *et al.*, 2001), a trend that continued in more recent surveys (Follesa *et al.*, 2019). In Greek waters of the Ionian Sea, the last confirmed records of *R. rhinobatos* date back several decades (Giovos *et al.*, 2022). Furthermore, the Common Guitarfish is not even listed as a valid species in the chondrichthyan list of Calabria (southern Italy), which includes the opposite coast of the Gulf of Taranto (Leonetti *et al.*, 2020). In the Iskenderun Bay (northeastern Mediterranean Sea, Turkish coast), it is landed as a bycatch and used for human consumption but as less commercial species (Başusta *et al.* 2008; Çek *et al.*, 2009). Yağlıoğlu *et al.* (2015) found that the frequency of occurrence of *R. rhinobatos* in bottom trawl bycatch in İskenderun Bay was 11.1%; on the other hand, Bengil & Başusta (2018) found that the bycatch rate of the species in the eastern Mediterranean was 2.47%.

Fig. 1: Map of locations of records: ★ - 2019 record; ✶ - 2023 record.
Sl. 1: Zemljevid obravnavnega območja z lokalitetami ulova: ★ - zapis iz leta 2019; ✶ - zapis iz leta 2023.

Given that *R. rhinobatos* is a demersal species primarily inhabiting shallow coastal waters, areas heavily impacted by a combination of subsistence, artisanal, and industrial fishing, its recent detection in regions where it was previously considered locally extinct is of great conservation significance. However, although the species is protected under various legal frameworks, Soldo & Lipej (2022) highlighted a major challenge affecting demersal chondrichthyans. Many of these species, which are often considered locally extinct across parts of the Mediterranean, are highly vulnerable to unselective fishing practices, particularly bottom trawling. Therefore, Soldo & Lipej (2022) argue that legal protection alone is insufficient to prevent bycatch, especially for species inhabiting inshore areas where fishing pressure is highest and a wide array of unselective bottom-fishing gear is used in both small- and large-scale fisheries. Thus, beyond incorporating existing conservation measures into national legislation, a key priority should be the identification and mapping of critical habitats for these species. A recent study revealed that guitarfishes are regularly aggregated in the same shallow embayments in summer months for parturition,

Fig. 2: Photos of the caught specimens: A - 2019 record; B- 2023 record.
Sl. 2: Fotografije ujetih primerkov: A - zapis iz leta 2019; B - zapis iz leta 2023.

which suggests site fidelity and underlines the importance of an integrated conservation approach for protecting not only the species, but also its' critical habitats (Bilgili & Kabasakal, 2023; Kyne *et al.*, 2024). These habitats can be relatively small, minimizing potential conflict with fisheries, but can be effective if bottom-fishing activities are restricted to highly selective gear types (Soldo & Lipej, 2022; Kyne *et al.*, 2024). In the case of *R. rhinobatos*, it is now evident that a probably very small, localized population persists in restricted areas of the Gulf of Taranto. Greater effort is therefore needed to accurately determine the species' area of occupancy in this region and to implement new conservation measures that, at a minimum, ensure the safe and unharmful release of individuals caught as bycatch.

To conclude, the recent records of *Rhinobatos rhinobatos* from the Gulf of Taranto represent the first confirmed presence of the species in the northern Mediterranean in decades, challenging prior assumptions of its regional extinction. These findings underscore the potential existence of remnant populations in areas previously considered devoid of the species. As *R. rhinobatos* is highly susceptible to coastal fishing activities, particularly due to its demersal nature and preference for shallow habitats, urgent measures are needed to mitigate bycatch and further population decline. Conservation priorities should include precise mapping of critical habitats, implementing selective fishing gear in these zones, and ensuring strict enforcement of existing protective regulations. Moreover, community engagement and fisher awareness are essential components in facilitating reporting and safe handling of future encounters. The rediscovery in the Gulf of Taranto provides a critical opportunity for renewed research, monitoring, and conservation strategies to prevent the complete disappearance of this critically endangered species from the region. Future studies should include genetic analyses to assess population structure and connectivity, which would help clarify whether these individuals represent an isolated relic population or part of a wider, underreported distribution.

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NEDAVNI ZAPISKI O POJAVLJANJU KRITIČNO OGROŽENEGA NAVADNEGA GOSLAŠA *RHINOBATOS RHINOBATOS* (LINNAEUS, 1758) V SEVERNEM SREDOZEMLJU

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POVZETEK

Navadni goslaš, Rhinobatos rhinobatos*, pridnena vrsta hrustančnic, ki je na rdečem seznamu IUCN uvrščena med kritično ogrožene vrste, je doživela močan upad populacije na celotnem območju razširjenosti, zlasti v severnem Sredozemlju, kjer velja za lokalno izumrlo. V pričujočem prispevku avtorji poročajo od dveh novih najdbah vrste* R. rhinobatos *iz Tarantskega zaliva na italijanski strani Jonskega morja, kar predstavlja prvi potrjeni opažanji v tej regiji v več desetletjih. Glede na ranljivost vrste za neselektivne obalne ribolovne prakse in nenehen pritisk na plitvo morsko okolje so ti zapisi o pojavljanju precejšnjega pomena za ohranjanje vrste. Poleg tega poudarjajo nujno potrebo po kartiranju kritičnih habitatov, izboljšanju ukrepov za zmanjšanje prilova in ponovni oceni regionalnega stanja ohranjenosti vrste. Odkritje te vrste na območjih, za katera se je prej mislilo, da v njih ni prisotna, ponuja redko priložnost za razvoj ciljno usmerjenih ukrepov za njeno obnovo.*

Ključne besede: *Rhinobatos rhinobatos*, kritično ogrožena vrsta, Sredozemsko morje, ohranjanje hrustančnic, Tarantski zaliv

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DEMERSAL ELASMOBRANCHS OF THE SEA OF MARMARA: UPDATED INVENTORY, TAXONOMIC ISSUES, AND ENVIRONMENTAL IMPLICATIONS

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ABSTRACT

A total of 16 elasmobranch species (nine shark and seven batoid species) were sampled in the Sea of Marmara (SoM) between 2014 and 2024 for this study. During the same period, an additional nine species (six shark and three batoid species) were recorded from the same area by other researchers. Over the past 100 years, 32 species of demersal elasmobranchs (16 shark and 16 batoid species) have been reported from the SoM, but applying "evidence-based confirmed or unconfirmed presence" criteria reduces the current number to 25 (15 shark species, 10 batoid species). Principal Component Analysis indicates that adaptability to shallower waters is now critical to the spatial distribution of demersal elasmobranchs in the SoM. This shift clearly shows how dramatically the environmental degradation, marine pollution, and deoxygenation have reduced the region's elasmobranch fauna primarily to demersal species over the last 40 years, underscoring the potentially devastating impact of such degradation on biodiversity.

Key words: Elasmobranchii, survival, conservation, inventory, Sea of Marmara,Turkey

ELASMOBRANCHI DEMERSALI DEL MARE DI MARMARA: INVENTARIO AGGIORNATO, QUESTIONI TASSONOMICHE E IMPLICAZIONI AMBIENTALI

SINTESI

Per questo studio, tra il 2014 e il 2024 sono state campionate nel Mar di Marmara (SoM) un totale di 16 specie di elasmobranchi (nove specie di squali e sette specie di batoidi). Nello stesso periodo, altri ricercatori hanno registrato altre nove specie (sei specie di squali e tre specie di batoidi) nella stessa area. Negli ultimi 100 anni, nel SoM sono state segnalate 32 specie di elasmobranchi demersali (16 specie di squali e 16 specie di batoidi), ma applicando i criteri di "presenza confermata o non confermata basata su prove" il numero attuale si riduce a 25 (15 specie di squali e 10 specie di batoidi). L'analisi delle componenti principali indica che l'adattabilità alle acque meno profonde è ora fondamentale per la distribuzione spaziale degli elasmobranchi demersali nel Mar di Marmara. Questo cambiamento mostra chiaramente come il degrado ambientale, l'inquinamento marino e la deossigenazione abbiano ridotto drasticamente la fauna di elasmobranchi della regione, principalmente alle specie demersali, negli ultimi 40 anni, sottolineando l'impatto potenzialmente devastante di tale degrado sulla biodiversità.

Parole chiave: Elasmobranchii, sopravvivenza, conservazione, inventario, Mar di Marmara, Turchia

INTRODUCTION

Fauna inventories provide the most direct means of assessing the components of animal diversity in a specific biome or locality at a given time (Silveira *et al.,* 2010). From this perspective, the elasmobranch species inventory of the Sea of Marmara (SoM) has been updated many times in studies by various researchers over the past 100 years. These studies either (1) include elasmobranchs as part of the region's general ichthyofauna (Ninni, 1923; Deveciyan, 1926; Rhasis Erazi, 1942; Kocataş *et al.,* 1993; Eryılmaz & Meriç, 2005; Torcu Koç *et al.*, 2012; Daban *et al*., 2021; Bilecenoğlu, 2024), or (2) focus specifically on the elasmobranch fauna of the SoM (Kabasakal, 2016, 2022; Artüz & Fricke, 2024; Karadurmuş & Sarı, 2024; Kabasakal & Karakulak, 2024). In one of the earliest general ichthyological studies listing sharks and batoids, Ninni (1923) reported 21 elasmobranch species among the 162 fish species landed at Istanbul Wholesale Fish Market. In another pioneering study, Deveciyan (1926) provided detailed information on 16 species of sharks and batoids landed at the same market. However, neither author specified the exact locations in the SoM where these elasmobranchs were captured. Although the most recent surveys report 35 (Bilecenoğlu, 2024) and 38 (Artüz & Fricke, 2024) elasmobranch species in the ichthyofauna of the SoM, the number of species with confirmed current presence in the region decreases to 25 (Kabasakal & Karakulak, 2024) when evidence-based confirmation criteria are applied (Kovačić *et al.,* 2020).

Based on commercial landings data, several researchers have pointed to a dramatic reduction (of up to 98%) in demersal elasmobranch species in the SoM over the past three decades (Demirel *et al*., 2020; Gül & Demirel, 2021). It has recently been suggested that this decline is primarily due to overfishing and deteriorating environmental conditions, particularly the deoxygenation of bottom waters (Kabasakal, 2025). According to Silveira *et al*. (2010), fauna inventories are essential for assessing projects with myriad environmental impacts, many of which may be significant and irreversible. Therefore, creating an accurate 'snapshot' of the specific locality to be impacted is a task of utmost importance and responsibility. Given that proper species identification is the foundational step in effective fisheries management (Stauffer Jr. & Kocovsky, 2007), updating the inventory of demersal elasmobranchs in the environmentally degraded and deoxygenated SoM is a critical initiative that extends far beyond mere taxonomic curiosity. The present article provides an updated and confirmed list of demersal elasmobranch species in the SoM, based on the latest environmental monitoring and stock assessment surveys. In addition, it discusses key environmental threats to the future survival of these species in the SoM, as well as factors contributing to taxonomic inconsistencies.

MATERIAL AND METHODS

An overview of the SoM

A significant environmental issue currently threatening marine ecosystems is the emergence and expansion of 'dead zones' – hypoxic or anoxic marine areas caused by human activity (Diaz, 2016). The SoM is experiencing severe hypoxia in its deep waters, with conditions in some areas progressing towards anoxia (Mantıkçı *et al*., 2022; Salihoğlu *et al*., 2022). Hypoxia in seawater is defined as a decrease in dissolved oxygen (DO) concentration to below 2 mg/L (or 80 μM; Diaz & Rosenberg, 2008; Vaquer-Sunyer & Duarte, 2008). The SoM, designated as geographical subarea (GSA) 28 by the General Fisheries Commission for the Mediterranean (GFCM, 2018), is one of the most damaged marine ecosystems in the Mediterranean Basin (Saygu *et al*., 2023).

It is a relatively small marine basin with a surface area of 11,500 km² and a maximum depth of 1,390 m, connected to the Mediterranean and Black Seas through narrow straits (Beşiktepe *et al*., 1994; Fig. 1). Its hydrographic characteristics are largely shaped by water exchange through these straits. A distinctive feature of this system is the persistent oxygen deficiency in the deeper sub-halocline layers (Ünlüata & Özsoy, 1988; Beşiktepe *et al*., 1994).

Acting as a receiving and settling basin for organic matter transported from the Black Sea via the Bosphorus Strait (Ünlüata & Özsoy, 1988; Yılmaz *et al*., 1990), the SoM has experienced substantial ecological degradation over the past four decades due to increasing anthropogenic pressures. As a result of eutrophication, DO concentrations – particularly in bathyal waters – have fallen below the hypoxia threshold (Yılmaz *et al*., 1990; Mantıkçı *et al*., 2022). In the eastern and northeastern parts of the SoM, where deoxygenation is most severe, hypoxic conditions now extend onto the continental shelf (ÇŞİDB, TUBİTAK-MAM, 2021, p. 27; Kabasakal, 2025).

Bottom trawl surveys

The bottom trawl surveys conducted throughout the SoM (Fig. 1) between 2014 and 2024 were mainly carried out as part of two projects: (1) the Stock Assessment of Demersal Fish Species in the Eastern Marmara Sea (Project No. 51922), and (2) the Marine Monitoring (DEN-İZ) project of the Ministry of Environment, Urbanisation and Climate Change.

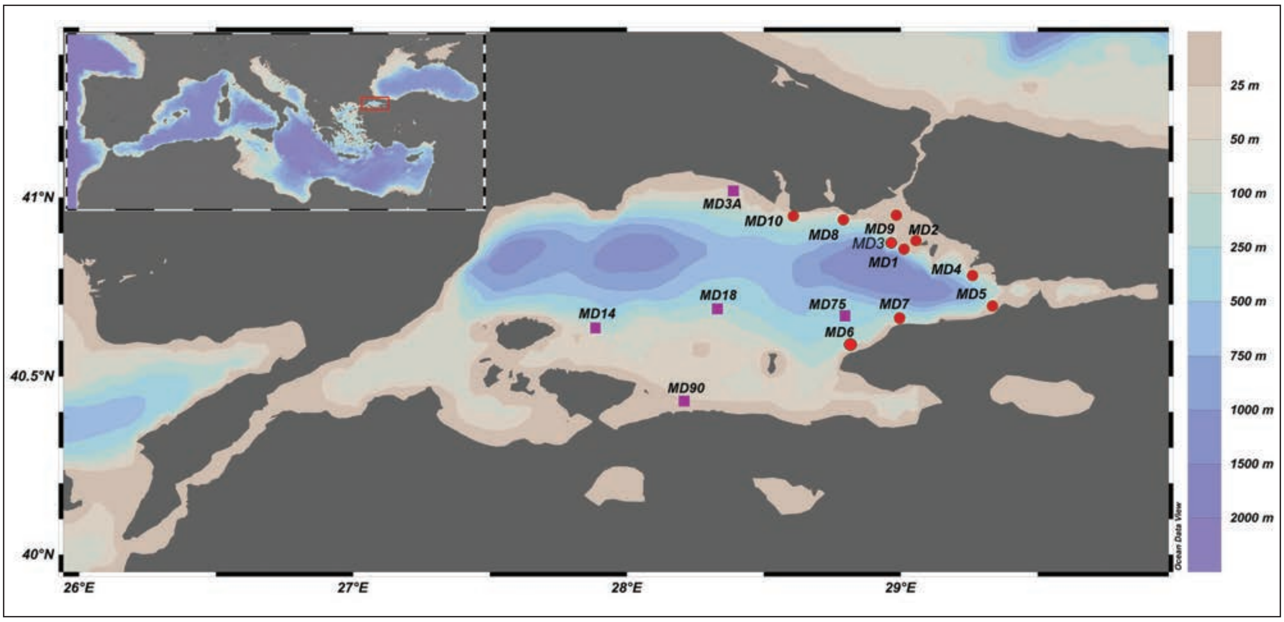


Fig. 1: Map of the study area showing sampling stations. Solid red circles denote the fixed stations of Project 51922, and solid purple squares indicate the fixed stations of DEN-İZ project.
Sl. 1: Zemljevid obravnavanega območja raziskave, ki prikazuje vzorčevalne postaje. Rdeči krogi označujejo fiksne postaje projekta 51922, vijolični kvadratki pa fiksne postaje projekta DEN-IZ.

Sampling was performed on board *R/V Yunus-S*, a 510 hp stern trawler operated by the Istanbul University's Faculty of Aquatic Sciences. A bottom trawl with a cod-end mesh size of 14 mm (approximately 22 mm mesh opening) was used for the hauls following the MEDITS protocol (Anonymous, 2017). Haul duration was set at 30 min for depths under 200 m and 60 min for depths over 200 m, with a standard towing speed of 3 knots (Anonymous, 2017). Oceanographic parameters (salinity, S; temperature, T; and dissolved oxygen, DO) were recorded using a SeaBird CTD probe. The start and end coordinates of each trawl haul, along with the corresponding seafloor depths, were determined using the vessel's onboard GPS and echo sounder.

Handling of specimens and species identification

To reduce at-vessel mortality and increase post-release survival of captured sharks and rays, we followed best-practice procedures proposed by Saygu and Deval (2014) and Ellis *et al*. (2016a). An on-board survival tank was improvised using a large container with a continuous supply of fresh seawater via a hose. Large specimens were handled according to the FAO and ACCOBAMS (2018) guides. All individuals were counted, weighed, and measured as soon as possible. With the exception of a few voucher samples, the remaining elasmobranch catch was gently released. Voucher samples are preserved at the laboratory of the Department of Fisheries Technologies and Management, Faculty of Aquatic Sciences, Istanbul University. For very large specimens (e.g., *Hexanchus griseus* or *Echinorhinus brucus*), photographs were taken and are kept in the authors' personal archives. Species identification is based on Serena (2005), Ebert and Stehmann (2013), Last *et al*. (2016), Ebert *et al*. (2021), and Barone *et al*. (2022). Scientific names follow WoRMS Editorial Board (2025).

The current status of elasmobranch species not sampled in the present survey, but known to occur in the SoM from previous studies (Ninni, 1923; Rhasis Erazi, 1942; Geldiay, 1969; Anonymous, 1974; JICA, 1993; Benli *et al*., 1993; Meriç, 1995; Uysal *et al*., 1996; Zengin *et al*., 2004; Yaka & Yüce, 2006; Torcu Koç *et al*., 2012; Yıldız *et al*., 2016; Bilecenoğlu, 2019; Kabasakal *et al*., 2023a, 2024a,b; Karadurmuş & Sarı; 2024), was assessed using evidence-based criteria for confirmed and unconfirmed presence (Kovačić *et al*., 2020). Detailed descriptions of these criteria are provided by Kovačić *et al*. (2020).

Dispersal/settlement success of demersal elasmobranch species

Principal Component Analysis (PCA) was used to examine the effect of life history characteristics and bathymetric distribution on the past and present abundance of demersal elasmobranch species in

Tab. 1: Species-specific life history traits used in the PCA of demersal elasmobranch species of the SoM. TL – total length; L_mM, L_mF length at 50% sexual maturity (males, females); GL – generation length. Continues in the next section.

Tab. 1: Vrstno specifične značilnosti življenjskega cikla, uporabljene pri PCA pridnenih vrst rib v Marmarskem morju. TL – skupna dolžina; L_mM, L_mF – dolžina pri doseženi 50% spolni zrelosti (samci, samice); GL – dolžina generacije. Nadaljevanje v naslednjem razdelku.

Species	**FAO code**	**TL (cm)**	**L_mM (cm)**	**L_mF (cm)**	**GL (years)**
Hexanchus griseus (Bonnaterre, 1788)	SBL	600	400	330	53
Galeus melastomus Rafinesque, 1810	SHO	90	42	45	5.7
Scyliorhinus canicula (Linnaeus, 1758)	SYC	80	56	60	?
Scyliorhinus stellaris (Linnaeus, 1758)	SYT	162	77	79	20
Mustelus asterias Cloquet, 1819	SDS	140	85	96	13
Mustelus mustelus (Linnaeus, 1758)	SMD	175	112	124	17.8
Mustelus punctulatus Risso, 1827	MPT	190	88.5	100	17.8
Galeorhinus galeus (Linnaeus, 1758)	GAG	195	170	185	30
Dalatias licha (Bonnaterre, 1788)	SCK	182	100	120	28.7
Oxynotus centrina (Linnaeus, 1758)	OXY	150	60	66	20
Centrophorus uyato (Rafinesque, 1810)	CPU	128	91	89	20
Squalus acanthias Linnaeus, 1758	DGS	195	64	93	8
Squalus blainville (Risso, 1827)	QUB	92	56	60	19.5
Echinorhinus brucus (Bonnaterre, 1788)	SHB	394	190	230	30
Squatina oculata Cuvier, 1829	SUT	160	82	100	12
Squatina squatina (Linnaeus, 1758)	AGN	244	132	169	11
Tetronarce nobiliana (Bonaparte, 1835)	TTO	180	?	?	?
Torpedo marmorata Risso, 1810	TTR	100	44	49	16
Torpedo torpedo (Linnaeus, 1758)	TTV	60	?	?	12.5
Dipturus batis (Linnaeus, 1758)	RJB	285	197.5	185.5	20
Dipturus oxyrinchus (Linnaeus, 1758)	RJO	150	103.5	91	10
Leucoraja naevus (Müller & Henle, 1841)	RJN	81	56.16	54.96	8
Raja asterias Delaroche, 1809	JRS	75	56	52	4.36
Raja clavata Linnaeus, 1758	RJC	105	85	75	11.5
Raja miraletus Linnaeus, 1758	JAI	63	41.8	34.3	7.2
Raja montagui Fowler, 1910	RJM	102	60.7	53.74	7
Raja radula Delaroche, 1809	JAR	70	46	40	9
Dasyatis pastinaca (Linnaeus, 1758)	JDP	69.5	32	38	7.5
Dasyatis tortonesei Capapé, 1975	JDO	80	38	47	?
Gymnura altavela (Linnaeus, 1758)	RGL	400	105	102	7
Aetomylaeus bovinus (Geoffroy St. Hilaire, 1817)	MPO	222	90	90	15
Myliobatis aquila (Linnaeus, 1758)	MYL	183	40	60	11

Tab. 1 (Continued): MRD – maximum recorded depth range; CDR – common depth range; TRL – trophic level. Continues in the next section.
Tab. 1 (nadaljevanje): MRD – največji zabeleženi razpon globin; CDR – običajni razpon globin; TRL – trofična raven. Nadaljevanje v naslednjem razdelku.

Species	MDR (m)			MDR (m)	CDR (m)			CDR (m)	TRL
	200–500	501–1000	>1000		0–100	101–200	>200		
H. griseus	0	0	1	2500	0	0	1	200–1100	4.48
G. melastomus	0	0	1	2000	0	0	1	200–500	4.2
S. canicula	0	1	0	800	1	1	1	0–450	3.8
S. stellaris	1	0	0	380	1	0	0	20–63	4
M. asterias	1	0	0	200	1	1	0	0–200	3.6
M. mustelus	0	1	0	800	1	0	0	5–50	4.3
M. punctulatus	1	0	0	200	1	1	0	0–200	3.8
G. galeus	0	1	0	800	1	1	1	0–800	4.3
D. licha	0	0	1	1800	0	0	1	1800	4.2
O. centrina	0	1	1	805	1	1	1	35–805	3.1
C. uyato	0	0	1	1400	0	1	1	115–745	4.5
S. acanthias	0	0	1	1978	1	1	1	0–600	4.4
S. blainville	0	0	1	1500	1	1	1	15–1500	4
E. brucus	0	0	1	1214	1	1	1	10–1214	4.4
S. oculata	1	0	0	500	1	0	0	50–100	4
S. squatina	1	0	0	150	1	1	0	1–150	4.1
T. nobiliana	0	1	0	800	1	1	0	10–150	4.5
T. marmorata	1	0	0	370	1	1	0	2–370	4.5
T. torpedo	1	0	0	400	1	0	0	2–70	4.5
D. batis	0	1	0	1000	1	1	1	30–600	4.1
D. oxyrinchus	0	1	1	1461	0	0	1	200	3.5
L. naevus	0	1	0	900	1	1	0	20–250	3.6
R. asterias	0	1	0	700	1	0	0	20–50	3.5
R. clavata	0	1	1	1020	1	0	0	10–60	4.2
R. miraletus	1	0	0	462	1	1	0	50–150	3.8
R. montagui	1	1	0	530	1	1	0	20–120	4
R. radula	1	0	0	300	1	1	1	0–300	3.7
D. pastinaca	1	0	0	200	1	0	0	20–35	4.1
D. tortonesei	1	0	0	200	0	1	0	100–200	4
G. altavela	1	0	0	100	1	0	0	5–100	4.5
A. bovinus	1	0	0	150	1	1	0	10–150	3.8
M. aquila	1	0	0	300	1	1	0	1–300	3.6

Tab. 1 (Continued): DFRSoM – Date of first record in the Sea of Marmara; DLRSoM – Date of last record in the Sea of Marmara; SLF – continental shelf; SUS – shelf–upper slope; DWT – deep bathyal water. Data on L_mM, L_mF, GL, and TRL were obtained from the literature cited in the reference column.
Tab. 1 (nadaljevanje): DFRSoM – Datum prvega zapisa v Marmarskem morju; DLRSoM – Datum zadnjega zapisa v Marmarskem morju; SLF – kontinentalni prag; SUS – kontinentalni prag–zgornje pobočje; DWT – globoki batial. Podatki o L_mM, L_mF, GL in TRL so bili pridobljeni iz literature, navedene v referencah.

Species	**Before 1990**	**DFR SoM**	**DLR SoM**	**After 2000**	**SLF**	**SUS**	**DWT**	**Reference**
H. griseus	1	1923	2022	1	0	1	1	Finucci *et al.* (2020)
G. melastomus	0	1993	2017	1	0	1	1	Abella *et al.* (2016)
S. canicula	1	1923	2024	1	1	1	0	Serena *et al.* (2015)
S. stellaris	1	1923	2023	1	1	0	0	Ellis *et al.* (2016b)
M. asterias	1	1969	2024	1	1	0	0	Farrell *et al.* (2016a)
M. mustelus	1	1923	2024	1	1	0	0	Farrell *et al.* (2016b)
M. punctulatus	0	2023	2023	1	1	0	0	Ebert *et al.* (2021)
G. galeus	1	1923	2021	1	1	0	0	McCully *et al.* (2016)
D. licha	0	1991	1991	0	0	1	0	Walls & Guallart (2016)
O. centrina	1	1942	2024	1	0	1	0	Soldo & Guallart (2016)
C. uyato	0	1992	2019	1	0	1	1	Guallart & Walls (2015)
S. acanthias	1	1923	2023	1	1	1	0	Ellis *et al.* (2016c)
S. blainville	1	1923	2024	1	1	1	0	Soldo *et al.* (2016)
E. brucus	1	1923	2023	1	1	1	1	Ferretti & Buscher (2016)
S. oculata	0	1995	2018	1	1	1	0	Ferretti *et al.* (2016a)
S. squatina	1	1923	2023	1	1	0	0	Ferretti *et al.* (2016b)
T. nobiliana	?	?	?	?	1	1	0	Finucci *et al.* (2021)
T. marmorata	1	1923	2023	1	1	1	0	Notarbartolo di Sciara *et al.* (2016)
T. torpedo	1	1923	2023	1	1	1	0	Serena *et al.* (2016a)
D. batis	1	1923	2023	1	1	1	0	Ellis *et al.* (2021)
D. oxyrinchus	1	1923	2024	1	0	1	1	Ellis *et al.* (2016d)
L. naevus	1	1996	1996	0	1	1	0	Ellis & Dulvy (2016)
R. asterias	0	1996	2009	1	1	0	0	Serena *et al.* (2016b)
R. clavata	1	1923	2023	1	1	0	0	Ellis *et al.* (2016e)
R. miraletus	1	1923	2014	1	1	0	0	Dulvy *et al.* (2020)
R. montagui	1	1996	1996	0	1	0	0	Ellis *et al.* (2016f)
R. radula	0	2006	2023	1	1	1	0	Mancusi *et al.* (2016)
D. pastinaca	1	1942	2023	1	1	0	0	Serena *et al.* (2016c)
D. tortonesei	0	2016	2016	1	1	0	0	Jabado & Derrick (2021)
G. altavela	0	1984	?	0	1	0	0	Walls *et al.* (2016)
A. bovinus	0	?	2019	1	1	0	0	Walls & Buscher (2016)
M. aquila	1	1923	2024	1	1	1	0	Serena *et al.* (2016d)

the SoM (Villagra *et al*., 2022). This analysis tested the hypothesis that "demersal elasmobranch species with a wider bathymetric distribution range are more likely to have adapted to, and persisted in, the SoM". The most recent species lists (Artüz & Fricke, 2024; Kabasakal & Karakulak, 2024; Karadurmuş & Sarı, 2024) were consulted to compile the life history parameters of the 32 demersal elasmobranch species reported from the SoM over the past century and currently categorised as 'present', 'absent' or 'doubtful' in this region. Information on the species' first and last recorded occurrences (date of first record in the Sea of Marmara (DFRSoM) and date of last record in the Sea of Marmara (DLRSoM) in Table 1), as well as depth distribution in the SoM (continental shelf occurrence (SLF), shelf-upper slope occurrence (SUS) and deep bathyal water occurrence (DWT) in Table 1) were retrieved from the literature (Tab. 1), specifically from Ninni (1923), Rhasis Erazi (1942), Geldiay (1969), Anonymous (1974), JICA (1993), Benli *et al*. (1993), Meriç (1995), Uysal *et al*. (1996), Zengin *et al*. (2004), Yaka and Yüce (2006), Torcu Koç *et al*. (2012), Yıldız *et al*. (2016), Bilecenoglu (2019), Kabasakal *et al*. (2023a, 2024a, b), and Karadurmus and Sarı (2024). The sources for data on total length (TL), male and female sexual maturation lengths (L_mM and L_mF, respectively), generation length (GL), depth distribution, and habitat are provided in Table 1. These life history parameters, compiled from the literature, were first organised in a raw data table. A matrix was then formulated where these data were expressed as numerical values (maximum TL and sexual maturation length in cm; GL in years; trophic level) and binary values (0 for absent and 1 for present). The PCA analysis was based on this final data matrix (Villagra *et al*., 2022), using PAST - Paleontological Statistics ver. 4.03 (Hammer *et al*., 2001; Rincón-Díaz *et al*., 2018).

RESULTS AND DISCUSSION

Updated species inventory and taxonomic issues

Sixteen elasmobranch species (nine sharks and seven batoids; Tab. 2) were sampled between 2014 and 2024 in the present study (Fig. 2). During the same period, an additional nine species (six sharks and three batoids; Table 2) were recorded in same area by Bilecenoğlu (2019), Daban *et al*. (2021), Kabasakal and Türetken (2021), Karadurmuş and Sarı (2024), and Kabasakal *et al*. (2024a, b). As evidenced by the ichthyological inventories presented in Table 2, a total of 32 species of demersal elasmobranchs (16 sharks and 16 batoids) have been reported from the SoM over the past 100 years. However, using the criterion proposed by Bilecenoğlu (2024) – including only species whose presence has been confirmed within the past 10 years – sets the current count at 25 (15 sharks and 10 batoids; Table 2). This figure is remarkably lower than the totals reported by Bilecenoğlu (2024; n = 34) and Artüz and Fricke (2024; n = 38), as these authors included in their checklists all shark and batoid species recorded in the SoM since 1923, regardless of whether any had been observed in the region within the past decade or not. Furthermore, the presence of the 25 species was assessed applying the criteria for "evidence-based confirmed or unconfirmed presence" proposed by Kovačić *et al*. (2020). Only 16 species have a verified presence under Criterion 1, which requires that at least one specimen from the SoM is stored in a scientific collection with a published reference. Six species were confirmed under Criterion 2, which applies where there are no stored specimens, but the species can be positively identified from a photo of the SoM locality provided in a published record. Three species were confirmed under Criterion 5; this is used when there are no stored specimens or published morphological/genetic evidence, but species citations can be traced back to an author – with expert knowledge of the taxon or fish guild of a particular habitat – who reported numerous findings (or, in a study on ecology or species biology, numerous specimens), making correct identification highly probable.

Although *Dalatias licha*, *Torpedo torpedo*, and *Leucoraja naevus* each have at least one positive historical record from the SoM and meet the criteria for verified presence (1, 5, and 2, respectively), they were not included in the updated inventory because none has been recorded in the region during the past decade. According to Bilecenoğlu (2024), *Tetronarce nobiliana* and *Gymnura altavela* are also present in the SoM; however, their listing among elasmobranch fauna of the SoM is based on a historical ichthyological inventory (Bilecenoğlu *et al*., 2014). A critical retrospective review of ichthyological checklists for the seas of Turkey, published at roughly ten-year intervals (Bilecenoğlu *et al*., 2002, 2014; Bilecenoğlu, 2024), reveals that all three studies cite the occurrence of *T. nobiliana* and *G. altavela* in the SoM based solely on Mater and Meriç (1996) – the first inventory of Turkish marine fishes. This original source, however, provides no information where the examined specimens were captured or deposited in a scientific collection for verification. Since the evidence was insufficient to confirm the contemporary occurrences of *T. nobiliana* and *G. altavela* in the SoM, the only applicable classification was exclusion Criterion 13 (Kovačić *et al*., 2020). This applies when a species' reported presence is based on a review publication citing an original reference that in itself contains no

Tab. 2: Chronological summary of demersal elasmobranch species (n=32) recorded in the SoM by different researchers between 1923 and 2024. The numbers in the top row refer to source references that reported shark and batoid records from the SoM (indicated by +). These references are as follows: (1) Ninni (1923), (2) Anonymous (1974), (3) JICA (1993), (4) Meriç (1995), (5) Mater and Meriç (1996), (6) Uysal** et al.* ***(1996), (7) Kabasakal (2003), (8) Zengin** et al.* ***(2004), (9) Yaka and Yüce (2006), (10) Torcu Koç** et al.* ***(2012), (11) Yıldız** et al.* ***(2016), (12) Bilecenoğlu (2019), (13) Kabasakal and Türetken (2021), (14) Daban** et al.* ***(2021), (15) Karadurmuş and Sarı (2024), (16) Kabasakal** et al.* ***(2023a), (17) Kabasakal** et al.* ***(2024a), (18) Kabasakal** et al.* ***(2024b), and (19) elasmobranch species captured during the 2014–2024 sampling period of the present study. Demersal elasmobranch species recorded in the SoM in the last 10 years are marked with a check (✓) in the 2025 column; these records constitute the updated list of elasmobranch species. C denotes the applicable criterion for confirmed or unconfirmed presence (Kovačić** et al.**, 2020). Elasmobranch species not included in the updated inventory are shown in bold.

Tab. 2: Kronološki povzetek pridnenih vrst hrustančnic (n=32), ki so jih v Marmarskem morju zabeležili različni raziskovalci med letoma 1923 in 2024. Številke v zgornji vrstici se nanašajo na vire, ki so poročali o zapisih o morskih psih in skatih iz Marmarskega morja (označeno z +). Ti viri so naslednji: (1) Ninni (1923), (2) Anonymous (1974), (3) JICA (1993), (4) Meriç (1995), (5) Mater in Meriç (1996), (6) Uysal in sod. (1996), (7) Kabasakal (2003), (8) Zengin in sod. (2004), (9) Yaka in Yüce (2006), (10) Torcu Koç in sod. (2012), (11) Yıldız in sod. (2016), (12) Bilecenoğlu (2019), (13) Kabasakal in Türetken (2021), (14) Daban in sod. (2021), (15) Karadurmuş in Sarı (2024), (16) Kabasakal in sod. (2023a), (17) Kabasakal in sod. (2024a), (18) Kabasakal in sod. (2024b) in (19) vrste pridnenih hrustančnic, ujete v obdobju vzorčenja 2014–2024 v tej študiji. Pridnene vrste hrustančnic, zabeležene v Marmarskem morju v zadnjih 10 letih, so označene s kljukico (✓) v stolpcu 2025; ti zapisi predstavljajo posodobljen seznam vrst hrustančnic. C označuje veljavno merilo za potrjeno ali nepotrjeno prisotnost (Kovačić in sod., 2020). Vrste hrustančnic, ki niso vključene v posodobljeni popis, so prikazane s krepko pisavo.

Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**2025**	**C**
Hexanchus griseus	+			+			+							+					+	✓	1
Galeus melastomus			+	+		+	+												+	✓	1
Scyliorhinus canicula	+	+	+	+				+		+				+	+				+	✓	1
Scyliorhinus stellaris	+	+					+	+							+					✓	2
Mustelus asterias	+		+	+			+							+	+					✓	1
Mustelus mustelus	+	+	+	+				+						+	+				+	✓	1
Mustelus punctulatus															+					✓	5
Galeorhinus galeus	+												+							✓	2
Dalatias licha				+																	1
Oxynotus centrina		+	+				+	+						+	+				+	✓	1
Centrophorus uyato			+	+												+			+	✓	1
Squalus acanthias	+	+	+	+			+	+						+	+				+	✓	1
Squalus blainville	+		+	+			+							+					+	✓	1
Echinorhinus brucus	+															+			+	✓	2
Squatina oculata																	+			✓	2
Squatina squatina	+	+	+				+							+	+					✓	1
Tetronarce nobiliana					+																13
Torpedo marmorata	+	+	+											+	+				+	✓	1
Torpedo torpedo	+	+								+											5
Dipturus batis	+	+						+							+					✓	5
Dipturus oxyrinchus	+					+												+		✓	2

Leucoraja naevus						+															2
Raja asterias					+							+									14
Raja clavata	+	+						+		+				+	+				+	✓	1
Raja miraletus	+	+													+				+	✓	1
Raja montagui					+																14
Raja radula									+										+	✓	1
Dasyatis pastinaca		+						+						+	+				+	✓	1
Dasyatis tortonesei											+								+	✓	5
Gymnura altavela					+																13
Aetomylaeus bovinus												+								✓	2
Myliobatis aquila	+	+												+	+				+	✓	1
Number of species per reference	**17**	**13**	**10**	**9**	**4**	**3**	**8**	**8**	**1**	**3**	**1**	**2**	**1**	**12**	**14**	**2**	**1**	**1**	**16**	**25**	

supporting data. Therefore, although listed in the most recent ichthyological checklist (Bilecenoğlu, 2024), *T. nobiliana* and *G. altavela* were excluded from our updated inventory.

The occurrence of *Raja asterias* in the SoM was first reported by Mater and Meriç (1996), again without information where the examined specimen was captured and without a voucher specimen stored for further inspection. In 2009, another purported specimen of *R. asterias* was recorded in the southwestern SoM (Torcu Koç *et al.*, 2012); although detailed collection data were provided (capture depth and coordinates, substratum type etc.), photographic evidence later revealed that the specimen was a misidentified juvenile *R. clavata* (Kabasakal *et al.*, 2025a). The occurrence record for *R. montagui* is also based on Mater and Meriç (1996) and does not provide the relevant information (e.g., original source reference) for this species either. Therefore, the only applicable criterion for SoM records of both *R. asterias* and *R. montagui* is exclusion Criterion 14, which is employed when a species' reported presence cited in a review publication is traceable to an original reference that, upon inspection, proves to have been based on synonymization or misidentification. Although *R. brachyura* was included in another recent elasmobranch inventory of the SoM (Artüz & Fricke, 2024), it does not appear in our updated list – not even as a 'questionable' or 'unconfirmed' species – due to its documented absence from Turkish seas (Kabasakal, 2002; Bilecenoğlu, 2024). Its inclusion in the aforementioned checklist may stem from misidentification of the polymorphic *R. clavata* (Criterion 14, Kovačić *et al.*, 2020), as emphasised by Kabasakal *et al.* (2025a).

Karadurmuş and Sarı (2024) recently reported *Mustelus punctulatus* from the SoM for the first time. However, their record was not supported by any morphological, genetic, or photographic evidence, aside from locality data. The principal diagnostic feature used to identify *M. punctulatus* is the presence of black spots on the body (Ebert *et al.*, 2021). Although Marino *et al.* (2018) note that black spots are almost exclusively associated with *M. punctulatus*, they also emphasise that their absence is not diagnostic of *M. mustelus*. Furthermore, Ebert and Stehmann (2013) pointed out that some *M. mustelus* specimens may also exhibit dark spotting. In this taxonomically challenging situation, a second diagnostic key feature for *M. punctulatus* is the presence of fringed posterior margins on the dorsal fins (Marino *et al.*, 2018). Bello *et al.* (2014) proposed a best-practice approach for avoiding unverified or unverifiable 'first records' in ichthyology, which entails the preparation and deposition of a voucher specimen in a curated collection, accompanied by photographs, meristic and morphometric data, and, where possible, a DNA sequence (barcode). This protocol was not followed for the *M. punctulatus* record reported by Karadurmuş and Sarı (2024). The same authors also reported a new occurrence of *Dipturus batis* in the SoM, based on a single specimen captured off the northern coast (Karadurmuş & Sarı, 2024). Aside from the locality data, no supporting material (e.g., morphometric data or photographs) was provided to substantiate this important record, contrary to the verification standards proposed by Bello *et al.* (2014). Although *D. batis* appears in the recent checklists of Bilecenoğlu (2024) and Artüz and Fricke (2024), its inclusion is based on two historical references (Deveciyan, 1915; Ninni, 1923). Notably, Kabasakal *et al.* (2024b) reported

Fig. 2: Examples of sharks and batoids occurring in the SoM: (a) *Hexanchus griseus*; ***(b)*** *Echinorhinus brucus*; ***(c)*** *Oxynotus centrina*; ***and (d)*** *Myliobatis aquila*. ***All specimens were held in a survival tank until examination and subsequently released alive (photos: Hakan Kabasakal & F. Saadet Karakulak).***

Sl. 2: Primeri morskih psov in skatov, ki se pojavljajo v južnem delu Marmarskega morja: (a) *Hexanchus griseus*; ***(b)*** *Echinorhinus brucus*; ***(c)*** *Oxynotus centrina*; ***in (d)*** *Myliobatis aquila*. ***Vsi primerki so bili do pregleda shranjeni v rezervoarju za preživetje in nato živi izpuščeni na prostost (fotografije: Hakan Kabasakal in F. Saadet Karakulak).***

sympatric *D. oxyrinchus* almost at the same location where Karadurmuş and Sarı (2024) claimed *D. batis*. As *D. oxyrinchus* and *D. batis* are morphologically very similar (Ebert & Stehmann, 2013; Barone *et al*., 2022), they may be confused by researchers not specialising in elasmobranchs. Because of ambiguous evidence, the presence of *M. punctulatus* and *D. oxyrinchus* in the SoM was classified as confirmed only under the lowest applicable criterion (Criterion 5; defined above). We hope that future studies will obtain additional specimens to clarify the occurrence of these elasmobranchs in the SoM, allowing their status to be assessed against more robust criteria.

Finally, a recent study showed that either a highly differentiated variety of *S. blainville* or an undescribed species within the *S. megalops* clade may occur in the SoM (Kabasakal *et al*., 2024c). Given the uncertainties surrounding several elasmobranch species – primarily arising from potential misidentifications by non-taxonomists or researchers without specialised expertise in elasmobranchology and species-specific polymorphism – a genetically informed revision of the elasmobranch fauna of the SoM is urgently needed. To summarise this section, as of 16 June 2025, the updated inventory of demersal elasmobranchs of the SoM consists of the following species: *Hexanchus griseus*, *Galeus melastomus*, *Scyliorhinus canicula*, *S. stellaris*, *Mustelus asterias*, *M. mustelus*, *M. punctulatus*, *Galeorhinus galeus*, *Oxynotus centrina*, *Centrophorus uyato*, *Squalus acanthias*, *S. blainville*, *Echinorhinus brucus*, *Squatina oculata*, *S. squatina*, *Torpedo marmorata*, *Dipturus batis*, *D. oxyrinchus*, *Raja clavata*, *R. miraletus*, *R. radula*, *Dasyatis pastinaca*, *D. tortonesei*, *Aetomylaeus bovinus*, and *Myliobatis aquila* (Tab. 2).

Dispersal/settlement success of demersal elasmobranch species

The PCA incorporating basic life history characteristics, first and last record dates, and bathymetric distribution (depth ranges) for the 32 demersal elasmobranch species recorded in the SoM (Tab. 2) explained 47.62% of the total variance (Fig. 3). In contrast, a second PCA considering only the species' first and last record dates and their common depth ranges in the SoM, accounted for a variance of approximately 61.34% (Fig. 3). While records from the SoM preceding 1990 show that elasmobranch species were more common in the deep continental shelf (100–200 m depth) and in waters deeper than 200 m, since the 2000s, these species have mostly been recorded at depths of 0–100 m. The PCA model based solely on common depth ranges and recording dates showed a 13.72% difference in explained variance compared to the PCA including basic life history parameters – such as maximum size, size at sexual maturity, and generation length – of demersal elasmobranchs. This suggests that adaptability to shallower waters is a key factor influencing the spatial distribution of demersal elasmobranch species in the SoM.

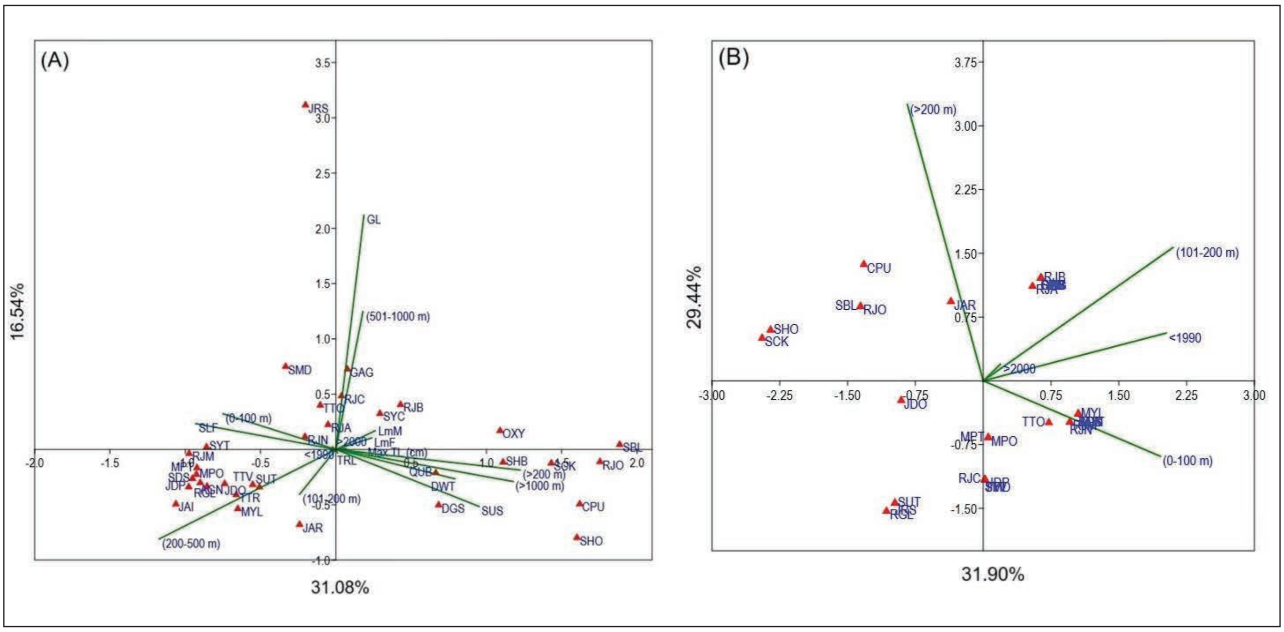


Fig. 3: Plots of Principal Component Analysis (PCA) of demersal elasmobranch species of the SoM, based on (a) all available data, and (b) only the first and last record dates and the common depths at which individuals were recorded in the SoM. The three-letter abbreviations next to the red triangles represent FAO codes for cartilaginous fishes, shown alongside their corresponding species names: *Hexanchus griseus*, ***SBL;*** *Galeus melastomus*, ***SHO;*** *Scyliorhinus canicula*, ***SYC;*** *Scyliorhinus stellaris*, ***SYT;*** *Mustelus asterias*, ***SDS;*** *Mustelus mustelus*, ***SMD;*** *Mustelus punctulatus*, ***MPT;*** *Galeorhinus galeus*, ***GAG;*** *Dalatias licha*, ***SCK;*** *Oxynotus centrina*, ***OXY;*** *Centrophorus uyato*, ***CPU;*** *Squalus acanthias*, ***DGS;*** *Squalus blainville*, ***QUB;*** *Echinorhinus brucus*, ***SHB;*** *Squatina oculata*, ***SUT;*** *Squatina squatina*, ***AGN;*** *Tetronarce nobiliana*, ***TTO;*** *Torpedo marmorata*, ***TTR;*** *Torpedo torpedo*, ***TTV;*** *Dipturus batis*, ***RJB;*** *Dipturus oxyrinchus*, ***RJO;*** *Leucoraja naevus*, ***RJN;*** *Raja asterias*, ***JRS;*** *Raja clavata*, ***RJC;*** *Raja miraletus*, ***JAI;*** *Raja montagui*, ***RJM;*** *Raja radula*, ***JAR;*** *Dasyatis pastinaca*, ***JDP;*** *Dasyatis tortonesei**;* ***JDO;*** *Gymnura altavela**;* ***RGL;*** *Aetomylaeus bovinus*, ***MPO;*** *Myliobatis aquila*, ***MYL.***

Sl. 3: Diagrami analize glavnih komponent (PCA) pridnenih vrst hrustančnic v Marmarskem morju, ki temeljijo na (a) vseh razpoložljivih podatkih in (b) le na datumu prvega in zadnjega zapisa ter skupnih globinah, na katerih so bili primerki osebki zabeleženi v Marmarskem morju. Tri črkovne okrajšave poleg rdečih trikotnikov predstavljajo kode FAO za hrustančnice, prikazane poleg njihovih ustreznih imen vrst: *Hexanchus griseus*, ***SBL;*** *Galeus melastomus*, ***SHO;*** *Scyliorhinus canicula*, ***SYC;*** *Scyliorhinus stellaris*, ***SYT;*** *Mustelus asterias*, ***SDS;*** *Mustelus mustelus*, ***SMD;*** *Mustelus punctulatus*, ***MPT;*** *Galeorhinus galeus*, ***GAG;*** *Dalatias licha*, ***SCK;*** *Oxynotus centrina*, ***OXY;*** *Centrophorus uyato*, ***CPU;*** *Squalus acanthias*, ***DGS;*** *Squalus blainville*, ***QUB;*** *Echinorhinus brucus*, ***SHB;*** *Squatina oculata*, ***SUT;*** *Squatina squatina*, ***AGN;*** *Tetronarce nobiliana*, ***TTO;*** *Torpedo marmorata*, ***TTR;*** *Torpedo torpedo*, ***TTV;*** *Dipturus batis*, ***RJB;*** *Dipturus oxyrinchus*, ***RJO;*** *Leucoraja naevus*, ***RJN;*** *Raja asterias*, ***JRS;*** *Raja clavata*, ***RJC;*** *Raja miraletus*, ***JAI;*** *Raja montagui*, ***RJM;*** *Raja radula*, ***JAR;*** *Dasyatis pastinaca*, ***JDP;*** *Dasyatis tortonesei**;* ***JDO;*** *Gymnura altavela**;* ***RGL;*** *Aetomylaeus bovinus*, ***MPO;*** *Myliobatis aquila*, ***MYL.***

Environmental implications

Table 3 compares the maximum recorded depths of demersal elasmobranchs in the SoM with records from other regions of the Mediterranean Basin. The table highlights notable differences in maximum recorded depths depending on the year of observation in SoM-specific studies. Specifically, in the early 1990s, elasmobranch species were recorded down to upper slope depths (≤500 m) throughout the SoM; however, since the mid-2000s, their bathymetric ranges have been restricted to shelf waters (see asterisked references in Tab. 3). The only exceptions to this narrowing of the bathymetry were observations of *E. brucus* and *G. melastomus* in the Tekirdağ Trench (northwestern SoM) at depths below 1,000 m. (Kabasakal *et al*., 2005; Oral, 2010). Several elasmobranchs (marked with an "δ") that elsewhere in the Mediterranean inhabit shelf waters as well as upper and lower slope depths (e.g., Follesa *et al*., 2019; Ruiz-García *et al*., 2023; Deval & Mutlu, 2024) have, in the SoM since the mid-2000s, had maximum recorded depths restricted to outer and even inner shelf waters (see asterisked references in Table 3). Daban *et al*. (2021) reported that the number of elasmobranch species in the SoM increases with depth, and that the highest catch per unit of effort (CPUE; kg/km^2) for *H. griseus*, *M. asterias* and *S. acanthias* was recorded at depths between 100 and 200 m. This suggests a distribution largely restricted to outer shelf waters. They also observed increased CPUE for *M. mustelus*, *S. squatina*, and several batoids at depths of 20–50 m. Karadurmuş and Sarı (2024) reported a similar shelf-restricted bathymetric distribution for elasmobranchs in the region. A recent study by Kabasakal (2025) found that the spatial distribution and abundance (number/km^2) of demersal elasmobranchs in the SoM are now restricted to the inner shelf at depths of 50–100 m. The author attributes this to vertical habitat compression, driven by deoxygenation and the emergence of dead zones in deep shelf and bathyal waters – a process particularly severe in the environmental degraded eastern SoM.

Based on correlations between captures of *H. griseus* and environmental parameters, Kabasakal *et al*. (2024d) concluded that the recent increase in bluntnose sixgill shark captures in continental shelf waters is primarily associated with an annual rise in dissolved organic compounds (NO_2+NO_3 nitrogen and PO_4 phosphorus) in bathyal waters. They also found that deteriorating environmental conditions and progressive deoxygenation in the deep waters of the SoM coincide with a reduction in the capture depth of *H. griseus* on the continental shelf. Severe hypoxia in deep continental shelf waters (>100 m) and anoxia in the slope waters of the northeastern SoM drastically constrict the bathymetric and spatial distribution of demersal elasmobranchs in the region. PCA shows that, since the 2000s, records of demersal elasmobranchs have been concentrated at depths shallower than 150 m, reflecting the ongoing mass migration of these species toward continental shelf areas. This suggests that 'adaptability to shallows on the continental shelf' is a key factor in determining the spatial distribution of these species in the SoM.

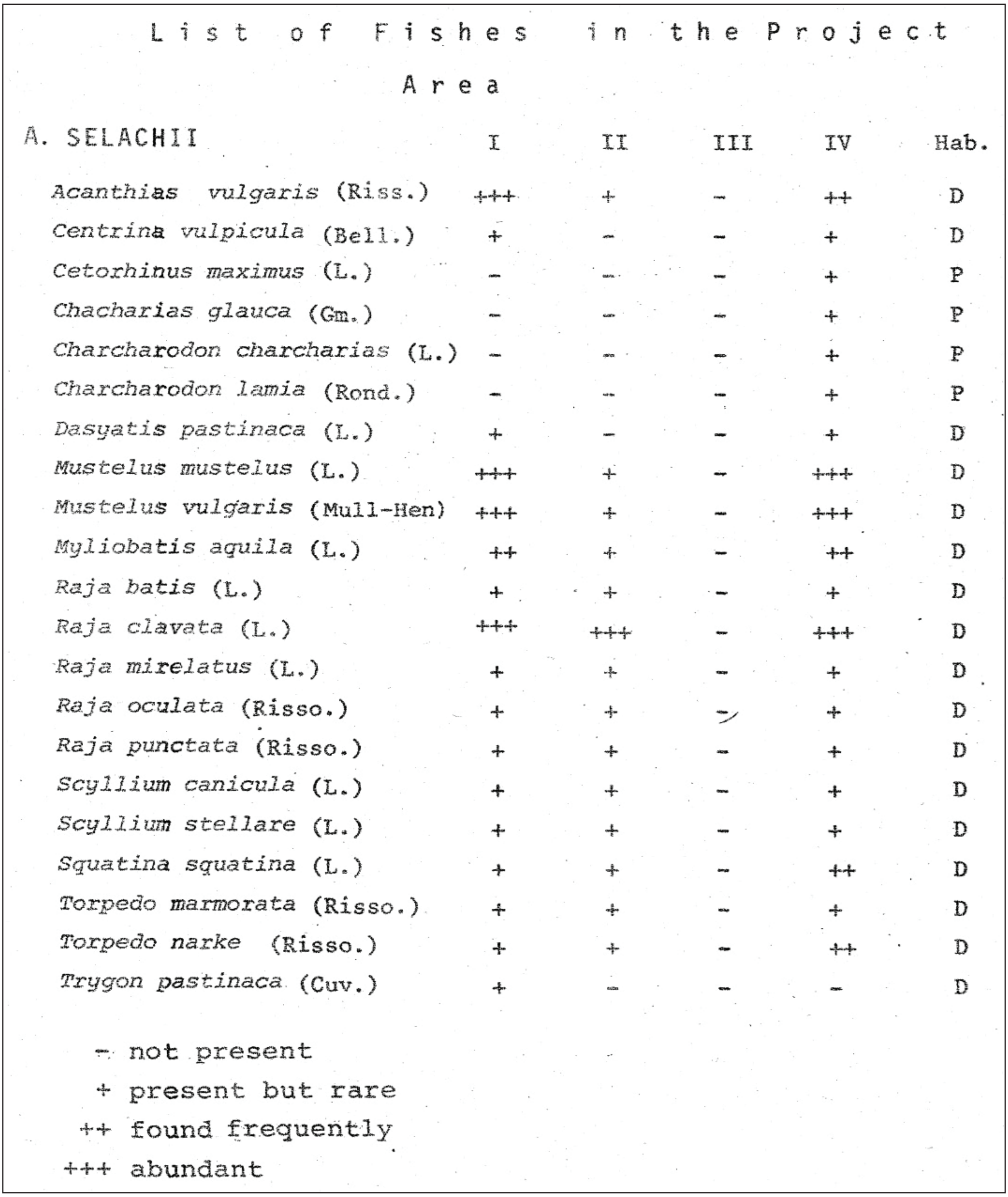
So what is the future of the demersal elasmobranchs still struggling to survive in the SoM today? According to Diaz and Rosenberg (2008), these species may recolonise their former habitats if dissolved oxygen (DO) levels and ecosystem functions improve, although they may not reach pre-hypoxia levels. Historical observations support the one-time suitability of deeper waters for demersal cartilaginous fish: *E. brucus* was recorded at 1,214 m in the Tekirdağ Trench in northwestern SoM in the early 2000s (Kabasakal *et al*., 2005), and *G. melastomus* was sampled at similar depths in the same region in 2008 (Oral, 2010). Additionally, Gallo *et al*. (2019) noted that certain elasmobranch species, such as cat sharks (e.g., *Cephalurus cephalus*), can tolerate suboxic conditions and withstand hypoxia better than previously believed. The species list presented in the 1974 Environmental Impact Assessment (EIA) report prepared by the Hydrobiology Research Institute to provide biological information prior to the construction of a sewage system discharging into the Bosphorus Strait – the gateway between the SoM and the Black Sea – offers insight into the historical species richness of elasmobranchs in the SoM (Anonymous, 1974; Fig. 4). Although the taxonomy used in the report is no longer valid, it is still possible to identify many of the listed species, especially pelagic ones, that have been absent from the region for years.

The extreme rarity of large pelagic sharks in the SoM is both remarkable and alarming. Early ichthyological inventories (Ninni, 1923; Deveciyan, 1926; Anonymous, 1974) considered the following pelagic shark species to be seasonal visitors to or residents of the region: *Alopias vulpinus*, *Cetorhinus maximus*, *Carcharodon carcharias*, *Lamna nasus*, and *Prionace glauca*. In addition, *A. superciliosus* was first recorded in the SoM in 2007 (Kabasakal & Karhan, 2008), with a second specimen captured in 2011. Since then, no *A. superciliosus* specimens have been captured or sighted. Today, all pelagic sharks except *A. vulpinus* have been extirpated from the SoM, and even incidental captures or sightings of this remaining species are becoming increasingly rare. This decline coincides with the warming of the region: over the past 20 years, the annual average sea surface temperature (SST) in the seas of Türkiye has increased by 0.4–1.4 °C due to global warming and climate change, with the SoM being the second most affected after the Black Sea (Demircan, 2022).

Tab. 3: Comparison between maximum recorded depths for demersal elasmobranchs included in the updated SoM inventory and values recorded in various studies from other regions of the Mediterranean. Notes: § species observed at the surface, no maximum depth record available; $^{\mu}$ record based on data from a commercial fisherman, no maximum depth record available; $^{\delta}$ species with bathyal distribution in Mediterranean subregions; * study specific to SoM.

Tab. 3: Primerjava med največjimi zabeleženimi globinami za pridnene hrustančnice, vključene v posodobljen popis vrst v Marmarskem morju, in vrednostmi, zabeleženimi v različnih študijah iz drugih regij Sredozemlja. Opombe: § - vrste, opažene na površini, ni na voljo zapisa o največji globini; µ - zapis temelji na podatkih komercialnega ribiča, ni na voljo zapisa o največji globini; δ - vrste z batialno razširjenostjo v sredozemskih podregijah; * študija, specifična za Marmarsko morje.

Species	**Present Study**	**JICA (1993)***	**Meriç (1995)***	**Kabasakal *et al.* (2005)***	**Oral (2010)***	**Torcu Koç *et al.* (2012)***	**Bilecenoğlu (2019)***	**Follesa *et al.* (2019)**	**Daban *et al.* (2021)***	**Ruiz-García *et al.* (2023)**	**Deval & Mutlu (2024)**	**Karadurmuş & Sarı (2024)***
Hexanchus griseus$^{\delta}$	188	–	350	–	–	–	–	800	200	537	–	–
Galeus melastomus$^{\delta}$	140	500	350	–	1213	–	–	800	–	685	800	–
Scyliorhinus canicula$^{\delta}$	124	500	350	–	–	60	–	800	200	649	600	146
Scyliorhinus stellaris	–	–	–	–	–	–	–	200	200	–	–	146
Mustelus asterias	–	500	350	–	–	–	–	200	200	–	–	45
Mustelus mustelus	188	100	350	–	–	–	–	200	200	–	200	85
Mustelus punctulatus	–	–	–	–	–	–	–	200	–	–	–	146
Galeorhinus galeus§	–	–	–	–	–	–	–	800	–	–	–	–
Oxynotus centrina$^{\delta}$	66	500	–	–	–	–	–	800	200	214	600	146
Centrophorus uyato$^{\delta}$	150	500	270	–	–	–	–	800	–	588	800	–
Squalus acanthias$^{\delta}$	140	200	350	–	–	–	–	800	200	–	–	146
Squalus blainville$^{\delta}$	140	500	350	–	–	–	–	800	200	–	600	–
Echinorhinus brucus	150	–	–	1214	–	–	–	–	–	–	–	–
Squatina oculata$^{\mu}$	–	–	–	–	–	–	–	–	–	–	–	–
Squatina squatina	–	–	–	–	–	–	–	–	50	–	–	47
Torpedo marmorata	116	200	–	–	–	45	–	200	200	257	300	85
Dipturus batis	–	–	–	–	–	–	–	–	–	–	–	68
Dipturus oxyrinchus$^{\delta}$	100	500	–	–	–	–	–	800	–	329	600	–
Raja clavata$^{\delta}$	188	500	–	–	–	45	–	800	50	329	500	146
Raja miraletus	95	–	–	–	–	–	–	200	–	–	200	85
Raja radula	25	–	–	–	–	–	–	200	–	–	–	–
Dasyatis pastinaca	84	200	–	–	–	–	–	200	50	133	200	146
Dasyatis tortonesei	67	–	–	–	–	–	–	–	–	–	–	–
Aetomylaeus bovinus	–	–	–	–	–	–	3	200	–	73	–	–
Myliobatis aquila	90	200	–	–	–	–	–	200	200	73	–	85



List of Fishes in the Project Area

A. SELACHII	I	II	III	IV	Hab.
Acanthias vulgaris (Riss.)	+++	+	-	++	D
Centrina vulpicula (Bell.)	+	-	-	+	D
Cetorhinus maximus (L.)	-	-	-	+	P
Chacharias glauca (Gm.)	-	-	-	+	P
Charcharodon charcharias (L.)	-	-	-	+	P
Charcharodon lamia (Rond.)	-	-	-	+	P
Dasyatis pastinaca (L.)	+	-	-	+	D
Mustelus mustelus (L.)	+++	+	-	+++	D
Mustelus vulgaris (Mull-Hen)	+++	+	-	+++	D
Myliobatis aquila (L.)	++	+	-	++	D
Raja batis (L.)	+	+	-	+	D
Raja clavata (L.)	+++	+++	-	+++	D
Raja mirelatus (L.)	+	+	-	+	D
Raja oculata (Risso.)	+	+	-	+	D
Raja punctata (Risso.)	+	+	-	+	D
Scyllium canicula (L.)	+	+	-	+	D
Scyllium stellare (L.)	+	+	-	+	D
Squatina squatina (L.)	+	+	-	++	D
Torpedo marmorata (Risso.)	+	+	-	+	D
Torpedo narke (Risso.)	+	+	-	++	D
Trygon pastinaca (Cuv.)	+	-	-	-	D

- not present
+ present but rare
++ found frequently
+++ abundant

Fig 4: Pelagic and demersal elasmobranch species reported from the southern entrance of the Bosphorus Strait (northeastern SoM) in the Environmental Impact Assessment (EIA) report compiled by the Hydrobiology Research Institute (adapted from Anonymous, 1974).
Sl. 4: Pelaške in pridnene vrste hrustančnic, o katerih so poročali pri južnem vhodu v Bosporsko ožino (severovzhodni del Marmarskega morja) v poročilu o presoji vplivov na okolje (EIA), ki ga je sestavil Raziskovalni inštitut za hidrobiologijo (prirejeno po Anonymous, 1974).

This rise in seawater temperatures has reduced the solubility of DO, causing elasmobranch species to become less tolerant of hypoxia, as their metabolic rates increase in parallel with warming (Breitburg *et al*., 2018; Waller *et al*., 2024). Vedor *et al*. (2021) suggested that the expanding oxygen minimum zones (OMZs) driven by climate change – (through shoaling of low-DO waters and rising SST) – will compress the habitat of pelagic sharks, such as the blue shark, *P. glauca*, forcing them into surface waters above the OMZs and thereby reducing their overall available habitat volume. Such dynamic is indeed described by the OMZ 'habitat trap' hypothesis. According to Sims (2019), the high oxygen demands of pelagic sharks compel them to retreat to normoxic zones when encountering oxygen-depleted waters of the open ocean (like those in the SoM). Consequently, the apparent absence of most pelagic shark species (except *A. vulpinus*) from the SoM today is likely due to regional deoxygenation and an increased rate of their incidental capture in the resulting OMZ habitat trap. It seems that decades of environmental degradation, marine pollution, and deoxygenation in the SoM have reduced the region's elasmobranch fauna largely to demersal species. This highlights the potentially devastating impact of environmental degradation on marine fauna and biodiversity. A comparable depletion of large mesopredators such as *G. galeus* and *Carcharhinus plumbeus*, and top predators such as *A. vulpinus*, *L. nasus*, and *P. glauca*, has been recorded in the Adriatic Sea, where environmental variability, in addition to fisheries, has been suggested to impact elasmobranch abundance (Barausse *et al*., 2014).

In conclusion, while overfishing was once considered the primary threat to chondrichthyans (sharks, rays, and chimaeras) (Stevens *et al*., 2000), habitat degradation, pollution, and climate change are now recognised as additional major drivers of species loss in this group (Dulvy *et al*., 2021). Based on the assessment of fish communities across several aquatic ecosystems worldwide, Moyle and Leidy (1992) concluded that most faunas are in serious decline, primarily due to commercial exploitation, habitat alteration, and pollution, and therefore require immediate protection. Pollom *et al*. (2024) reported of two South African cat shark species (*Haploblepharus fuscus* and *H. kistnasamyi*) threatened not only by overfishing but also by coastal urbanisation, industrialisation, and increasing marine pollution. The combined pressures have led to both species being categorised as 'Vulnerable' on the Red List. The findings of Pollom *et al*. (2024) align with numerous other studies demonstrating the drastic effects of human activities on regional fish faunas, as also documented by Bin Aziz *et al*. (2021) and Yang *et al*. (2024). The assumption that shallow continental shelf areas may become a habitat trap for demersal elasmobranchs – forcing these out of deep waters and exposing them to higher fishing pressure – has now materialised in the SoM, as pointed out by Kabasakal *et al*. (2023b) and Waller *et al*. (2024). According to Akoğlu *et al*. (2024), the pattern traditionally observed in demersal fishery – years of overfishing followed by stock collapse and gradual recovery over decades – no longer holds true for demersal elasmobranchs in the SoM. Although Important Shark and Ray Areas (ISRAs) have recently been designated in the SoM (Jabado *et al*., 2023) – that confirm the presence of 25 demersal elasmobranch species and encompass potential breeding grounds for various taxa (e.g., *S. canicula*, *O. centrina*, *S. blainvillei* and *M. aquila*) distributed across the region (Daban *et al*., 2021; Kabasakal *et al*. 2024e, 2025b) – we propose that the entire SoM be declared an ISRA to protect the taxonomic diversity of these sensitive species in an area undergoing severe environmental degradation.

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PRIDNENE HRUSTANČNICE V MARMARSKEM MORJU: POSODOBLJENA INVENTARIZACIJA, TAKSONOMSKA VPRAŠANJA IN OKOLJSKE POSLEDICE

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POVZETEK

Pričujoča raziskava temelji na vzorcih 16 vrst hrustančnic (devet vrst morskih psov in sedem vrst skatov), pridobljenih med letoma 2014 in 2024 v Marmarskem morju (SoM). V istem obdobju so drugi raziskovalci na istem območju zabeležili še dodatnih devet vrst (šest vrst morskih psov in tri vrste skatov). V zadnjih 100 letih je bilo na območju SoM tako zabeleženih 32 vrst pridnenih hrustančnic (16 vrst morskih psov in 16 vrst skatov), vendar uporaba meril za „potrjeno ali nepotrjeno prisotnost na podlagi dokazov" trenutno število zmanjša na 25 (15 vrst morskih psov, 10 vrst skatov). Analiza glavnih komponent (PCA) kaže, da je prilagodljivost plitvejšim vodam zdaj ključnega pomena za prostorsko porazdelitev pridnenih hrustančnic v morskem okolju. Ta premik jasno kaže, kako dramatično so degradacija okolja, onesnaževanje morja in deoksigenacija v zadnjih 40 letih zmanjšali favno hrustančnic v regiji, predvsem pridnenih vrst, kar poudarja potencialno uničujoč vpliv takšne degradacije na biotsko raznovrstnost.

Ključne besede: Elasmobranchii, preživetje, ohranjanje, inventarizacija, Marmarsko morje, Turčija

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FIRST RECORDS OF BLENNIES (SUBORDER BLENNIOIDEA) OFF THE COAST OF LIBYA

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ABSTRACT

Visual census surveys in two areas along the western coast of Libya, conducted in 2012 and from 2018 to 2024, led to the first records of nine species of blennies (suborder Blennioidea) in Libyan waters. These species, comprising seven Blenniidae and two Tripterygiidae, were Aidablennius sphynx *(Valenciennes, 1836),* Coryphoblennius galerita *(Linnaeus, 1758),* Microlipophrys canevae *(Vinciguerra, 1880),* Microlipophrys dalmatinus *(Steindachner & Kolombatovic, 1883),* Parablennius gattorugine *(Linnaeus, 1758),* Parablennius zvonimiri *(Kolombatovic, 1892),* Scartella cristata *(Linnaeus, 1758),* Tripterygion melanurus Guichenot*, 1850 and* Tripterygion tripteronotum *(Risso, 1810).*

Key words: bony fish, cryptobenthic, native, North Africa, visual census

PRIME SEGNALAZIONI DI BLENNIDI (SOTTORDINE BLENNIOIDEA) AL LARGO DELLA COSTA LIBICA

SINTESI

In due aree esaminate lungo la costa occidentale della Libia nel 2012 e tra il 2018 e il 2024, sono stati segnalati per la prima volta nelle acque libiche otto pesci del sottordine Blennioidea, tramite censimenti visivi. Le specie identificate, appartenenti a sette Blenniidae e due Tripterygiidae, sono: Aidablennius sphynx *(Valenciennes, 1836),* Coryphoblennius galerita *(Linnaeus, 1758),* Microlipophrys canevae *(Vinciguerra, 1880),* Microlipophrys dalmatinus *(Steindachner & Kolombatovic, 1883),* Parablennius gattorugine *(Linnaeus, 1758),* Parablennius zvonimiri *(Kolombatovic, 1892),* Scartella cristata *(Linnaeus, 1758),* Tripterygion melanurus *Guichenot, 1850* e Tripterygion tripteronotum *(Risso, 1810).*

Parole chiave: pesci ossei, criptobentonici, specie native, Nord Africa, censimento visivo

INTRODUCTION

Coastal waters ecosystems are increasingly endangered by anthropogenic factors that often lead to habitat destruction and biodiversity loss (Macura *et al.,* 2019). Blennies (suborder Blennioidea) are among the most abundant fishes in shallow coastal waters, including tidal pools and intertidal zone, with only a few species recorded in deeper waters (Golani *et al.,* 2014; Tiralongo *et al.,* 2016). The narrow and shallow depth range makes them particularly vulnerable to habitat loss, as these strata are the most directly impacted by human activities (Piazzolla *et al.,* 2015). Blennies show a preference for rocky shelters covered by algae, where they are found residing in holes and crevices, and sometimes inhabiting empty barnacle and bivalve shells or polychaete tubes (Zander, 1986a; Lipej & Orlando-Bonaca, 2006; Tiralongo *et al.,* 2016). However, due to their cryptobenthic behaviour, there is still limited information on their ecology (Tiralongo, 2015; Kesici & Dalyan, 2019).

According to Eschmeyer *et al.* (2025), the family Blenniidae comprises 58 genera and 406 species distributed worldwide, with the highest abundance in tropical and subtropical waters (Tiralongo, 2020). Blenniidae are identified by distinctive external features, including cephalic tentacles (ocular cirri) in most species, head and teeth morphology, and unique colour patterns (Lipej & Dulčić, 2010). The latter are especially pronounced in some males during the breeding season, such as the "reproductive head mask" of species within the genus *Microlipophrys* (De Jonge & Videler, 1989; Zander, 1986a; Tiralongo, 2020). A similar colour pattern is also displayed by the family Tripterygiidae, which comprises a total of 190 valid species and 29 genera distributed worldwide (Eschmeyer *et al.,* 2025). Of the 23 blenniid species reported for the Mediterranean Sea (Vecchioni *et al.*, 2019; Tiralongo, 2020), only six had been recorded in Libya prior to this study (Elbaraasi *et al.*, 2019). By comparison, only four species of the genus *Tripterygion* (triplefin blennies) are known from the Mediterranean, none of which had been reported from Libyan waters.

Blennies (suborder Blennioidea) are mostly small-sized fish, with a mean total length of about 5–7 cm. Members of the family Blenniidae (combtooth blennies) are typically scaleless and slender (Randall, 1995), exhibiting carnivorous, omnivorous, or herbivorous feeding habits (Tiralongo, 2020). While they are not of interest to fisheries, they are worldwide commonly used as ornamental fish in public and domestic aquariums and play a relevant ecological role (Townsend & Tibbetts, 2004; Ditty, 2005). Despite numerous records of combtooth blennies in the Mediterranean Sea, with 21 species documented in Italy alone (Relini & Lanteri, 2010; Tiralongo, 2015; Azzurro *et al.*, 2018), only the following six had been recorded in Libyan waters: *Blennius ocellaris* Linnaeus, 1758, *Lipophrys trigloides* (Valenciennes, 1836), *Parablennius incognitus* (Bath, 1968), *Parablennius sanguinolentus* (Pallas, 1814), *Salaria basilisca* (Valenciennes, 1836), and *Salaria pavo* (Risso, 1810) (Tab. 1).

Following are brief descriptions of the nine species recorded in Libya for the first time.

Aidablennius sphynx (Valenciennes, 1836) is a blenny that inhabits shallow waters, typically from 0–1.5 m in depth and often well exposed to wave action (Tiralongo, 2015). This species is widespread across the Mediterranean Sea (Zander, 1986a).

Coryphoblennius galerita (Linnaeus, 1758) is an intertidal and semi-amphibious blenny that resides in holes, where it remains during low tide (Martin & Bridges, 1999). Its diet includes copepods and algae (Zander, 1986a). Native to the eastern Atlantic from the western British Islands southward to the Canary Islands, the species also occurs in the Mediterranean Sea (Zander, 1986a) and was recently reported from the Black Sea (Khutornoy & Kvach, 2019).

Microlipophrys canevae (Vinciguerra, 1880) is a blenny that inhabits shallow waters, at depths of 0 to 1 m (Tiralongo *et al.*, 2016), showing a preference for steep and sub-horizontal rocks and typically dwelling in holes. The species has an elongated and laterally compressed body, reaching a maximum total length of 7.5 cm (Froese & Daniel, 2025). Its diet consists mainly of small invertebrates, especially crustaceans, but it also feeds on algae. Considered an endemic Mediterranean species, it is also found in the northeast Atlantic along the southern Portuguese coast (Zander, 1986a).

Microlipophrys dalmatinus (Steindachner & Kolombatović, 1883) is a very elongated and slender combtooth blenny with a small body, rarely exceeding 4 cm in total length (Zander, 1986a). It occurs in the northeastern Atlantic and the Mediterranean Sea (Almada *et al.*, 2001). The species prefers horizontal to sub-horizontal rocky habitats covered by algal growth, typically at depths around 1.5 m (Bilecenoglu *et al.,* 2013; Tiralongo, 2020), and is often found living in holes. As an omnivore, it feeds on a variety of food items, including small crustaceans and algae (Goldschmid *et al.,* 1984). This species has been recorded along the Tyrrhenian coast (Relini & Lanteri, 2010), in the central Mediterranean Sea (Falzon, 2009), and in the Ionian Sea (Bilecenoglu *et al.,* 2013).

Parablennius gattorugine (Linnaeus, 1758) is the largest blenny of the Mediterranean Sea, reaching a total length of 30 cm (Zander, 1986a). It has a brownish to reddish body with six to seven irregular dark transverse bands and is characterised by thick and highly branched supraocular tentacles. This species is typically found on rocky bottoms at depths between 3 and 32 m, where it rarely shelters in holes. It feeds on benthic invertebrates (Bauchot, 1987).

Parablennius zvonimiri (Kolombatović, 1892) is a medium-sized combtooth blenny found in various parts of the Mediterranean Sea (Zander, 1986a; Tiralongo *et al.,* 2016). It has an infralittoral distribution and occurs at depths ranging from 0 m (Pallaoro & Števčić, 1989) to 12 m (Zander, 1986a). This species shows a preference for slopes with algal cover at depths of 0.5 to 2 m, where it feeds by grazing on periphyton (Zander, 1986a; Tiralongo *et al.,* 2016).

Scartella cristata (Linnaeus, 1758) is a species found both in the Mediterranean and the Atlantic (Springer, 1993). It inhabits very shallow waters and tide pools that are well exposed to wave action (Randall, 1967; Tiralongo *et al.,* 2016). Among other food items, this omnivorous fish feeds on filamentous algae and invertebrates (Mendes *et al.,* 2009).

Tripterygion melanurus Guichenot, 1850 is a small triplefin blenny (family Tripterygiidae), reaching a total length of 5.3 cm (Zander, 1986b). It has a thin, elongated and scaled body. Mature males are characterised by a red body with a black head marked with irregular blue stripes, while females are less brightly coloured.

Tripterygion tripteronotum (Risso, 1810) is another small species of triplefin blenny, reaching a maximum total length of approximately 6 cm. Its body is thin, elongated, and scaled. Mature males exhibit a distinctive red body and black head, particularly marked during the bearding season, which extends from March to August (De Jonge & Videler, 1989). A bottom-dwelling species, it inhabits depths from the intertidal zone down to a maximum depth of 12 m (Zander, 1986b).

The newly recorded seven combtooth blennies (Blenniidae) and two triplefin blennies (Tripterygiidae) expand Libya's ichthyological checklist and provide additional information on their habitat and mating season.

Tab. 1: Updated list of Blenniidae (N = 12) and Tripterygiidae (N = 2) species recorded in Libyan waters. Abbreviation: NS= Not specified (location where the sample was taken from was not specified).
Tab. 1: Posodobljen seznam vrst iz družin Blenniidae (N = 12) in Tripterygiidae (N = 2), zabeleženih v libijskih vodah. Okrajšava: NS = Ni določeno (lokacija odvzema vzorca ni bila navedena).

Species	Family	Location	Fig.	Reference
Aidablennius sphynx (Valenciennes, 1836)	Blenniidae	Regatta, Tripoli; Surman	2A; 2B	Present
Blennius ocellaris Linnaeus, 1758	Blenniidae	Benghazi	no	Al-Hassan & El-Silini (1999)
Coryphoblennius galerita (Linnaeus, 1758)	Blenniidae	Regatta, Tripoli	2C	Present
Lipophrys trigloides (Valenciennes, 1836)	Blenniidae	Benghazi; Regatta, Tripoli	2D	Al-Hassan & El-Silini (1999)
Microlipophrys canevae (Vinciguerra, 1880)	Blenniidae	Regatta, Tripoli	3A-D	Present
Microlipophrys dalmatinus (Steindachner & Kolombatovic, 1883)	Blenniidae	Regatta, Tripoli	4A&B	Present
Parablennius gattorugine (Linnaeus, 1758)	Blenniidae	Regatta, Tripoli	5A	Present
Parablennius incognitus (Bath, 1968)	Blenniidae	Benghazi, Surman	6A	Al-Hassan & El-Silini (1999)
Parablennius sanguinolentus (Pallas, 1814)	Blenniidae	NS; Regatta, Tripoli, Surman	6B	Elbaraasi *et al.* (2019)
Parablennius zvonimiri (Kolombatovic, 1892)	Blenniidae	Regatta, Tripoli	6C-F	Present
Salaria basilisca (Valenciennes, 1836)	Blenniidae	Benghazi	no	Al-Hassan & El-Silini (1999)
Salaria pavo (Risso, 1810)	Blenniidae	Benghazi	no	Al-Hassan & El-Silini (1999)
Scartella cristata (Linnaeus, 1758)	Blenniidae	Surman	7A	Present
Tripterygion melanurus Guichenot, 1850	Tripterygiidae	Surman	7B-C	Present
Tripterygion tripteronotum (Risso, 1810)	Tripterygiidae	Regatta, Tripoli	7D-F	Present

MATERIAL AND METHODS

Snorkelling surveys were conducted during the day (typically between 9 am and 12 pm) at two natural bays along the Libyan coast, both characterised by mixed rocky and sandy substrates. The first site, Surman, located approximately 70 km west of Tripoli (32°47′46.7″N 12°33′59.0″E; Fig. 1A, B), was surveyed in August 2012 and from 2024-2025. The second site, Regatta, the other natural bay off the coast of Tripoli (32°51′13.9″N 13°03′15.6″E; Fig. 1A, C), was surveyed intermittently from 2018 to 2024; survey efforts were suspended in 2020 due to the global COVID-19 pandemic and regional armed conflict. *In situ* photographs were taken using an Olympus Tough TG-4 Underwater Camera.

Specimens were collected on a single occasion in Surman in 2012 using a hand net. Morphological identification was based on descriptions provided by Bauchot (1987) and Tiralongo (2015, 2020). Mature males of *M. canevae* and *M. dalmatinus* were identified based on a "reproductive head mask" that the two species develop during the breeding season; specifically, a black head and snout and bright yellow cheeks in mature *M. canevae* (De Jonge & Videler, 1989; Tiralongo *et al.,* 2016; Froese & Daniel, 2025), and yellow cheeks, a head that gradually darkens to a uniform black in *M. dalmatinus*; a distinctive feature in the latter was also a markedly slender body (Zander, 1986; Bilecenoglu *et al.,* 2013).

Species nomenclature was verified using FishBase (Froese and Pauly, 2025; https://www.fishbase.se/search.php) and the World Register of Marine Species (WoRMS Editorial Board, 2025; https://www.marinespecies.org/).

RESULTS

The seven blenniids and two tripterygiids were observed at shallow depths, ranging from 20 cm to 1 m (Tab. 1; Figs. 2–7). The following records summarize the sampling events and observations of these species.

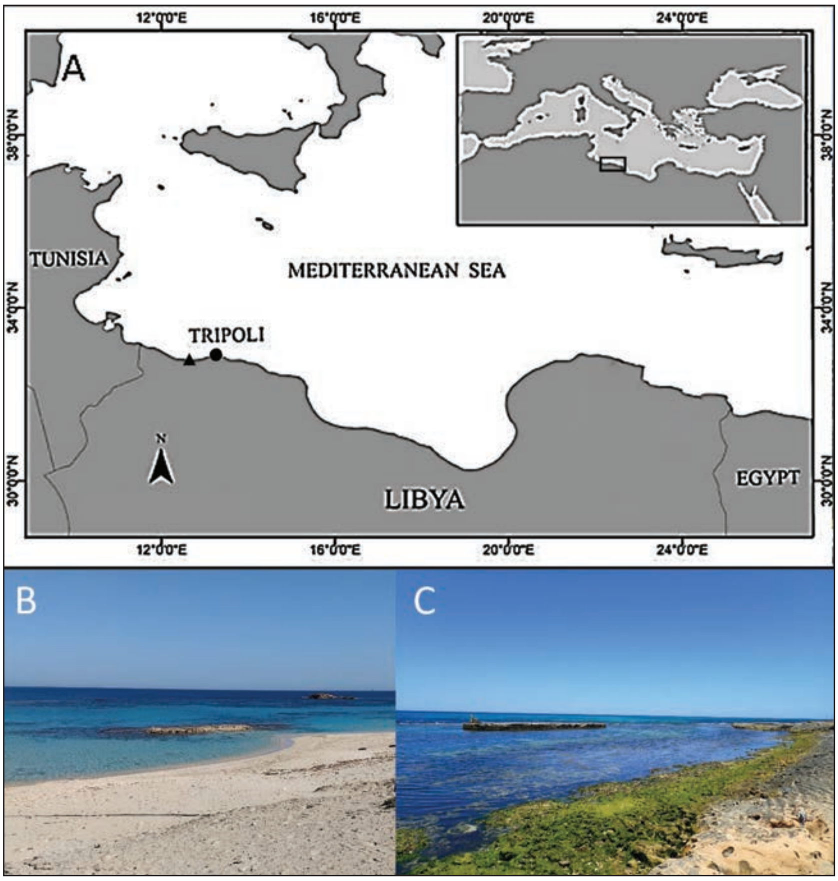

Fig. 1: Map of the survey area showing the locations of Regatta (black circle) and Surman (triangle) off the coast of Libya. Insets B (Surman) and C (Regatta) show both natural bays during low tide (photo: J. Rizgalla).
Sl. 1: Zemljevid obravnavanega območja, ki prikazuje lokaciji Regatta (črni krog) in Surmana (trikotnik) ob obali Libije. Vstavka B (Surman) in C (Regata) prikazujeta oba naravna zaliva med oseko (foto: J. Rizgalla).

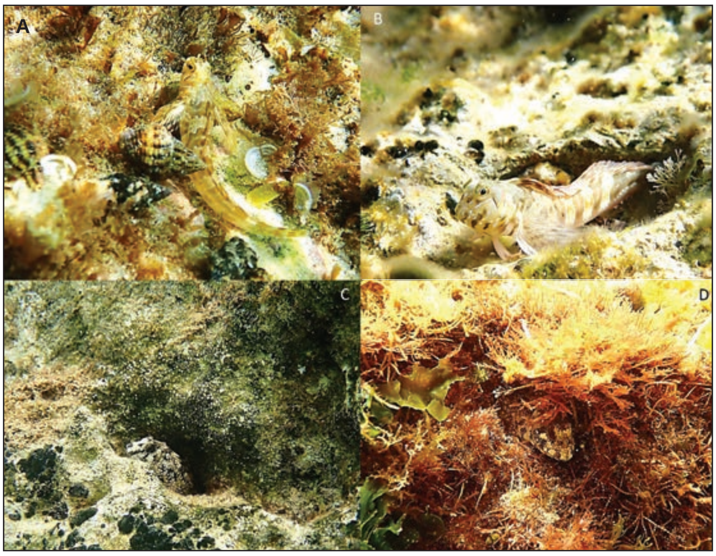

Fig. 2: (A) *Aidablennius sphynx* ***in shallow waters in Regatta. (B)*** *A. sphynx* ***at a shallow depth in Surman. (C)*** *Coryphoblennius galerita* ***inside a hole in the shallow waters of Regatta bay. (D)*** *Lipophrys trigloides* ***among algae, at a depth of 20 cm in Regatta (photo: J. Rizgalla).***

Sl. 2: (A) *Aidablennius sphynx* ***v plitvi vodi v zalivu Regatta. (B)*** *A. sphynx* ***na majhni globini v zalivu Surman. (C)*** *Coryphoblennius galerita* ***v rovu v plitvini zaliva Regatta. (D)*** *Lipophrys trigloides* ***med algami, na globini 20 cm v zalivu Regatta (foto: J. Rizgalla).***

Fig. 3: *Microlipophrys* ***canevae in shallow waters in Regatta. (A, B) Male individual displaying the characteristic reproductive head mask, with bright yellow cheeks and a black head. (C) A pair of*** *M. canevae* ***on an algae-covered rocky bottom (indicated by white circle), at a depth of approximately 20 cm. (D) Close-up of an additional*** *M. canevae* ***specimen (photo: J. Rizgalla).***

Sl. 3: Vrsta *Microlipophrys canevae* ***v plitvi vodi v zalivu Regatta. (A, B) Samec z značilno razmnoževalno masko na glavi, s svetlo rumenimi lici in črno glavo. (C) Par primerkov vrste*** *M. canevae* ***na z algami pokritem skalnatem dnu (označeno z belim krogom), na globini približno 20 cm. (D) Posnetek od blizu še enega primerka vrste*** *M. canevae* ***(foto: J. Rizgalla).***

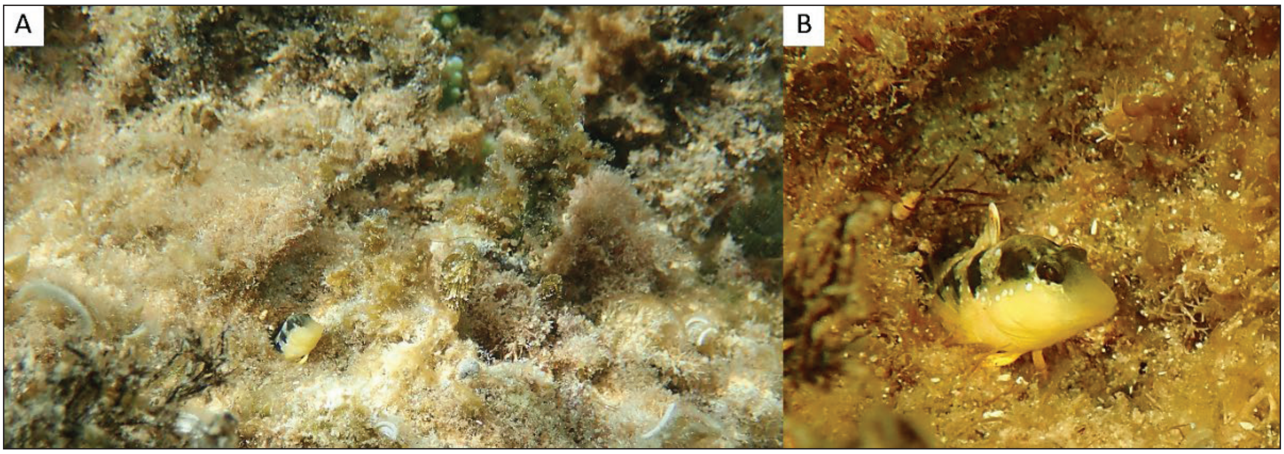

Fig. 4: (A, B) A male *Microlipophrys dalmatinus* **sheltering in a hole at shallow depth, in Regatta. This individual displays the typical reproductive head mask, characterised by yellow cheeks and a black dorsal area of the head (photo: J. Rizgalla).**
Sl. 4: (A, B) Samec vrste *Microlipophrys dalmatinus* **se skriva v plitvem rovu v zalivu Regatta. Ta osebek ima tipično razmnoževalno masko na glavi, za katero so značilni rumena lica in črn hrbtni del glave (foto: J. Rizgalla).**

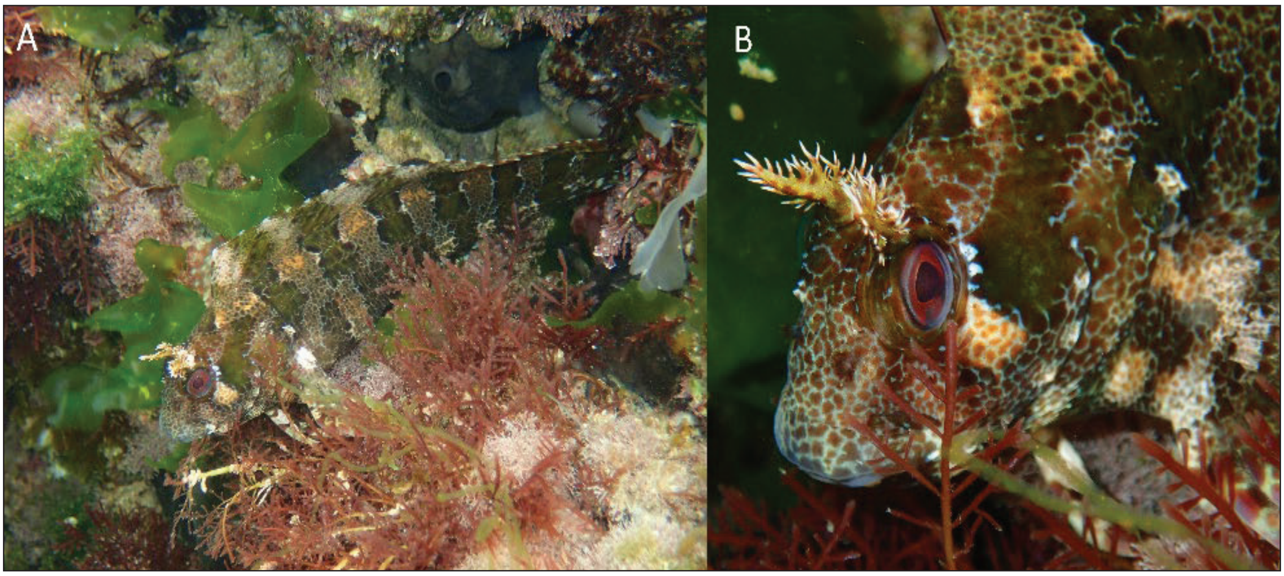

Fig. 5: (A, B) Parablennius gattorugine observed in Regatta natural bay (photo: J. Rizgalla).
Sl. 5: (A, B) Parablennius gattorugine, opažen v naravnem zalivu Regatta (foto: J. Rizgalla).

On 18 August 2012, three specimens of *A. sphynx* were collected from the sloping side of an island in the natural bay of Surman, at a depth of 30–40 cm (Fig. 2B). Subsequently, on 31 August 2018, a fourth specimen of *A. sphynx* was observed at a depth of 20–30 cm in the bay of Regatta, Tripoli (Fig. 2A).

On 11 June 2019, a single specimen of *C. galerita* was observed peeking its head out of a hole in a rock wall in the Regatta natural bay (Fig. 2C).

On 25 August 2018, a single specimen of *M. canevae* was observed within its shelter – a hole on the sloping side of an algae-covered rock in Regatta natural bay, at a depth of 20–30 cm. The individual exhibited yellow cheeks with black coloration on the head, snout and dorsal area (Fig. 3A–D), which indicated a male specimen in breeding season.

On 5 September 2018, at a depth of 20–30 cm, two *M. canevae* were observed close to one another; both individuals were similar in size, measuring approximately 5–6 cm TL.

On 30 June 2021, one specimen of *M. dalmatinus* was observed in a hole in a sub-horizontal flat rock plate, with only its head visible, in the natural bay of Regatta (Fig. 4A, B). The blenny exhibited a typical

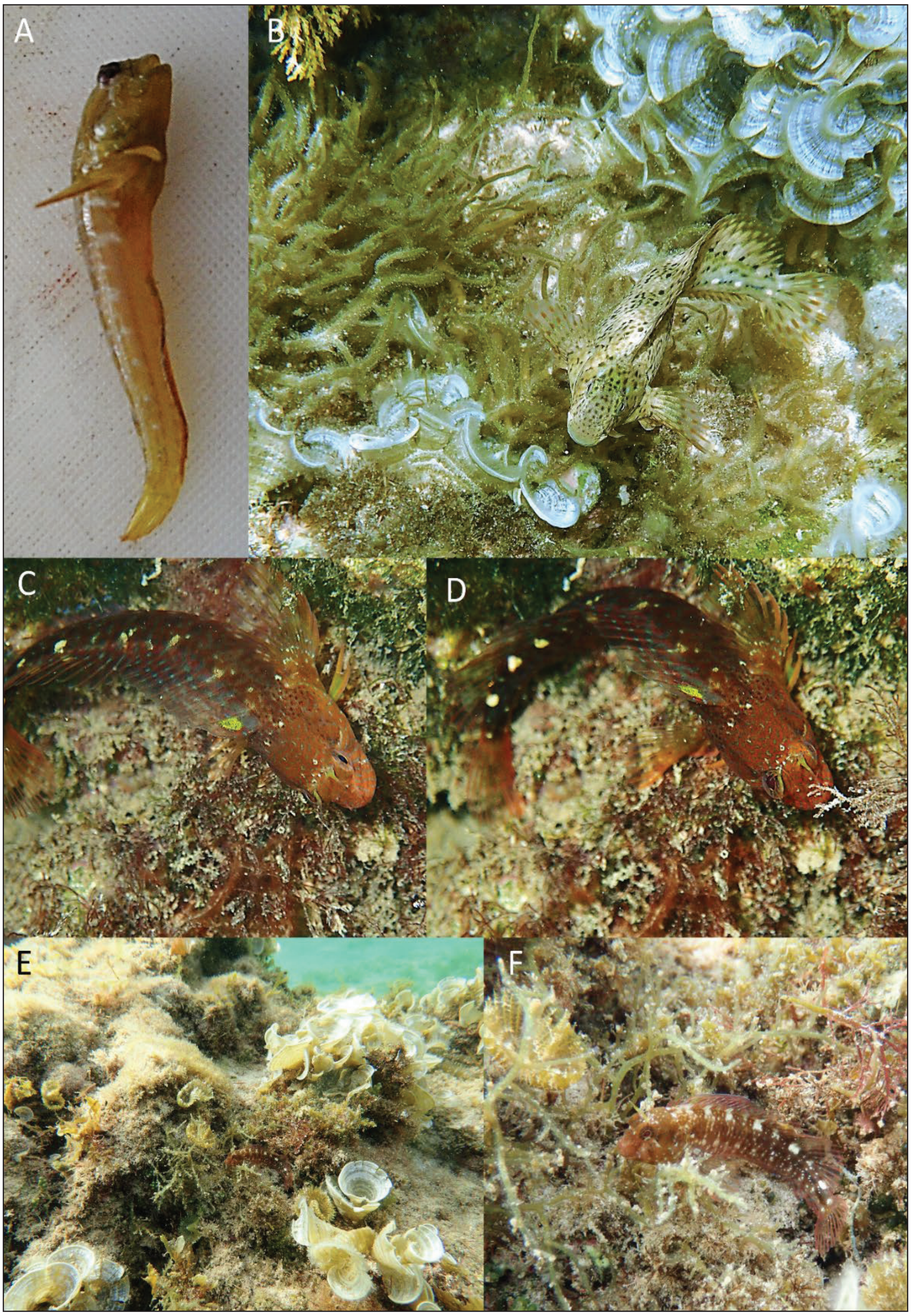

Fig. 6: (A) *A* Parablennius incognitus ***specimen collected in Surman. (B)*** *Parablennius sanguinolentus* ***near a crevice in an algae-covered rocky slope in Regatta natural bay; the algal community includes*** *Padina pavonica*. ***(C–F)*** *Parablennius zvonimiri* ***on an algae-covered rock in Regatta, retreating into its hole when approached; the algal cover includes*** *P. pavonica* ***(photo: J. Rizgalla).***

Sl. 6: (A) Primerek vrste *Parablennius incognitus*, ***ujet v Surmanu. (B)*** *Parablennius sanguinolentus* ***blizu razpoke v z algami poraščenem skalnem pobočju v naravnem zalivu Regatta; združba alg vključuje vrsto*** *Padina pavonica*. ***(C–F)*** *Parablennius zvonimiri* ***na z algami poraščeni skali v zalivu Regatta, ki se ob približevanju umakne v svoj rov; med algami je tudi*** *P. pavonica* ***(foto: J. Rizgalla).***

reproductive head mask, and the hole was surrounded by various algae.

On 6 June 2019, one specimen of *P. gattorugine* was found on the sea floor at a depth of 50–60 cm among algae and seagrasses, in the natural bay of Regatta (Fig. 5A).

On 23 June 2023, a specimen of *P. zvonimiri* was observed on a rocky slope covered in algae, in the natural bay of Regatta (Fig. 6C). When approached, the fish quickly retreated into its burrow. On 29 May 2021, another specimen of *P. zvonimiri* was observed on a rock covered with algae, at a depth of 30 cm (Fig. 6D–F).

On 18 August 2012, a single specimen of *S. cristata* was collected from the natural bay of Surman, at a depth of 30–40 cm (Fig. 7A).

On 19 August 2025, two male specimens of *T. melanurus* were observed in the natural bay of Surman, at a depth of 30–40 cm. They were identified by the typical coloration of territorial adult males: a predominantly bright red body with a black head marked by light, irregular stripes (Fig. 7B, C). The fish were seen from August to October 2025 at similar depths and always in proximity of holes and crevices.

On 19 May 2019, two specimens of *T. tripteronotum* were found at a depth of 30 cm in the natural bay of Regatta. They were identified as mature males by their markedly black heads and reddish background coloration of the body (Fig. 7B, D).

On 8 June 2019, two individuals of *T. tripteronotum* were found in the natural bay of Regatta, at a depth of 30–40 cm. They both exhibited a reddish background coloration, while the head appeared almost greyish (Fig. 7E).

All specimens where consistently observed throughout the survey period and across years.

In addition to the recently recorded species mentioned above, *Lipophrys trigloides* (Valenciennes, 1836) was frequently observed in the natural bay of Regatta, hiding among various algae and rocks or within little holes (Fig. 2D), with *Parablennius sanguinolentus* (Pallas, 1814) was also found at similar depths, in proximity to the other species reported here, in both Regatta and Surman (Fig. 6B).

DISCUSSION

Microlipophrys canevae, *M. dalmatinus*, *T. melanurus*, and *T. tripteronotum* reported herein displayed the typical chromatic dimorphism of mature males during the breeding season. In *M. canevae* and *M. dalmatinus*, this was characterised by a black coloration of the head, dorsal area, and snout, contrasted with bright yellow cheeks – a pattern also known as the "reproductive head mask" (Tiralongo *et al.*, 2015). In *T. melanurus* and *T. tripteronotum*, it included a dark blackish head and a reddish body (De Jonge & Videler, 1989). In the observed *M. dalmatinus* specimens, the body was not entirely black, though the black discoloration of the head was clearly visible (Zander, 1986a). Based on the present observation, the mating season for *M. canevae*, *M. dalmatinus*, and *T. tripteronotum* was estimated to range from May to August. This aligns with the previous reports for *M. canevae*, and *T. tripteronotum*, where mating season starts in March and lasts approximately five months (De Jonge & Videler, 1989).

Sheltered among algae-covered slopes in the natural bay of Regatta, the habitat and depth in which *P. zvonimiri* specimens were found align with similar observations made on this species (Tiralongo *et al.,* 2016). The sea level in the part of the bay where specimens of *P. zvonimiri* were found never dropped below 40 cm. The two-year interval between these records demonstrates a consistent presence of this species in the study area. Similarly, *M. dalmatinus* and *C. galerita* were also observed in shallow waters at depths of approximately 50 cm.

The limited species diversity of Blennioidea in Libya, compared to other Mediterranean regions, is likely attributable to a lack of extensive scientific research. This scarcity of studies is due to the country's ongoing political instability, extensive coastline, and limited funding for scientific research (Rizgalla, 2021). Moreover, blennies are not targeted by commercial fisheries, which contributes to their underrepresentation in checklists of Libyan bony fish (see Al-Hassan & El-Silini, 1999; Elbaraasi *et al.,* 2019). Prior to this study, six combtooth blennies (Blenniidae) had been known from Libyan waters (Al-Hassan & El-Silini, 1999; Elbaraasi *et al.,* 2019). The addition *of A. sphynx*, *C. galerita*, *M. canevae*, *M. dalmatinus*, *P. gattorugine*, *P. zvonimiri*, and *S. cristata* thus increases the number of documented Blenniidae species to thirteen. Furthermore, we report the first records of two triplefin blennies (Tripterygiidae), *T. melanurus* and *T. tripteronotum*, in Libyan waters.

Further surveys are needed to explore the richness and distribution of these species along Libya's 1,770 km coastline to improve our understanding of the biodiversity of Libyan waters.

CONCLUSIONS

Nine species of blennies (Blennioidea) were documented at shallow depths in two natural bays along the western coast of Libya. Individuals were often observed near or within holes and rock crevices. Several species, including *M. canevae*, *T. melanurus*, and *T. tripteronotum*, displayed a marked sexual dichromatism. The discovery of these species highlights the need for additional targeted surveys to fully assess blenny biodiversity along the Libyan coastline.

ACKNOWLEDGMENTS

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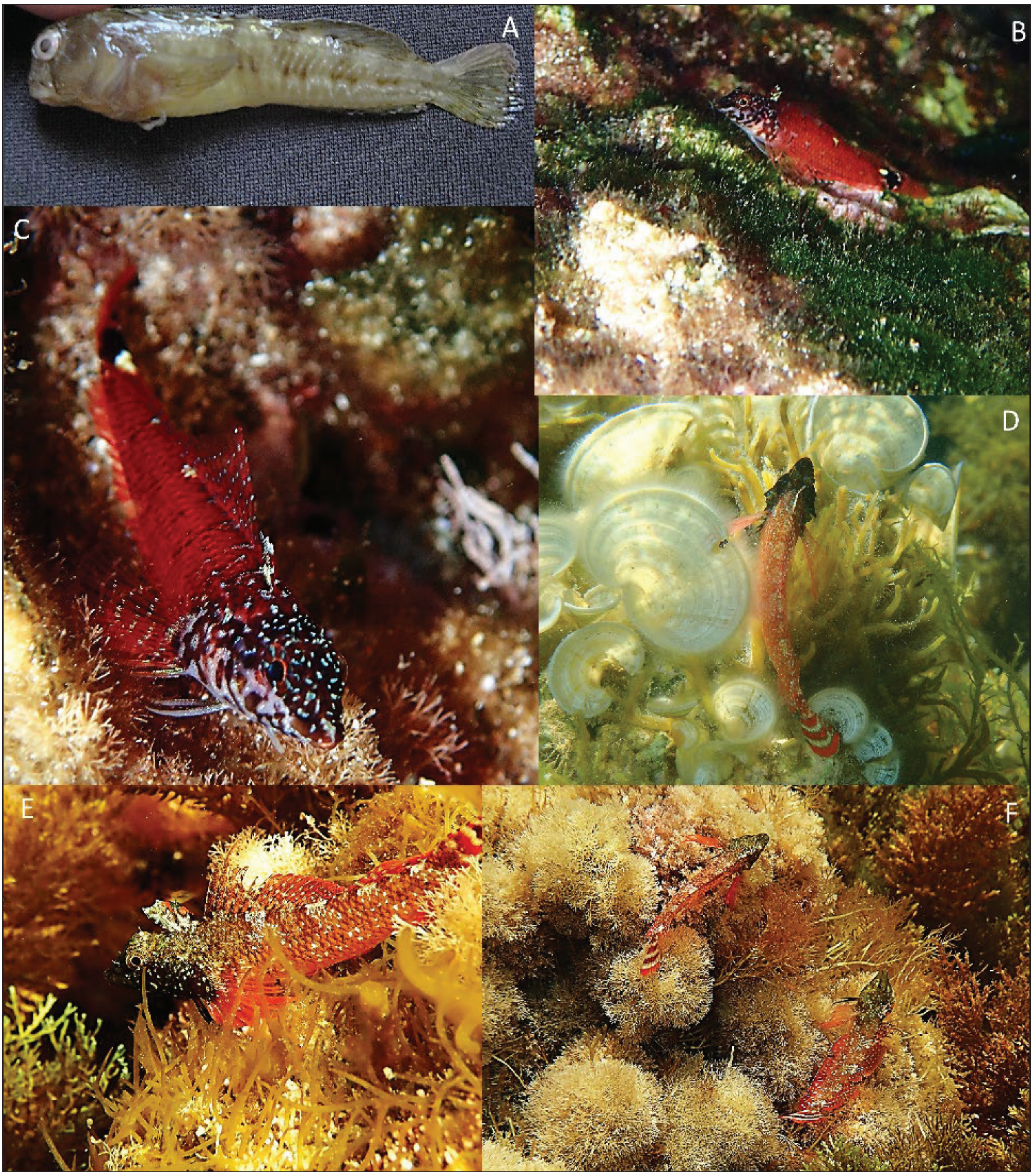

Fig. 7: (A) *Scartella cristata* **observed in Surman. (B, C) Male** *Tripterygion melanurus* **among algae in Regatta, displaying sexual dichromatism. (D, E) Male** *Tripterygion tripteronotum* **among algae in Regatta, featuring sexual dichromatism. (F) Two males** *T. tripteronotum* **exhibiting less pronounced sexual dichromatism (photo: J. Rizgalla).**

Sl. 7: (A) *Scartella cristata***, opažena v Surmanu. (B, C) Samec vrste** *Tripterygion melanurus* **med algami v zalivu Regatta kaže spolni dikromatizem. (D, E) Samec** *Tripterygion tripteronotum* **med algami v zalivu Regatta kaže spolni dikromatizem. (F) Dva samca** *T. tripteronotum* **kažeta manj izrazit spolni dikromatizem (foto: J. Rizgalla).**

PRVI ZAPISI O POJAVLJANJU BABIC (PODRED BLENNIOIDEA) OB LIBIJSKI OBALI

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POVZETEK

Na opazovalnih popisih na dveh območjih vzdolž zahodne obale Libije, ki so bili izvedeni leta 2012 in od leta 2018 do 2024, so prvič potrdili devet vrst babic (podred Blennioidea) v libijskih vodah. Sedem vrst, ki je pripadalo družini Blenniidae in dve, ki sta pripadali družini Tripterygiidae, so bile Aidablennius sphynx *(Valenciennes, 1836),* Coryphoblennius galerita *(Linnaeus, 1758),* Microlipophrys canevae *(Vinciguerra, 1880),* Microlipophrys dalmatinus *(Steindachner & Kolombatovic, 1883),* Parablennius gattorugine *(Linnaeus, 1758),* Parablennius zvonimiri *(Kolombatovic, 1892),* Scartella cristata *(Linnaeus, 1758),* Tripterygion melanurus *Guichenot, 1850 in* Tripterygion tripteronotum *(Risso, 1810).*

Ključne besede: kostnice, kriptobentoške vrste, domorodne, Severna Afrika, opazovalni popis

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CONFIRMED OCCURRENCE OF THE MEDITERRANEAN SPEARFISH *TETRAPTURUS BELONE* (OSTEICHTHYES: ISTIOPHORIDAE) FROM THE ALGERIAN COAST (SOUTHWESTERN MEDITERRANEAN SEA)

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ABSTRACT

The paper reports on the capture of two specimens of the Mediterranean spearfish Tetrapturus belone *Rafinesque, 1810. Each specimen measured about 1110 mm in total length and weighed 20 kg. They were captured off Annaba, on the eastern Algerian coast. The specimens were described in detail and constitute the first well-documented* T. belone *in this area, confirming the presence of the species and supporting its inclusion in the local ichthyofauna.*

Key words: *Tetrapturus belone*, records, Algerian coast, description, local status

PRESENZA CONFERMATA DELL’AGUGLIA IMPERIALE *TETRAPTURUS BELONE* (OSTEICHTHYES: ISTIOPHORIDAE) LUNGO LA COSTA ALGERINA (MEDITERRANEO SUD-OCCIDENTALE)

SINTESI

L’articolo riporta la cattura di due esemplari dell’aguglia imperiale Tetrapturus belone *Rafinesque, 1810. Ciascun esemplare misurava circa 1110 mm di lunghezza totale e pesava 20 kg. Sono stati catturati al largo di Annaba, lungo la costa orientale dell’Algeria. Gli esemplari sono stati descritti in dettaglio e costituiscono i primi esemplari ben documentati di* T. belone *provenienti da questa zona, confermando la presenza della specie e sostenendone l’inclusione nell’ittiofauna locale.*

Parole chiave: *Tetrapturus belone,* segnalazioni, costa algerina, descrizione, stato locale

INTRODUCTION

The Mediterranean spearfish *Tetrapturus belone* Rafinesque, 1810, is, as its name suggests, a species endemic to the Mediterranean Sea, where it occurs in relatively high abundance, particularly in the central basin (Nakamura, 1986; Quignard & Tomasini, 2000). *T. belone* is commonly caught in Italian waters (Tinti *et al.*, 2019; Di Natale, 2020) but is considered a rare species in the Adriatic Sea (Dulčić & Soldo, 2004). To the east, the species is reported from parts of the northeastern Aegean Sea (Akyol, 2020) and throughout Turkish marine waters but remains unrecorded in the Black Sea (Bilecenoğlu et *al.*, 2014). While the distribution range of *T. belone* seems to have expanded to include the Levant Basin—with the species documented in Israel (Golani, 2005), Lebanon (Bariche & Fricke, 2020), and Syria (Saad *et al.*, 2023)—this may either be attributable to the warming of Mediterranean waters (Francour *et al.*, 1994) or, possibly, to previous regional underreporting.

In the central Mediterranean Sea, historical records of *T. belone* are sporadic. A mounted skeleton of an individual collected in the Strait of Messina by Gabriel Bibron around year 1824, which is deposited in the National Museum of Natural History of Paris, constitutes the only representative specimen of the species in the ichthyological collection of that museum (Chagnoux, 2025). While Tortonese (1975) documented captures of large individuals in the Straits of Messina and Malara *et al.* (2020) reported a predation event involving a tagged spearfish in that area more recently, the species was absent from several other regional checklists. It was not reported from the Tunisian (Bradai *et al.*, 2004) nor Algerian coast (Dieuzeide *et al.*, 1954; Derbal & Kara, 2001; Refes *et al.*, 2010). While Bourjot (1870) did not report any occurrence of *T. belone* along the Algerian coast either, he suggested that the species could be captured in the western region, a pattern that should be taken into consideration by future researchers. However, the recent inclusion of *T. belone* in the ichthyofauna of Malta and the surrounding waters (Borg *et al.*, 2023) and a new report of the species' occurrence from the Algerian coast (Alkhalili *et al.*, 2025) suggest a changing distribution. The capture of individuals off eastern Algeria provided an opportunity to observe and describe *T. belone* and perhaps reassess its status in the region.

MATERIAL AND METHODS

The two specimens of *Tetrapturus belone* were observed at the main fish market of Algiers, which receives landings from across the Algerian coast, from the Moroccan to the Tunisian border. On August 25, 2008, two specimens were captured by drift nets off Annaba, in the eastern region, at 35°42′35′′ N and 1°22′17′′ W (Fig. 1). The examined specimens of *T. belone* were captured within the boundaries of the GFCM Geographical Subarea 4 (FAO, 2019). They were carefully examined and identified using field guides and ichthyological references (see below). The specimens were photographed and selected morphometric measurements, and meristic counts were recorded. Total body weight was kindly provided by the fishmongers, as the specimens were rapidly sliced and sold, primarily for local consumption.

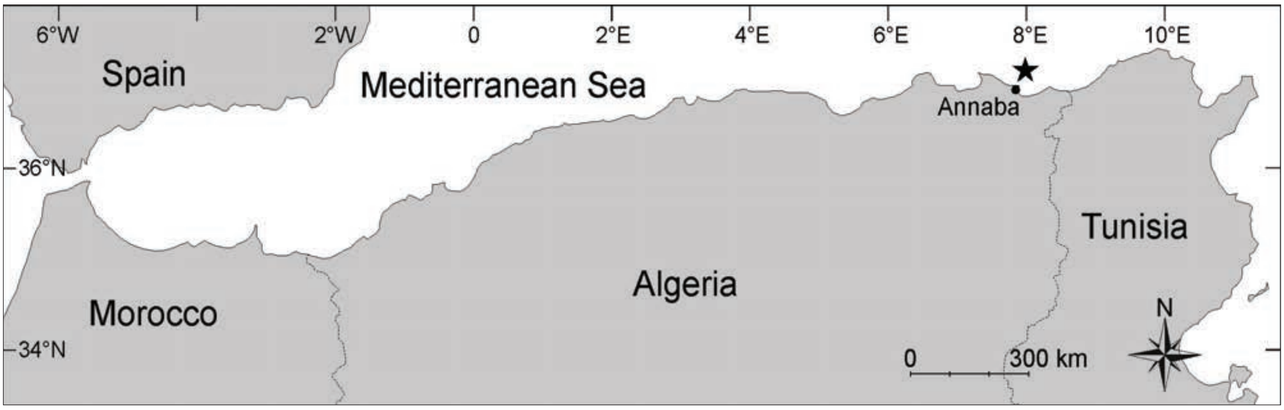

Fig. 1: Map of the Algerian coast showing the capture site (black star) of *Tetrapturus belone* **off Annaba.**
Sl. 1: Zemljevid alžirske obale z označeno lokaliteto ulova (črna zvezdica) primerkov vrste *Tetrapturus belone* **blizu Annabe.**

RESULTS AND DISCUSSION

According to information provided by the fishmongers, each specimen of *T. belone* measured 1100 mm TL and weighed 20 kg. Given that the species can reach a maximum size of 2.4 m (Nakamura, 1986), the specimens were likely juveniles. They were identified as *Tetrapturus belone* based on a combination of key morphological characters (Fig. 2): body elongate and fairly compressed, bill rather short and slender, round in cross-section; nape almost straight; both jaws and palatines (roof of mouth) with small, file-like teeth; two dorsal fins, base of first long, extending from above posterior margin of preopercle to just anterior to the origin of second, first fin exhibiting 43 rays, second 6 rays; two anal fins, first with 11 rays, second with 7, the latter fin very similar in size and shape to second dorsal fin; pectoral fins short with curved upper margins, nearly straight lower margins and pointed tips; pelvic fins long and slender, slightly less than twice the pectoral fin length and depressible into deep ventral grooves; caudal peduncle prominently compressed laterally and slightly depressed dorsoventrally, with strong double keels on each side and a shallow notch on both (Fig. 3); anus located far anterior to first anal fin origin; lateral line single and visible; body color dark bluish grey to nearly black dorsally and silvery white ventrally (Fig. 2).

The general morphology, meristic counts, and coloration of both specimens are consistent with previous descriptions of the species provided by Tortonese (1975), Nakamura (1985, 1986), Soldo & Dulčić (2004), Collette & Graves (2019), Saad *et al.* (2023), thereby confirming their identification as *T. belone*.

General knowledge on the species' biology and ecology remains limited (Collette & Heessen, 2015), but specific aspects have been documented, such as its piscivorous diet (Romeo *et al.*, 2009).

While the observations on the species' presence in Algerian waters made by Alkhalili *et al.* (2025), whether obtained directly or from the local fishermen, should not be doubted, it appears that no specimen was described or was available for confirmation. The specimens presented herein therefore constitute the first well-documented records of *T. belone* from the Algerian coast. The scarcity of records likely reflects a low population density in the area, as modern fishing methods would otherwise facilitate more frequent captures. These efficient fishing techniques could potentially result in a further decrease of local stocks, threatening the Mediterranean spearfish, a

Fig. 2: *Tetrapturus belone* ***captured off Annaba. The two specimens measured 1100 mm in total length. Scale bar = 200 mm (Photo by F. Hemida).***

Sl. 2: Vrsta *Tetrapturus belone* ***ujeta pri Annabi. Primerka sta merila približno 1100 mm celotne dolžine. Merilo = 200 mm (Foto: F. Hemida).***

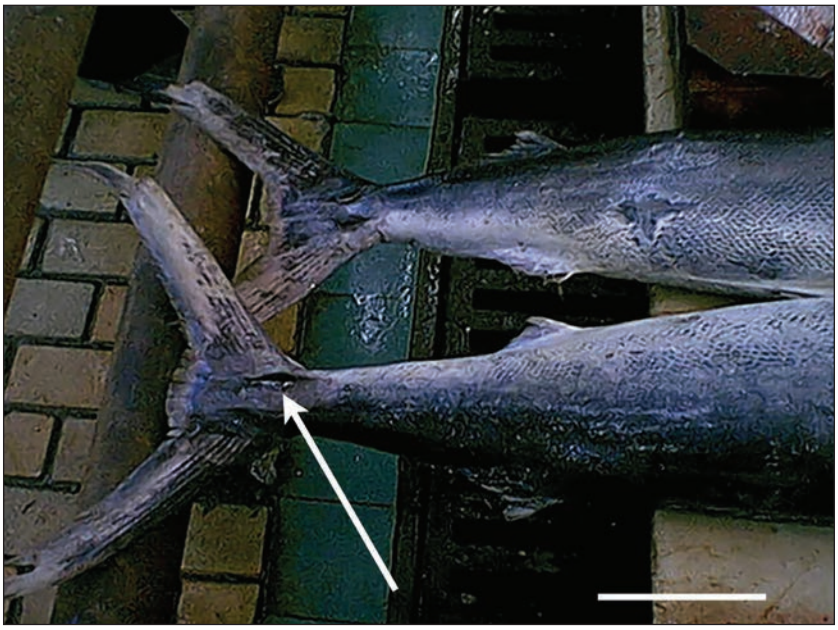

Fig. 3: Tail of a *Tetrapturus belone* ***specimen, with the white arrow indicating a pronounced double keel on each side and a shallow notch on both. Scale bar = 200 mm (Photo by F. Hemida).***

Sl. 3: Rep primerka vrste *Tetrapturus belone* ***z označeno belo puščico, ki kaže izrazit dvojni greben na obeh straneh in plitko zajedo. Merilo = 200 mm (Foto: F. Hemida).***

species highly valued by local consumers. Given this scarcity, the species may also be vagrant in the area, a hypothesis that remains plausible.

Although the IUCN classifies *T. belone* as a species of Least Concern (LC) globally, its population in Algerian waters warrants a management and preservation plan within the local fisheries framework that will engage the assistance of fishermen to help protect any potentially viable population of this species in Algerian waters.

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POTRJENO POJAVLJANJE SREDOZEMSKE JADROVNICE, *TETRAPTURUS BELONE* (OSTEICHTHYES: ISTIOPHORIDAE) IZ ALŽIRSKE OBALE (JUGOVZHODNO SREDOZEMSKO MORJE)

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POVZETEK

Prispevek poroča o ulovu dveh primerkov sredozemske jadrovnice, Tetrapturus belone *Rafinesque, 1810. Vsak primerek je meril okoli 1110 mm celotne dolžine in tehtal 20 kg. Ujeta sta bila v vodah pri Annabi na vzhodni alžirski obali. Primerka sta bila natančno opisana in predstavljata prvi potrjeni zapis o pojavljanju* T. belone *v tem predelu, ki dokazuje da je bila vrsta na obravnavanem območju prisotna in dopolnjuje seznam lokalne ihtiofavne.*

Ključne besede: *Tetrapturus belone*, zapisi o pojavljanju, alžirska obala, opis, lokalni status

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FIRST SUBSTANTIATED RECORD OF BLACKFISH *CENTROLOPHUS NIGER* (CENTROLOPHIDAE) FROM THE SYRIAN COAST (EASTERN MEDITERRANEAN SEA)

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ABSTRACT

A specimen of blackfish, Centrolophus niger *(Gmelin, 1789), was caught on 13 April 2025 by trawl gear at a depth of 30 m off Baniya, Syria (eastern Mediterranean Sea). The specimen, measuring 281 mm in total length and weighing 195 g, is the first confirmed record of* C. niger *recorded to date in the coastal waters of Syria. Its description, including morphometric measurements and meristic counts, is provided in this study. This finding fills a distributional gap in the Levant Basin and suggests a viable population may be present in the region.*

Key words: *Centrolophus niger*, distribution, population, extension range, Levant Basin

PRIMA SEGNALAZIONE CONFERMATA DELLA RICCIOLA DI FONDALE *CENTROLOPHUS NIGER* (CENTROLOPHIDAE) AL LARGO DELLA COSTA SIRIANA (MEDITERRANEO ORIENTALE)

SINTESI

Un esemplare della ricciola di fondale, Centrolophus niger *(Gmelin, 1789), è stato catturato il 13 aprile 2025 con una rete a strascico a una profondità di 30 m al largo di Baniya, in Siria (Mediterraneo orientale). L'esemplare, che misura 281 mm di lunghezza totale e pesa 195 g, è il primo esemplare confermato fino ad oggi di* C. niger *nelle acque costiere della Siria. Lo studio fornisce la sua descrizione, comprese le misurazioni morfometriche e i conteggi meristici. Questa scoperta colma una lacuna nella distribuzione nel bacino del Levante e suggerisce che nella regione potrebbe essere presente una popolazione vitale.*

Parole chiave: *Centrolophus niger*, distribuzione, popolazione, estensione dell'areale, bacino del Levante

INTRODUCTION

The blackfish, *Centrolophus niger* (Gmelin, 1788), is a teleost species widely distributed in temperate and warm-temperate marine waters and typically found at depths between 200 and 400 m (Haedrich, 1986). It displays a near-circumglobal distribution – from the Atlantic Ocean (including the western Baltic Sea and North Sea) to the Mediterranean Sea, as well as the Indian and Pacific oceans (Haedrich, 1990) – but is notably absent from the northern Pacific (Fricke *et al.*, 2025). This pelagic, mesopelagic, and epibenthic deep-water species inhabits the edge of the continental shelf. While larvae occur in the plankton, juveniles and young adults commonly associate with pelagic medusae or floating objects such as boxes or barrels, and feed on jellyfish, crustaceans, sparids, and small fishes (Carpenter & De Angelis, 2016). Little is known about the species' reproductive biology, a notable exception being the thorough study by Kennedy *et al.* (2024) on specimens collected in Icelandic waters.

C. niger is one of the four species in the family Centrolophidae recorded to date in the Mediterranean Sea, where it has been mostly reported in western basins (Haedrich, 1986). More recently, its range has expanded into the central Mediterranean (Capapé *et al.*, 2017; Hattour & Koched, 2017; Ben Amor *et al.*, 2018) and eastward into the Adriatic

Tab. 1: Morphometric measurements (in mm and as percentages of standard length, %SL), meristic counts, and total body weight (in grams) of the *Centrolophus niger* **specimen from Banias, Syria, compared with records from other marine areas. SL = standard length.**

Tab. 1: Morfometrične meritve (v mm in kot odstotki standardne dolžine, %SL), meristično štetje in skupna telesna teža (v gramih) osebka vrste *Centrolophus niger* **iz Baniasa v Siriji v primerjavi z zapisi iz drugih morskih območij. SL = standardna dolžina.**

References	**MSL 1/2025**		**Ayas** *et al.,* **2018**		**Hattour & Koched, 2017**		**Ben Amor** *et al.*, **2018**	
Sapture area	**Syria**		**Türkiye**		**Tunisia**		**Tunisia**	
Measurements	**mm**	**SL%**	**mm**	**SL%**	**mm**	**SL%**	**mm**	**SL%**
Total Length	281	122.1	51.9	119.5	801	114.5	271	130.9
Fork Length	262	113.9	47.6	109.6	750	107.2	226	109.2
Standard Length	230	100	43.4	100	699	100	207	100
Body Depth	60	26	10.8	24.8	147	21	93	44.9
Head Length	57	24.7	10.3	23.7	186	26.6	57	27.5
Eye Diameter	11	4.7	2.1	4.8	38	5.4	15	7.2
Snout Length	170	73.9	2.3	5.2	31	4.4	23	11.1
Pre-dorsal length	67	29.1	18.4	42	254	36.3	102	49.3
Pre-pectoral length	60	26	-	-	178	25.4	71	34.3
Pre-pelvic length	62	26.9	11.5	26.4	165	23.6	-	-
Pre-anal length	134	58.2	23.8	54.8	399	57	167	80.7
Meristic counts								
Dorsal fin	IV +34		D, V-37-41		VI+36		V+38	
Anal fin	III+23		III, 20-24.		III+23		III+21	
Pectoral fin rays	20		-		21		22	
Pelvic fin	6		-		I+5		5	
Total body weight Gram	195		-		-		195.9	

Sea (Dulčić & Lipej, 2002; Mersinaj, 2024) and the Aegean Sea (Akyol, 2008; Ceyhan & Akyol, 2011; Cengiz *et al.*, 2019, 2023). To date, *C. niger* has not been recorded in the Black Sea or Marmara Sea (Bilecenoğlu *et al.*, 2014). In the southern Mediterranean, *C. niger* has been recorded off the Egyptian coast (El Sayed *et al.*, 2017), with juvenile forms also reported from Algeria (Dieuzeide *et al.*, 1955). Its presence has also been documented in the Levant Basin, including Iskenderun Bay (Türkiye), Raouché in Beirut (Lebanon), and Isreal (Golani, 2005; Ergüden *et al.*, 2012; Farrag, 2016; Badreddine & Bitar, 2020). Previous studies indicated an absence of the species from the Syrian coast (Saad, 2005; Ali, 2018), but recently, during investigations regularly conducted in this area, a specimen of blackfish was collected. The present study provides a description of the specimen and discusses this unusual finding.

MATERIAL AND METHODS

The present study follows the methodology for reporting first records of fish species as outlined by Bello *et al.* (2014). On 13 April 2025, a single specimen of *Centrolophus niger* was captured off the coast of Banias, Syria (35°06′14.4″ N, 35°53′08.0″ E; Fig. 1) using a trammel net at a depth 30 m. The morphometric measurements recorded to the nearest millimeter and expressed as percentages of standard length (SL), along with meristic counts and total body weight (in grams) are presented in Table 1. The specimen was preserved in 10% buffered formalin and deposited in the Ichthyological Collection of the Marine Sciences Laboratory, Faculty of Agriculture, Tishreen University, under reference number MSL 1/2025.

RESULTS AND DISCUSSION

The blackfish specimen (MSL 1/2025) measured 281 mm in total length (TL), 230 mm in standard length (SL), and weighed 195 g (Fig. 2). It was identified as *C. niger* based on the following combination of morphological characters: body elongate, slightly compressed, with a long and compressed caudal peduncle, maximum body depth approximately 30% SL; head small, brownish to bluish-black, with pores visible in the naked skin; snout obtuse and rounded, slightly longer than the eye diameter; mouth small with small and sharp teeth distributed on jaws in a single row, no teeth on palate; operculum thin, fine denticulations on edge of preoperculum; 19 gill rakers on first gill arch; median fin spines weak, hardly distinguishable from rays; a single continuous dorsal fin usually behind the beginning of pectoral fins, dorsal fin spines plus soft rays 40, (IV+34), anal fin beginning a little behind mid-body, anal fin spines plus soft rays 24 (III+22), pectoral fin pointed rays 21, pelvic fins inserted under the base of pectoral fins, connected to the abdomen by a small membrane and folding into a shallow groove; caudal fin broad, moderately forked. Median and pelvic fins darker than the body, lateral line very slightly arched anteriorly then straight, extending onto the caudal peduncle.

The general morphology, morphometric measurements, meristic counts, and coloration of the present specimen are consistent with previous descriptions of *C. niger* (Haedrich, 1986; Fischer *et al.*, 1987; Carpenter & De Angelis, 2016; Ben Amor *et al.*, 2018; Cengiz *et al.*, 2019). This confirmation supports the inclusion of *C. niger* in the documented ichthyofauna of Syrian waters.

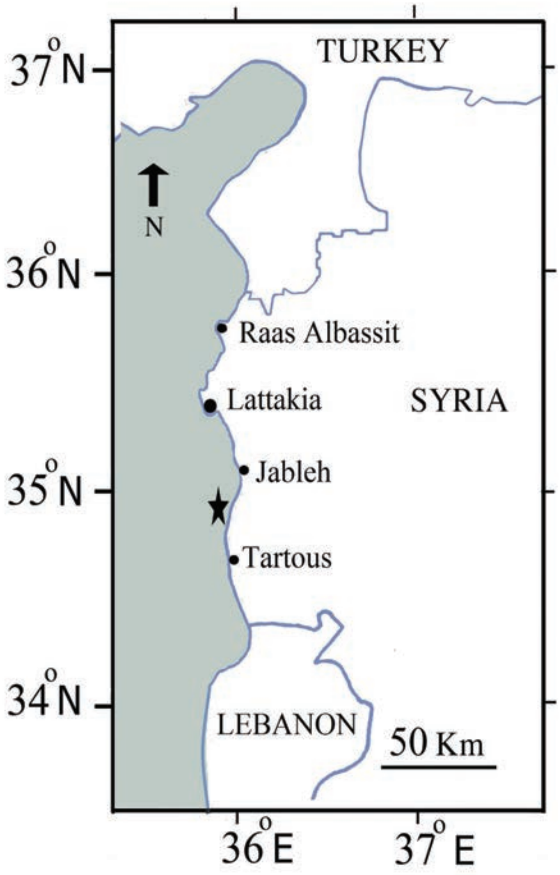

Fig. 1: Map of the Syrian coast indicating the capture site of Centrolophus niger (black star).
Sl. 1: Zemljevid sirske obale z oznako lokalitete, kjer je bil ulovljen primerek vrste Centrolophus niger (črna zvezda).

Fig. 2: Specimen of the** Centrolophus niger **caught off Banias. Scale bar = 50 mm.
Sl. 2: Primerek vrste** Centrolophus niger**, ulovljen pri Baniasu. Lestvica = 50 mm.

This finding represents the first substantiated record of *C. niger* in the area, filling a known distribution gap along the Levant Basin shore and suggesting a viable local population may be established. It also constitutes additional evidence of the species' range expansion within the Mediterranean Sea, likely influenced by climate change and the resulting alterations in the environmental characteristics of the region's marine waters (Ben Rais Lasram & Mouillot, 2009). The phenomenon was previously suggested by Ben Amor *et al.* (2018), who noted a migration of the fish from northern to southern Tunisian marine waters. Conversely, the reported capture of the species off Iceland remains questionable (see Kennedy *et al.*, 2024). The fact that such atypical records have been reported in this northern region locally suggests the possibility of local environmental changes – a hypothesis that cannot be entirely dismissed.

Throughout the Mediterranean Sea *C., niger* is considered rare even in the regions where it has been reported. This rarity is likely due to the fact that the species inhabits deep areas that are poorly exploited by commercial fisheries. Furthermore, misidentification with closely related species cannot be ruled out, and due to the species' low commercial value, small specimens are probably discarded at sea after capture. In this context, dedicated monitoring studies are needed to assess the continued presence of this rare fish and its potential breeding sites. This study will contribute to future studies on fisheries management and biodiversity conservation in Syria and broader Levant Basin.

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PRVI POTRJEN ZAPIS ČRNUHA, CENTROLOPHUS NIGER (CENTROLOPHIDAE), S SIRSKE OBALE (VZHODNO SREDOZEMSKO MORJE)

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ABSTRACT

Avtorji poročajo o primerku črnuha, Centrolophus niger *(Gmelin, 1789), ki je bil ulovljen 13. aprila 2025 z vlečno mrežo na globini 30 m pri Baniji v Siriji (vzhodno Sredozemsko morje). Primerek, ki je v dolžino meril 281 mm in tehtal 195 g, je prvi potrjeni zapis o pojavljanju vrste* C. niger *v obalnih vodah Sirije. Avtorji podajajo njen opis, vključno z morfometričnimi meritvami in merističnim štetjem. Ta ugotovitev zapolnjuje vrzel v razširjenosti te vrste v Levantskem bazenu in nakazuje, da je v regiji morda prisotna viabilna populacija.*

Ključne besede: *Centrolophus niger,* razširjenost, populacija, razširjanje areala, Levantski bazen

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MARINE FISHES (TELEOSTEI / OSTEICHTHYES) OF SYRIA (EASTERN MEDITERRANEAN): AN UPDATED CHECKLIST

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ABSTRACT

An updated checklist of marine fishes (Teleostei / Osteichthyes) recorded to date in Syrian marine waters is presented here. Out of the 62 fish orders present in the whole oceans, 37 (60%) are found in the marine water of Syria. These orders comprise 303 species, 208 genera and 103 families. Sparidae is the most divers family (32 species), followed by Blenniidae (14 species) and Carangidae (13 species). Out of the 303 teleost species recorded in this checklist, 48 species were recorded during the period 2018-2025, accounting for 7 species per year and 17.1% of overall fish species previously recorded. This is noticeably higher than what was recorded by the previous checklist (32 species, 1.45%) during the entire period 2005-2018. Climate change, other environmental factors and human activities are thought to be the most acceptable reasons behind that.

Key words: Levantine Basin, Teleost, Syrian coast, Lessepsian species, native species

PESCI MARINI (TELEOSTEI / OSTEICHTHYES) DELLA SIRIA (MEDITERRANEO ORIENTALE): ELENCO AGGIORNATO

SINTESI

L'articolo presenta la lista aggiornata dei pesci marini (Teleostei / Osteichthyes) trovati fino ad oggi nelle acque marine siriane. Dei 62 ordini di pesci presenti in tutti gli oceani, 37 (60%) si trovano nelle acque marine della Siria. Questi ordini comprendono 303 specie, 208 generi e 103 famiglie. La famiglia più diversificata è quella degli Sparidae (32 specie), seguita dai Blenniidae (14 specie) e dai Carangidae (13 specie). Delle 303 specie di teleostei comprese in questa checklist, 48 specie sono state segnalate nel periodo 2018-2025, pari a 7 specie all'anno e al 17,1% delle specie ittiche complessivamente ritrovate in precedenza. Questo dato è notevolmente superiore a quello riportato dalla precedente checklist (32 specie, 1,45%) durante l'intero periodo 2005-2018. Si ritiene che i cambiamenti climatici, altri fattori ambientali e le attività umane siano le ragioni più plausibili alla base di tale fenomeno.

Parole chiave: bacino del Levante, Teleostei, costa siriana, specie lessepsiane, specie autoctone

INTRODUCTION

The Mediterranean Sea is a common biodiversity hotspot, hosting about 11% of marine species (more than 17,000) in less than 1% of the world's oceans area. It is hosting 28% of endemic species, 7.5% of the world's marine fauna, and 18% of its marine flora (UNEP/MAP & Bleu Plan, 2020). The Mediterranean Sea is rich in islands, unique habitats, major breeding areas and refuges for migratory species (Cheminée *et al.*, 2021; Azzurro *et al.*, 2022; Nota *et al.*, 2025). The intense and increasing human activities around the Mediterranean basin, climate changes, and the resulted species migration and pollution have all led to the present destruction of biodiversity composition (Aurelle *et al.*, 2022).

Despite the extensive scientific studies, our understanding of the biodiversity in the Mediterranean Sea remains incomplete, as new species are constantly being revealed (Garcia-Bustos, 2025). FAO (2022) report indicated that the number of species introduced to the Mediterranean Sea from the Indian Ocean, Red Sea, and Atlantic Ocean reached about 1,000 species, of which about 400 are fish species. In this context, since Suez Canal opening in 1869 and its expansion in 2015 to include a second canal, the arrival of non-native marine organisms from the Red Sea to the Mediterranean Sea has increased. For these reasons, the eastern Mediterranean basin is considered as a biodiversity hotspot. To date, over 70% of the exotic fishes found in the Mediterranean are found in the eastern basin: they arrived from the Indo-Pacific region through the Red Sea and Suez Canal; i.e Lessepsian migrants (Zenetos *et al.*, 2010). To a lesser extent, Atlantic species arrived from the western Mediterranean basin, and few species originating from the Black Sea, had been found in the eastern Mediterranean (Harmelin & Dhondt, 1993).

Few studies have comprehensively surveyed the fish diversity of the Syrian coast: Gruvel (1931) identified 88 bony fish species (Osteichthyes) and 6 cartilaginous fish species. A Korean cooperation mission in 1976 revealed the presence of 93 fish species (Anon., 1976), and Sbaihi (1994a) documented 150 species of bony fish, to which 8 species were later added (Saad, 1996). Ibrahim *et al.* (1999) had documented 5 new records from the sandy area of Jableh Bay – south of Lattakia city, bringing the number of bony fishes recorded until the year 1999 to 163 species.

Two checklists of Syrian bony fish species have been later produced: they were prepared by Saad (2005), where 224 species were included, and by Ali (2018), where 256 species were included (along with 40 species of Elasmobranchii and 2 species of holocephali). In addition, Saad & Khrema (2023), although focused on non-endogenous marine fish, they had stated that a total of 292 Actinopterygii fish species (belonging to 98 families and 26 orders) present in Syrian marine water until the end of Aug. 2023; the majority of which are Teleost's species.

After 2018, (Ali, 2018), and even after 2023 (Saad & Khrema, 2023), many species were found in Syrian marine water and published in dispersed scientific journals. Therefore, the current work aimed to collect such newly published species and produce an updated comprehensive checklist of bony fishes available in Syrian marine water.

MATERIAL AND METHODS

The current checklist focuses on information collected on bony fish species (Teleostei: Osteichthyes) found in Syrian marine water, starting from Al- Badrusiya area in the north (35.913232° N and 35.886477° E) to Sheikh Jaber area near the Lebanese border in the south (34.62128° N and 35.97190° E), passing through the areas of Ras Al-Basit, Latakia, Jableh, Baniyas, Tartous, and al-Hamidiyah (Fig. 1). The present checklist is based on information previously published in various scientific journals. Species and other taxa classification was updated and revised according to the recent taxonomic developments. Species recording-primacy were checked and corrected, and those species missed from previous checklists were also added. For ease of

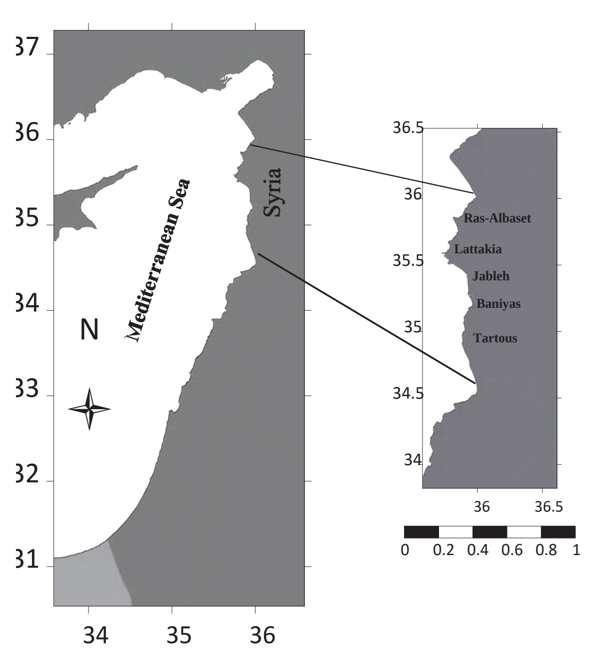

Fig. 1: Locations of Syrian marine waters where fishes were collected (reproduced from surfer16 software).
Sl. 1: Lokalitete v sirskih morskih vodah, kjer so bile potrjene ribe (reproducirano iz programske opreme surfer16).

inspection, various taxa were presented alphabetically. When applicable, the original author(s) of the basionyms, was put in parentheses to indicate that a species is reclassified or removed to a different genus or rank: the fishbase portal was used for this purpose.

Overall, the following details are presented for each species: classification according to family and order, scientific name and first documentation. Some taxa, namely Carangaria, Eupercaria and Ovalentaria contain a series of families that are not yet definitively placed under a specific order; thus, the suffix "/misc"(i.e. miscellaneous) was assigned to those families that do not perfectly fit into any established order.

RESULTS AND DISCUSSION

The documented records of teleost fish species found in Syrian marine waters; their taxonomic affiliation and their first documentation are presented in Appendix 1. Three hundreds and three fish species (Teleost/Osteichthyes) were so far documented from Syrian marine water (eastern Mediterranean). Compared to the previously recorded species (Ali, 2018 as an example), 48 species were added to the checklist, as during the period 2018-2025; accounting for 7 species per year and 17.1% of overall fish species previously recorded. Detailed local and global distributions of these newly recorded species are given in Ibrahim *et al.* (2025). This number of species (48 species) is noticeably higher than what was recorded by Ali (2018) (32 species; 1.45%) during the entire period 2005-2018. This dramatic increase may due to climate change acceleration and the subsequent changes in water quality (Urdiales-Flores *et al.*, 2023) and to species behavior (Valente *et al.*, 2023), impact of human activities and/or the noticeable monitoring intensification of fish diversity along the Syrian coast.

In fact, the true number of fish species is most likely to be higher from what was stated in this article, since that some species were not considered here as they are not properly documented. In addition, many other species are already present in the neighboring eastern Mediterranean countries of similar environmental conditions (Golani *et al.*, 2021; Turan *et al.*, 2024; Golani, 2025) and most likely to exist in Syrian marine water.

In addition to those added species, the current checklist introduces the following additions to the previously published lists: Assignment of fish species to their taxonomic categories according to the most recent developments in scientific taxonomy (Froese & Pauly, 2025), corrections related to the precedency in species documentation and corrections related to species misidentification (as many species were given false scientific names).

Out of the 62 fish orders present in the global oceans (Froese & Pauly, 2025), 37 (60%) are found in the marine water of Syria (Appendix 1). These orders comprise 103 families (20.2%), 208 genera (4.59%) and 303 species (0.99%). Spread of such species, especially those newly-arrived exotic species, over this wide range of families and genera indicates a pattern of successful adaptation and colonization to the new environment (Davidsen *et al.*, 2021). Understanding the spread patterns and detailed factors contributing to invasion is essential for developing effective and comprehensive management plan to control the spread of the exotic species (Marcolin *et al.*, 2025).

The content of Appendix 1 reveals that, Sparidae was the richest family in species composition (32 species), followed by Blenniidae (14 species), Carangidae (13 species) and each of Scombridae, Gobiidae and Labridae (12 species), besides Scorpaenidae and Epinephelidae (8 species each). Similarly, the families Triglidae, Mullidae, Mugilidae and Apogonidae have 7 species each, Tetraodontidae and Soleidae have 6 species each and Syngnathidae, Trachinidae and Sphyraenidae have 4 species each. Fourteen other families have 3 species each, 23 families have 2 species each and the remaining 49 families have 1 species each.

The checklist produced in this article can be a complimentary one to those checklists of other Mediterranean countries (eg. Golani *et al.,* 2012; Turan *et al.*, 2024; Golani, 2025), especially those of the neighboring ones (eg. Turan *et al.*, 2024; Bitar & Badreddine, 2021), to give a general updated view of the eastern Mediterranean fish fauna. This checklist would also be used for assessing the current state and monitoring potential future changes in fish diversity in the area.

CONCLUSIONS

A total of 303 teleost species (belong to 208 genera, 103 families and 37 orders) have been recorded in Syrian marine water by Oct. 2025, 48 of which have been categorized as exotic species documented for the first time during the period 2018-2025. These newly documented fish species account for 7 species per year and 17.1% of overall fish species previously recorded: this is noticeably higher than what was recorded by the previous checklist (32 species and 1.45%) during the entire period 2005-2018. Climate change (with the resulting changes in sea water characteristics) and human activities (such as Suez Canal opening and marine transportation) are thought to be the key reasons behind.

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Appendix 1: Species recorded from Syrian marine water, their taxonomic affiliation and their first documentation.
Priloga 1: Vrste, zabeležene v sirskem morju, njihova taksonomska pripadnost in prvi dokumentiran zapis o pojavljanju.

	Order	Family	Species	1st documentation
1.	Acanthuriformes	Caproidae	*Capros aper* (Linnaeus, 1758)	Sbaihi (1994a)
2.		Chaetodontidae	*Chaetodon larvatus* Cuvier, 1831	Ali *et al.* (2017b)
3.			*Heniochus intermedius* Steindachner, 1893	Ibrahim *et al.* (2022)
4.		Leiognathidae	*Equulites berbis* (Valenciennes, 1835)	Alshawy *et al.* (2016)
5.			*Equulites klunzingeri* (Steindachner, 1898)	Gruvel (1931)
6.			*Equulites popei* (Whitley, 1932)	Ibrahim *et al.* (2020)
7.		Lutjanidae	*Lutjanus fulviflamma* (Forsskål, 1775)	Saad *et al.* (2022b)
8.		Lobotidae	*Lobotes surinamensis* (Bloch, 1790)	Gruvel (1931)
9.		Pomacanthidae	*Chromis chromis* (Linnaeus, 1758)	Sbaihi (1994a)
10.			*Pomacanthus maculosus* (Forsskål, 1775)	Capapé *et al.* (2023)
11.			*Pomacanthus imperator* (Bloch, 1787)	Saad *et al.* (2018)
12.		Priacanthidae	*Priacanthus hamrur* (Fabricius, 1775)	Capapé *et al.* (2022)
13.			*Priacanthus sagittarius* Starnes, 1988	Alshawy *et al.* (2019e)
14.		Siganidae	*Siganus javus* (Linnaeus, 1766)	Ibrahim *et al.* (2010)
15.			*Siganus luridus* (Ruppel, 1829)	Gruvel (1931)
16.			*Siganus rivulatus* Forsskal & Niebuhr, 1775	Gruvel (1931)
17.	Acropomatiformes	Champsodontidae	*Champsodon nudivittis* (Ogilby, 1895)	Ali *et al.* (2017a)
18.		Epigonidae	*Epigonus denticulatus* Dieuzeide, 1950	Ibrahim *et al.* (2023)
19.			*Epigonus constanciae* (Giglioli, 1880)	Sbaihi (1994a)
20.		Pempheridae	*Pempheris rhomboidea* Kossmann & Rauber, 1877	Sbaihi & Saad (1992) (as *P. vanicolensis*)
21.	Anguilliformes	Anguillidae	*Anguilla anguilla* (Linaeus, 1758)	Gruvel (1931)
22.		Heterenchelyidae	*Panturichthys fowleri* (Ben-Tuvia, 1953)	Sbaihi (1994)
23.		Congridae	*Ariosoma balearicum* (Delaroche, 1809)	Ibrahim *et al.* (2002a)
24.			*Conger conger* (Linnaeus, 1758)	Gruvel (1931)
25.		Muraenidae	*Enchelycore anatina* (Lowe, 1838)	Saad (2005)
26.			*Gymnothorax unicolor* (Delaroche, 1809)	Ibrahim & Galiya (2004)
27.			*Muraena helena* Linnaeus, 1758	Ibrahim *et al.* (2002b)
28.		Nettastomatidae	*Nettastoma melanurum* Rafinesque, 1810	Ali (2018)
29.		Ophichthidae	*Dalophis imberbis* (Delaroche, 1809)	Capapé *et al.* (2021)
30.			*Echelus myrus* (Linnaeus, 1758)	Ibrahim *et al.* (2002b)
31.			*Ophisurus serpens* (Linnaeus, 1758)	Alshawy *et al.* (2019f)
32.	Argentiniformes	Argentinidae	*Argentina sphyraena* Linnaeus, 1758	Sbaihi (1994)
33.			*Glossanodon leioglossus* (Valenciennes, 1848)	Sbaihi (1994)
34.	Atheriniformes	Atherinidae	*Atherina boyeri* Risso,A 1810	Saad *et al.* (2002)
35.			*Atherinomorus forskalii* (Ruppell, 1838)	Saad (2005)
36.			*Atherinomorus lacunosus* (Forster, 1801)	Othman *et al.* (2022)
37.	Aulopiformes	Aulopidae	*Aulopus filamentosus* (Bloch, 1792)	Saad (2005)
38.		Chlorophthalmidae	*Chlorophthalmus agassizi* Bonaparte, 1840	Ghanem *et al.* (2012)
39.		Paralepididae	*Sudis hyalina* Rafinesque, 1810	Ali *et al.* (2014)
40.		Synodontidae	*Saurida lessepsianus* Russell, Golani & Tikochinski, 2015	Anon. (1976) (as *S. undosquamis*)
41.			*Synodus saurus* (Linneaus, 1758)	Ibrahim *et al.* (2002b)
42.	Beloniformes	Belonidae	*Ablennes hians* (Valenciennes, 1846)	Alshawy *et al.* (2019d)
43.			*Belone belone* (Linnaeus, 1760)	Gruvel (1931)
44.			*Tylosurus choram* (Ruppell, 1837)	Saad *et al.* (2002)
45.		Exocoetidae	*Cheilopogon heterurus* (Rafinesque, 1810)	Saad (2005)
46.			*Hirundichthys rondeletii* (Valenciennes, 1847)	Sbaihi (1994)
47.			*Parexocoetus mento* (Valenciennes, 1847)	Ibrahim *et al.* (2002a), Saad *et al.* (2002)
48.		Hemiramphidae	*Hemiramphus far* (Forsskal, 1775)	Gruvel (1931)
49.			*Hyporhamphus affinis* (Gunther, 1866)	Saad (2005)

50.	Blenniiformes	Blenniidae	*Aidablennius sphynx* (Valenciennes, 1836)	Hallom *et al.* (2014)
51.			*Blennius ocellaris* Linnaeus, 1758	Galiya (2000)
52.			*Coryphoblennius galerita* (Linaeus, 1758)	Saad (2005)
53.			*Lipophrys trigloides* (Valenciennes, 1836)	Saad (2005)
54.			*Microlipophrys canevae* (Vinciguerra, 1880)	Saad (2005)
55.			*Microlipophrys nigriceps* (Vincigerra, 1883)	Saad (2005)
56.			*Parablennius incognitus* (Bath, 1968)	Saad (2005)
57.			*Parablennius rouxi* (Cocco, 1833)	Saad (2005)
58.			*Parablennius tentacularis* (Brunnich, 1768)	Saad (2005)
59.			*Parablennius gattorugine* Linnaeus, 1758)	Galiya (2000)
60.			*Parablennius sanguinolentus* (Pallas, 1814)	Galyia (2000)
61.			*Petroscirtes ancylodon* Ruppell, 1835	Saad (2005)
62.			*Salaria pavo* (Risso, 1810)	Gruvel (1931)
63.			*Scartella cristata* (Linnaeus, 1758)	Sbaihi (1994)
64.		Clinidae	*Clinitrachus argentatus* (Risso, 1810)	Sbaihi (1994)
65.		Tripterygiidae	*Tripterygion delaisi* Cadenat & Blanche, 1970	Sbaihi (1994)
66.			*Tripterygion melanurum* Guichenot, 1850	Sbaihi (1994)
67.			*Tripterygion tripteronotum* (Risso, 1810)	Saad (2005)
68.	Callionymiformes	Callionymidae	*Callionymus filamentosus* Valenciennes, 1837	Ibrahim *et al.* (2002b) (as *L. aurata*)
69.			*Synchiropus phaeton* (Günther, 1861)	Othman & Galiya (2024)
70.	Carangaria/misc	Sphyraenidae	*Sphyraena chrysotaenia* Klunzinger, 1884	Ibrahim *et al.* (2002a) Saad (2002)
71.			*Sphyraena flavicauda* Ruppell, 1838	Saad *et al.* (2002)
72.			*Sphyraena sphyraena* (Linnaeus, 1758)	Gruvel (1931)
73.			*Sphyraena viridensis* Cuvier, 1829	Gruvel (1931)
74.	Carangiformes	Carangidae	*Alectis alexandrina* (Geoffroy Saint-Hilaire, 1817)	Gruvel (1931)
75.			*Alepes djedaba* (Forsskal, 1775)	Bauchot (1987)
76.			*Caranx crysos* (Mitchill, 1815)	Sbaihi (1994)
77.			*Caranx rhonchus* Geoffroy saint-Hilaire, 1817	Anon. (1976)
78.			*Lichia amia* (Linnaeus, 1758)	Gruvel (1931)
79.			*Naucrates ductor* (Linnaeus, 1758)	Ali-Basha *et al.* (2021)
80.			*Pseudocaranx dentex* (Bloch & Schneider, 1801)	Saad (2005)
81.			*Seriola dumerili* (Risso, 1810)	Gruvel (1931)
82.			*Seriola fasciata* (Bloch, 1793)	Jawad *et al.* (2015)
83.			*Trachinotus ovatus* (Linnaeus, 1758)	Gruvel (1931)
84.			*Trachurus mediterraneus* (Steindachner, 1868)	Sbaihi (1994)
85.			*Trachurus picturatus* (Bowdich, 1825)	Saad (2005)
86.			*Trachurus trachurus* (Linnaeus, 1758)	Anon. (1976)
87.		Coryphaenidae	*Coryphaena hippurus* Linnaeus, 1758	Gruvel (1931)
88.		Echeneidae	*Echeneis naucrates* Linnaeus, 1758	Gruvel (1931)
89.		Istiophoridae	*Tetrapturus belone* Rafinesque, 1810	Saad *et al.* (2024)
90.		Xiphiidae	*Xiphias gladius* Linnaeus, 1758	Gruvel (1931)
91.	Centrarchiformes	Terapontidae	*Pelates quadrilineatus* (Bloch, 1790)	Saad (2005)
92.			*Terapon puta* (Cuvier, 1829)	Saad (2005)
93.	Clupeiformes	Alosidae	*Alosa fallax* (Lacepede, 1803)	Gruvel (1931)
94.			*Sardina pilchardus* (Walbaum, 1792)	Saad (2005)
95.		Clupeidae	*Sprattus sprattus* (Linnaeus, 1758)	Gruvel (1931)
96.		Dorosomatidae	*Herklotsichthys punctatus* (Ruppell, 1837)	Saad (2005)
97.			*Sardinella aurita* Valenciennes, 1847	Gruvel (1931)
98.			*Sardinella gibbosa* (Bleeker, 1849)	Fortič *et al.* (2023)
99.			*Sardinella maderensis* (Lowe, 1838)	Gruvel (1931)
100.		Dussumieriidae	*Dussumieria elopsoides* Bleeker, 1849	Saad (2002)
101.			*Etrumeus golanii* DiBattista, Randall & Bowen, 2012	Sbaihi (1994b), Ibrahim *et al.* (2002b) (as *E. teres*)
102.		Engraulidae	*Engraulis encrasicholus* (Linnaeus, 1758)	Gruvel (1931)
103.	Cyprinodontiformes	Aphaniidae	*Aphanius dispar dispar* (Ruppell, 1829)	Saad (2005)
104.	Dactylopteriformes	Dactylopteridae	*Dactylopterus volitans* (Linaeus, 1758)	Gruvel (1931)

105.	Eupercaria/misc	Callanthiidae	*Callanthias ruber* (Rafinesque, 1810)	Saad (2005)
106.		Cepolidae	*Cepola macrophthalma* (Linnaeus, 1758)	Sbaihi (1994)
107.		Haemulidae	*Pomadasys incisus* (Bowdich, 1825)	Sbaihi (1994)
108.			*Pomadasys stridens* (Forsskal, 1775)	Saad (2005)
109.		Labridae	*Acantholabrus palloni* (Risso, 1810)	Saad (2005)
110.			*Coris julis* (Linnaeus, 1758)	Gruvel (1931)
111.			*Labrus merula* Linnaeus, 1758	Whitehead *et al.* (1984)
112.			*Labrus mixtus* Linnaeus, 1758	Foulquié & Dupuy de la Grandrive (2003)
113.			*Pteragogus trispilus* Randall, 2013	Ibrahim *et al.* (2019b),
114.			*Symphodus bailloni* (Valenciennes, 1839)	Khrema *et al.* (2022)
115.			*Symphodus cinereus* (Bonnaterre, 1788)	Saad (2005)
116.			*Symphodus mediterraneus* (Linnaeus, 1758)	Saad (2005)
117.			*Symphodus roissali* (Risso, 1810)	Saad (2005)
118.			*Symphodus tinca* (Linnaeus, 1758)	Sbaihi (1994)
119.			*Thalassoma pavo* (Linnaeus, 1758)	Sbaihi (1994)
120.			*Xyrichtys novacula* (Linnaeus, 1758)	Anon. (1976)
121.		Moronidae	*Dicentrarchus labrax* (Linnaeus, 1758)	Sbaihi (1994)
122.			*Dicentrarchus punctatus* (Bloch, 1792)	Sbaihi (1994)
123.		Nemipteridae	*Nemipterus randalli* Russell, 1986	Ali *et al.* (2013)
124.		Scaridae	*Scarus ghobban* Forsskal, 1775	Ali (2018)
125.			*Sparisoma cretense* (Linnaeus 1758)	Gruvel (1931)
126.		Sciaenidae	*Argyrosomus regius* (Asso, 1801)	Saad (2005)
127.			*Sciaena umbra* Linnaeus, 1758	Gruvel (1931)
128.			*Umbrina cirrosa* (Linnaeus, 1758)	Gruvel (1931),
129.		Sillaginidae	*Sillago suezensis* Golani, Fricke & Tikochinski, 2013	Ibrahim et *al.* (2002b) (as *S. sihama*)
130.		Sparidae	*Acanthopagrus bifasciatus (*Forsskål, 1775)	Saad et *al.* (2022c)
131.			*Boops boops* (Linneaus, 1758)	Gruvel (1931)
132.			*Centracanthus cirrus* Rafinesque, 1810	Sbaihi (1994)
133.			*Crenidens crenidens* (Forsskal, 1775)	Saad et *al.* (2002)
134.			*Dentex dentex* (Linneaus, 1758)	Anon. (1976)
135.			*Dentex gibbosus* (Rafinesque, 1810)	Anon. (1976)
136.			*Dentex macrophthalmus* (Bloch, 1791)	Gruvel (1931)
137.			*Dentex maroccanus* Valenciennes, 1830	Gruvel (1931)
138.			*Diplodus annularis* (Linneaus, 1758)	Gruvel (1931)
139.			*Diplodus cervinus* (Lowe, 1838)	Gruvel (1931)
140.			*Diplodus puntazzo* (Walbaum, 1792)	Sbaihi (1994)
141.			*Diplodus sargus* (Linnaeus, 1758)	Gruvel (1931)
142.			*Diplodus vulgaris* (Geoffroy Saint-Hilaire, 1817)	Gruvel (1931)
143.			*Evynnis ehrenbergii* (Valenciennes, 1830)	Saad (2005)
144.			*Lithognathus mormyrus* (Linnaeus, 1758)	Gruvel (1931)
145.			*Oblada melanura* (Linnaeus, 1758)	Gruvel (1931)
146.			*Pagellus acarne* (Risso, 1827)	Gruvel (1931)
147.			*Pagellus bellottii* Steindachner, 1882	Sbaihi (1994)
148.			*Pagellus bogaraveo* (Brünnich, *1768)*	Saad et *al.* (2020a)
149.			*Pagellus erythrinus* (Linnaeus, 1758)	Gruvel (1931)
150.			*Pagrus auriga* Valenciennes, 1843	Gruvel (1931)
151.			*Pagrus caeruleostictus* (Valenciennes, 1830)	Sbaihi (1994)
152.			*Pagrus major* (Temminck & Schlegel, 1843)	Saad et *al.* (2022d)
153.			*Pagrus pagrus* (Linnaeus, 1758)	Gruvel (1931)
154.			*Rhabdosargus haffara* (Forsskal, 1775)	Saad (2005)
155.			*Rhabdosargus sarba* (Forsskål, 1775)	Hamwi & Ali-Basha (2021)
156.			*Sarpa salpa* (Linnaeus, 1758)	Gruvel (1931)
157.			*Sparus aurata* Linnaeus, 1758	Gruvel (1931)
158.			*Spicara flexuosum Rafinesque, 1810*	Sbaihi (1994)
159.			*Spicara maena* (Linnaeus, 1758)	Sbaihi (1994)

160.			*Spicara smaris* (Linnaeus, 1758)	Gruvel (1931)
161.			*Spondyliosoma cantharus* (Linnaeus, 1758)	Gruvel (1931)
162.	Gadiformes	Bregmacerotidae	*Bregmaceros nectabanus* Whitley, 194	Othman & Galiya (2019)
163.		Gadidae	*Gadiculus argenteus* Guichenot, 1850	Sbaihi (1994)
164.			*Micromesistius poutassou* (Risso, 1827)	Sbaihi (1994)
165.		Macrouridae	*Coelorinchus caelorhincus* (Risso, 1810)	Ali *et al.* (2016a), Hussein (2023)
166.			*Hymenocephalus italicus* Giglioli, 1884	Ali (2018)
167.			*Nezumia aequalis* (Günther, 1878)	Othman & Galiya (2023)
168.		Merlucciidae	*Merluccius merluccius* (Linnaeus, 1758)	Anon. (1976)
169.		Phycidae	*Phycis blennoides* (Brünnich, 1768)	Anon. (1976)
170.			*Phycis phycis* (Linnaeus, 1766)	Anon. (1976)
171.	Gobiesociformes	Gobiesocidae	*Lepadogaster candolii* Risso 1810	Sbaihi (1994)
172.			*Lepadogaster lepadogaster* (Bonnaterre, 1788)	Sbaihi (1994)
173.	Gobiiformes	Gobiidae	*Aphia minuta* (Risso, 1810)	Saad (2005)
174.			*Chromogobius quadrivittatus* (Steindachner, 1863)	Saad (2005)
175.			*Deltentosteus quadrimaculatus* (Valenciennes, 1837)	Saad (2005)
176.			*Gobius cobitis* Pallas, 1811	Gruvel (1931)
177.			*Gobius cruentatus* Gmelin, 1789	Saad (2005)
178.			*Gobius geniporus* Valenciennes, 1837	Saad *et al.* (2022a)
179.			*Gobius niger* Linnaeus, 1758	Gruvel (1931)
180.			*Gobius paganellus* Linnaeus, 1758	Saad (2005)
181.			*Lesueurigobius friesii* (Malm, 1874)	Saad (2005) ,
182.			*Oxyurichthys petersii* (Valenciennes, 1837)	Saad (2005)
183.			*Silhouettea aegyptia* (Chabanaud, 1933)	Sbaihi (1994)
184.			*Zebrus zebrus* (Risso, 1827)	Saad (2005)
185.	Holocentriformes	Holocentridae	*Sargocentron rubrum* (Forsskal, 1775)	Anon. (1976)
186.	Kurtiformes	Apogonidae	*Apogon atradorsatus* Heller & Snodgrass, 1903	Alshawy *et al.* (2019c)
187.			*Apogon imberbis* (Linnaeus, 1758)	Sbaihi (1994)
188.			*Apogonichthyoides pharaonis* (Bellotti, 1874)	Sbaihi & Saad (1992)
189.			*Cheilodipterus novemstriatus* (Ruppell, 1838)	Ali *et al.* (2018)
190.			*Ostorhinchus fasciatus* (White, 1790)	Alshawy *et al.* (2019a)
191.			*Jaydia smithi* Kotthaus, 1970	Alshawy *et al.* (2017)
192.			*Jaydia queketti* (Gilchrist, 1903)	Alshawy *et al.* (2019g)
193.	Lampriformes	Lophotidae	*Lophotus lacepede* Giorna, 1809	Ali *et al.* (2021)
194.	Lophiiformes	Lophiidae	*Lophius budegassa* Spinola, 1807	Saad (2005)
195.			*Lophius piscatorius* Linneaus, 1758	Saad (2005)
196.	Mugiliformes	Mugilidae	*Chelon auratus* (Risso, 1810)	Gruvel (1931), Ibrahim *et al.* (2002b) (as *Liza aurata*)
197.			*Chelon labrosus* (Risso, 1827)	Gruvel (1931)
198.			*Chelon ramada* (Risso, 1827)	Saad (2005) (as *Liza ramada*)
199.			*Chelon saliens* (Risso, 1810)	Gruvel (1931)
200.			*Liza carinata* (Valenciennes, 1836)	Saad (1995)
201.			*Mugil cephalus* Linnaeus, 1758	Ibrahim *et al.* (2002b)
202.			*Oedalechilus labeo* (Cuvier, 1829)	Gruvel (1931)
203.	Mulliformes	Mullidae	*Mullus barbatus barbatus* Linnaeus, 1758	Gruvel (1931)
204.			*Mullus surmuletus* Linnaeus, 1758	Anon. (1976)
205.			*Parupeneus forsskali* (Fourmanoir & Gueze, 1976)	Ali *et al.* (2016b)
206.			*Parupeneus rubescens* (Lacepède, 1801)	Sabour & Masri (2022)
207.			*Parupeneus spilurus* (Bleeker, 1854)	Baddour *et al.* (2025)
208.			*Upeneus moluccensis* (Bleeker, 1855)	Gruvel (1931)
209.			*Upeneus pori* Ben-Tuvia & Golani, 1989	Sbaihi & Saad (1992)
210.	Myctophiformes	Myctophidae	*Myctophum punctatum* Rafinesque, 1810	Saad (2005)

211.	Ophidiiformes	Ophidiidae	*Ophidion barbatum* Linaeus, 1758	Sbaihi (1994)
212.			*Ophidion rochei* Müller, 1845	Othman *et al.* (2020)
213.	Ovalentaria/misc	Pomacentridae	*Abudefduf vaigiensis* (Quoy & Gaimard, 1825)	Saad *et al.* (2020a)
214.	Perciformes	Anthiadidae	*Anthias anthias* (Linnaeus, 1758)	Sbaihi (1994)
215.		Epinephelidae	*Epinephelus aeneus* (Geoffroy Saint- Hilaire,1817)	Gruvel (1931)
216.			*Epinephelus areolatus* (Forsskål, 1775*)*	Hassan & Alchikh Ahmad (2023)
217.			*Epinephelus costae* (Steindachner, 1878)	Gruvel (1931)
218.			*Epinephelus fasciatus* (Forsskal, 1775)	Ibrahim *et al.* (2002b) (as *E. alexandrinus*)
219.			*Epinephelus malabaricus* (Bloch & Schneider, 1801)	Ibrahim & Galiya (2004)
220.			*Epinephelus marginatus* (Lowe, *1834)*	Gruvel (1931)
221.			*Hyporthodus haifensis* (Ben-Tuvia, 1953)	Gruvel (1931) (As *Epinephelus haifensis*)
222.			*Mycteroperca rubra* (Bloch, 1793)	Saad (2005)
223.		Peristediidae	*Peristedion cataphractum* (Linnaeus, 1758*)*	Ibrahim *et al.* (2002b)
224.		Platycephalidae	*Platycephalus indicus* (Linnaeus, 1758)	Saad *et al.* (2002)
225.		Serranidae	*Serranus cabrilla* (Linnaeus, 1758)	Sbaihi (1994)
226.			*Serranus hepatus* (Linnaeus, 1758)	Anon. (1976)
227.			*Serranus scriba* (Linnaeus, 1758)	Gruvel (1931)
228.		Sebastidae	*Helicolenus dactylopterus* (Delaroche, 1809)	Ibrahim *et al.* (2002b)
229.		Scorpaenidae	*Parascorpaena mcadamsi* (Fowler, 1938)	Ali *et al.* (2025)
230.			*Pterois miles* (Bennet, 1828)	Ali *et al.* (2016a)
231.			*Pterois volitans* (Linnaeus, 1758)	Fandi *et al.* (2022)
232.			*Scorpaena elongata* Cadenat, 1943	Saad (2005)
233.			*Scorpaena maderensis* Valenciennes, 1833	Saad (2005)
234.			*Scorpaena notata* Rafinesque, 1810	Saad (2005)
235.			*Scorpaena porcus* Linnaeus, 1758	Sbaihi (1994)
236.			*Scorpaena scrofa* Linnaeus, 1758	Gruvel (1931)
237.		Synanceiidae	*Synanceia verrucosa* Bloch & Schneider, 1801	Ibrahim *et al.* (2019a)
238.		Trachinidae	*Echiichthys vipera* (Cuvier, 1829)	Saad (2005)
239.			*Trachinus araneus* Cuvier, 1829	Gruvel (1931)
240.			*Trachinus draco* Linnaeus, 1758	Gruvel (1931)
241.			*Trachinus radiatus* Cuvier, 1829	Saad (2005)
242.		Triglidae	*Chelidonichthys cuculus* (Linnaeus, 1758)	Anon. (1976)
243.			*Chelidonichthys lastoviza* (Bonnaterre, 1788)	Sbaihi (1994), Ibrahim *et al.* (2002b) (as *Trigloporus lastoviza*)
244.			*Chelidonichthys lucerna* (Linnaeus, 1758)	Anon. (1976), Ibrahim *et al.* (2002b) (as *Trigla lucerna*)
245.			*Eutrigla gurnardus* (Linnaeus, 1758)	Saad (2005)
246.			*Lepidotrigla cavillone* (Lacepede, 1801)	Anon. (1976) Saad (2005)
247.			*Lepidotrigla dieuzeidei* Blanc & Hureau, 1973	Gruvel (1931)
248.			*Trigla lyra* Linnaeus, 1758	Gruvel (1931)
249.		Uranoscopidae	*Uranoscopus scaber* Linnaeus, 1758	Gruvel (1931)

250.	Pleuronectiformes	Bothidae	*Arnoglossus kessleri* Schmidt, 1915	Saad (2005)
251.			*Arnoglossus laterna* (Walbaum, 1792)	Ibrahim *et al.* (2002b)
252.			*Bothus podas* (Delaroche, 1809)	Sbaihi (1994)
253.		Citharidae	*Citharus linguatula* (Linnaeus, 1758)	Sbaihi (1994)
254.		Cynoglossidae	*Cynoglossus sinusarabici* (Chabanaud, 1931)	Saad & Sbaihi (1992)
255.			*Symphurus nigrescens* Rafinesque, 1810	Saad (2005)
256.		Scophthalmidae	*Lepidorhombus boscii* (Risso, 1810)	Saad (2005)
257.			*Lepidorhombus whiffiagonis* (Walbaum, 1792)	Saad (2005)
258.			*Scophthalmus rhombus* (Linnaeus, 1758)	Sbaihi (1994)
259.		Soleidae	*Dicologlossa cuneata* (Moreau, 1881)	Ali *et al.* (2015b)
260.			*Microchirus ocellatus* (Linnaeus, 1758)	Ibrahim & Galiya (2004)
261.			*Pegusa impar* (Bennett, 1831)	Ali *et al.* (2018)
262.			*Pegusa lascaris* (Risso, 1810)	Sbaihi (1994)
263.			*Solea solea* (Linnaeus, 1758)	Anon. (1976) (as *S. vulgaris*)
264.			*Synapturichthys kleinii* (Risso, 1827)	Ali *et al.* (2015a)
265.	Scombriformes	Bramidae	*Brama brama* (Bonnaterre, 1788)	Sbaihi (1994)
266.		Centrolophidae	Schedophilus ovalis (Cuvier, 1833)	Badran & Ghanem (2024)
267.		Pomatomidae	*Pomatomus saltatrix* (Linnaeus, 1766)	Gruvel (1931)
268.		Scombridae	*Auxis rochei rochei* (Risso, 1810)	Sbaihi (1994)
269.			*Auxis thazard* (Lacepède, 1800)	Othman *et al.* (2023a)
270.			*Euthynnus alletteratus* (Rafinesque, 1810)	Sbaihi (1994)
271.			*Katsuwonus pelamis* (Linnaeus, 1758)	Sbaihi (1994)
272.			*Orcynopsis unicolor* (Geoffroy Saint- Hilaire, 1817)	Saad (2005)
273.			*Sarda sarda* (Bloch, 1793)	Gruvel (1931)
274.			*Scomber colias* Gmelin, 1789	Sbaihi (1994) (as *S. japonicus*)
275.			*Scomber indicus*	Othman *et al.* (2023b)
276.			*Scomber scombrus* Linnaeus, 1758	Gruvel (1931)
277.			*Scomberomorus commerson* (Lacepede, 1800)	Anon. (1976)
278.			*Thunnus obesus* (Lowe, 1839)	Hamwi (2024b)
279.			*Thunnus thynnus* (Linnaeus, 1758)	Hamwi (2024a)
280.		Trichiuridae	*Lepidopus caudatus* (Euphrasen, 1788)	Saad (2005)
281.			*Trichiurus lepturus* Linneaus, 1758	Gruvel (1931)
282.	Siluriformes	Plotosidae	*Plotosus lineatus* (Thunberg, 1787)	Ali *et al.* (2015c)
283.	Stomiiformes	Stomiidae	*Stomias boa boa* (Risso, 1810)	Ali (2018)
284.	Syngnathiformes	Centriscidae	*Macroramphosus scolopax* (Linnaeus, 1758)	Gruvel (1931)
285.		Fistulariidae	*Fistularia commersonii* Ruppell, 1838	Galiya (2003)
286.			*Fistularia petimba* Lacepède, 1803	Hussein *et al.* (2019)
287.		Syngnathidae	*Hippocampus guttulatus* Cuvier, 1829	Saad (2005)
288.			*Hippocampus hippocampus* (Linnaeus, 1758)	Sbaihi (1994)
289.			*Syngnathus abaster* Risso, 1827	Saad (2005)
290.			*Syngnathus acus* Linnaeus, 1758	Saad (2005)

291.	Tetraodontiformes	Balistidae	*Balistes capriscus* Gmelin, 1789	Gruvel (1931), Ibrahim *et al.* (2002b) (as *B. carolinensis*)
292.			*Odonus niger*	Ali *et al.* (2024)
293.		Molidae	*Mola mola* (Linneaus, 1758)	Saad (2005)
294.		Monacanthidae	*Stephanolepis diaspros* Fraser-Brunner, 1940	Gruvel (1931)
295.		Ostraciidae	*Tetrosomus gibbosus* (Linnaeus, 1758)	Saad (2002)
296.		Tetraodontidae	*Lagocephalus sceleratus* (Gmelin, 1789)	Khalaf *et al.* (2014)
297.			*Lagocephalus guentheri* (Miranda Ribeiro, 1915*)*	Anon. (1976), Ibrahim *et al.* (2002b) (*as L. spadiceus*)
298.			*Lagocephalus lagocephalus* (Linnaeus, 1758)	Alshawy *et al.* (2019b)
299.			*Lagocephalus suezensis* Clark & Gohar, 1953)	Saad *et al.* (2002)
300.			*Sphoeroides pachygaster* (Muller & Troschel, 1848)	Rahman *et al.* (2014)
301.			*Torquigener flavimaculosus* Hardy & Randall, 1983	Sabour *et al.* (2014)
302.	Trachichthyiformes	Trachichthyidae	*Hoplostethus mediterraneus* Cuvier, 1829	Gruvel (1931)
303.	Zeiformes	Zeidae	*Zeus faber* Linnaeus, 1758	Gruvel (1931)

MORSKE RIBE (TELEOSTEI / OSTEICHTHYES) SIRIJE (VZHODNO SREDOZEMSKO MORJE): POSODOBLJENI SEZNAM VRST

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POVZETEK

Avtorji predstavljajo posodobljen seznam morskih rib (Teleostei / Osteichthyes), ki so bile do danes zabeležene v sirskih morskih vodah. Od 62 ribjih redov, ki so prisotni v oceanih, jih 37 (60%) najdemo v morskih vodah Sirije. Ti redovi obsegajo 303 vrste, 208 rodov in 103 družine. Najštevilčnejša družina je Sparidae (32 vrst), sledijo ji Blenniidae (14 vrst) in Carangidae (13 vrst). Od 303 vrst kostnic iz seznama morskih rib, je bilo v obdobju 2018–2025 zabeleženih 48 vrst, kar predstavlja 7 vrst na leto in 17,1% vseh prej zabeleženih vrst rib. To je znatno več kot je bilo zabeleženo na prejšnjem seznamu vrst (32 vrst, 1,45%) v celotnem obdobju 2005–2018. Podnebne spremembe, drugi okoljski dejavniki in človekove dejavnosti veljajo za najbolj sprejemljive razloge za to.

Ključne besede: levantski bazen, kostnice, sirska obala, lesepske selivke, domorodne vrste

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CASSIOPEA ANDROMEDA AT THE SOUTHERNMOST TIP OF ITALY: A RECENT ARRIVAL OR AN OVERLOOKED RESIDENT?

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ABSTRACT

The Lessepsian jellyfish Cassiopea andromeda *is an invasive scyphozoan originating from the Red Sea and Indo-Pacific region. It was first recorded in the Mediterranean at the beginning of the 20th century and has since expanded its distribution across the basin. The main goal of this contribution is to document the first and well-documented record of this jellyfish from the Portopalo di Capo Passero area, which represents the southernmost tip of Italy (Sicily, Ionian Sea). The observation, made in October 2025, provides new evidence of the species' expansion along the Sicilian Ionian coast. This finding raises questions about whether the species is a recent colonizer or an overlooked resident and highlights the biogeographical and ecological importance of this area as a potential hotspot for the monitoring of Lessepsian and thermophilic species.*

Key words: jellyfish, alien species, Ionian Sea, Mediterranean, Lessepsian migrant

CASSIOPEA ANDROMEDA ALL'ESTREMO SUD D'ITALIA: UNA PRESENZA RECENTE O UNA SPECIE PASSATA INOSSERVATA?

SINTESI

La medusa lessepsiana Cassiopea andromeda *è uno scifozoo invasivo originario del Mar Rosso e della regione indo-pacifica. È stata segnalata per la prima volta nel Mar Mediterraneo all'inizio del XX secolo e da allora ha progressivamente ampliato la propria distribuzione in tutto il bacino. Il principale obiettivo di questo studio è quello di documentare la prima segnalazione di questa specie nell'area di Portopalo di Capo Passero, estrema punta meridionale d'Italia (Sicilia, Mar Ionio). L'osservazione, effettuata nell'ottobre 2025, fornisce nuove evidenze dell'espansione della specie lungo la costa ionica siciliana. Questo ritrovamento solleva interrogativi sul fatto che si tratti di un colonizzatore recente o di una specie precedentemente passata inosservata, e sottolinea l'importanza biogeografica ed ecologica di quest'area come potenziale hotspot per specie lessepsiane e termofile.*

Parole chiave: medusa, specie aliena, Mar Ionio, Mediterraneo, migrante lessepsiano

INTRODUCTION

The Mediterranean Sea, recognized as a global biodiversity hotspot, hosts an exceptionally rich marine fauna with over 17,000 recorded species, representing about 7% of the world's marine animals (Coll *et al*., 2010). Nowadays, this biodiversity is undergoing profound transformations driven by human activities, including both direct and indirect species introductions (Stock *et al*., 2018). The spread of non-indigenous species (NIS), also referred to as alien, exotic, or non-native species, has become a key indicator of ecological imbalance and biodiversity decline (Katsanevakis *et al*., 2014; Tiralongo *et al*., 2020). Invasive alien species are now regarded as one of the primary threats to the integrity and functioning of Mediterranean marine ecosystems (Pyšek *et al*., 2020).

In this context, the "upside-down jellyfish" *Cassiopea andromeda* (Forskål, 1775) is a Lessepsian immigrant native to the Red Sea and is widely distributed throughout the Indo-Pacific region. It entered the Mediterranean Sea through the Suez Canal and was first recorded off Cyprus in 1903 (Maas, 1903). Since then, it has progressively expanded westwards, with confirmed records of the species in the Levantine, Aegean and central Mediterranean sub-basins (Galil *et al*., 1990; Çevik *et al*., 2006; Schembri *et al*., 2010; Ramos-Pérez *et al*., 2025). More recently, dense aggregations of the jellyfish have been reported in semi-enclosed eutrophic environments such as harbours and salt pans (Cillari *et al*., 2018; Deidun *et al*., 2018; Kleitou *et al*., 2025), while the westernmost Mediterranean record of the species was documented in Spain (Marambio *et al*., 2025).

This species is highly tolerant to environmental fluctuations and is capable of asexual reproduction, which facilitates its rapid establishment in shallow coastal habitats (Thé *et al*., 2021). Species of the genus *Cassiopea* exhibit a mixotrophic lifestyle sustained by an intracellular symbiosis with dinoflagellates (Symbiodiniaceae), which are acquired from the environment during the polyp stage (Djeghri *et al*., 2019). This mutualistic association significantly shapes the holobiont's biochemical composition, nutritional strategy and overall metabolism (De Domenico *et al*., 2025). Moreover, given the high

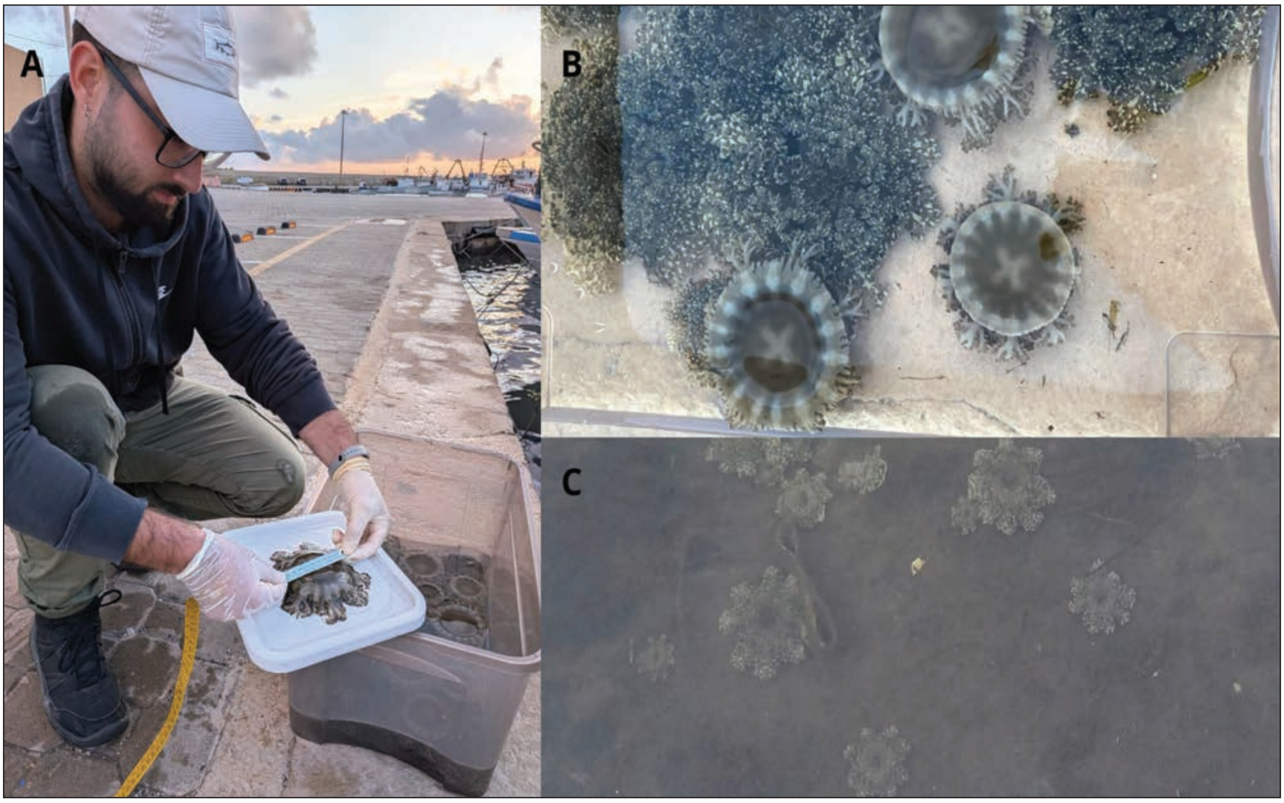

Fig. 1: Specimens of *C. andromeda* **observed inside the harbour of Portopalo di Capo Passero (Sicily, Ionian Sea) on 19 October 2025: (A) during measurements; (B) sampled specimens; (C) in situ individuals.**
Sl. 1: Primerki vrste *C. andromeda***, opaženi v pristanišču Portopalo di Capo Passero (Sicilija, Jonsko morje) 19. oktobra 2025: (A) med meritvami; (B) vzorčeni osebki; (C) osebki in situ.**

interspecific morphological similarity within the genus, accurate species identification of *Cassiopea* often requires an integrative taxonomic approach, combining both morphological and molecular data (Rowe *et al.*, 2025). From a morphological perspective, diagnostic characters such as the number and distribution of large appendages as well as the oral arm branching pattern have proven useful for species discrimination within the genus (Rowe *et al.*, 2025).

Following its introduction from the Red Sea into the Mediterranean through the Suez Canal, *Cassiopea andromeda* has expanded its range under the influence of climate change and consequently to increasing seawater temperatures, now occurring more widely than previously recorded (Holland *et al.*, 2004; Fumarola *et al.*, 2025).

Here, we report the first well-documented occurrence of *C. andromeda* from the Portopalo di Capo Passero area (southeastern Sicily, Ionian Sea), providing new evidence of its range expansion within southern Italian waters. Preliminary data on individual size composition and on local abundance were also collected.

MATERIAL AND METHODS

On 19 October 2025, several individuals of *Cassiopea andromeda* were observed and photographed by the authors in a sheltered coastal area inside the fishery harbour of Portopalo di Capo Passero (36.67095N, 15.12699E), at a depth of about 0.7 m (Fig. 1). The site is characterized by sandy and muddy substrates with reduced water circulation and elevated summer temperatures. Moreover, during the survey, two alien invasive crab species, namely *Callinectes sapidus* and *Portunus segnis*, were detected. A total of 42 specimens of *C. andromeda* were measured, recording the diameter of the exumbrella using a flexible measuring tape with a 0.1 cm precision. A total of 10 specimens were sampled in order to verify the identity of the species, whose general morphology clearly matched that of *C. andromeda* (Ames *et al.*, 2020; Karunarathne *et al.*, 2020). After the analyses, the specimens were preserved in alcohol for potential future laboratory examinations (*e.g.*, molecular analysis) and deposited in the zoological collection of the Ente Fauna Marina Mediterranea in Avola (Sicily) under the code #EFMM191025. A species' density (individuals/m^2) estimation was carried out. Finally, an updated map (Fig. 2) based on our new record and on the data provided by Katsanevakis *et al.* (2020) was produced, using the recent model proposed for the Mediterranean by Ramos-Pérez *et al.* (2025).

RESULTS AND DISCUSSION

Specimens displayed the typical morphology and general colour pattern of *Cassiopea andromeda*: a flattened umbrella, whitish to brownish coloration, conspicuous white blotches on the exumbrella, and eight branched oral arms. However, although the general morphology and colour pattern clearly point to the genus *Cassiopea*, the absence of molecular analyses prevents a definitive species-level identification (Gamero-Mora *et al.*, 2022; Rowe *et al.*, 2025). The bell diameters of specimens measured from 5 to 13 cm, with a mean value of 8.6±2.4 cm. This size variability reflects a population composed of both juvenile and adult individuals, suggesting that the species is able to complete different stages of its life cycle within the studied area. Individuals rested inverted on the seabed, with the oral arms oriented upward to maximize exposure of the zooxanthellae to light, an adaptive strategy associated with their mixotrophic feeding (Symbiodiniaceae symbiosis) (Arossa *et al.*, 2021). The estimated mean jellyfish density in the area, where the species was unevenly distributed, was that of approximately 8 jellyfish individuals/m^2.

This record represents the southernmost occurrence of *C. andromeda* in Italian waters, about 120 km south of the population recently documented in the Augusta salt pans (Kleitou *et al.*, 2025). The environmental conditions of Portopalo's harbour, with warm, eutrophic, and semi-enclosed calm waters, closely resemble habitats where the species has established stable aggregations elsewhere in the Mediterranean (Schembri *et al.*, 2010; Cillari *et al.*, 2018; Deidun *et al.*, 2018; Kleitou *et al.*, 2025).

Given its broad thermal (6–39 °C, with an optimum at 35.7 °C; Fumarola *et al.*, 2025) and moderate salinity tolerance (30–50, Aljbour & Agustí, 2025), *Cassiopea andromeda* is likely to be more widespread in the Mediterranean Sea than previously assumed. This suggests that transitional environments such as saltpans, coastal lagoons, and harbours are particularly suitable for the presence of the species and should therefore be carefully inspected and monitored. The finding also raises the possibility that the species had previously remained undetected due to a limited monitoring in shallow coastal lagoons and harbour areas. The location of Portopalo, near the confluence of Ionian and Strait of Sicily currents, could act as an ecological "gateway" for a further dispersal of the species towards western and northern Mediterranean waters. Several hypotheses can be considered regarding the putative introduction pathway responsible for bringing the species to Portopalo. The proximity of Portopalo to main

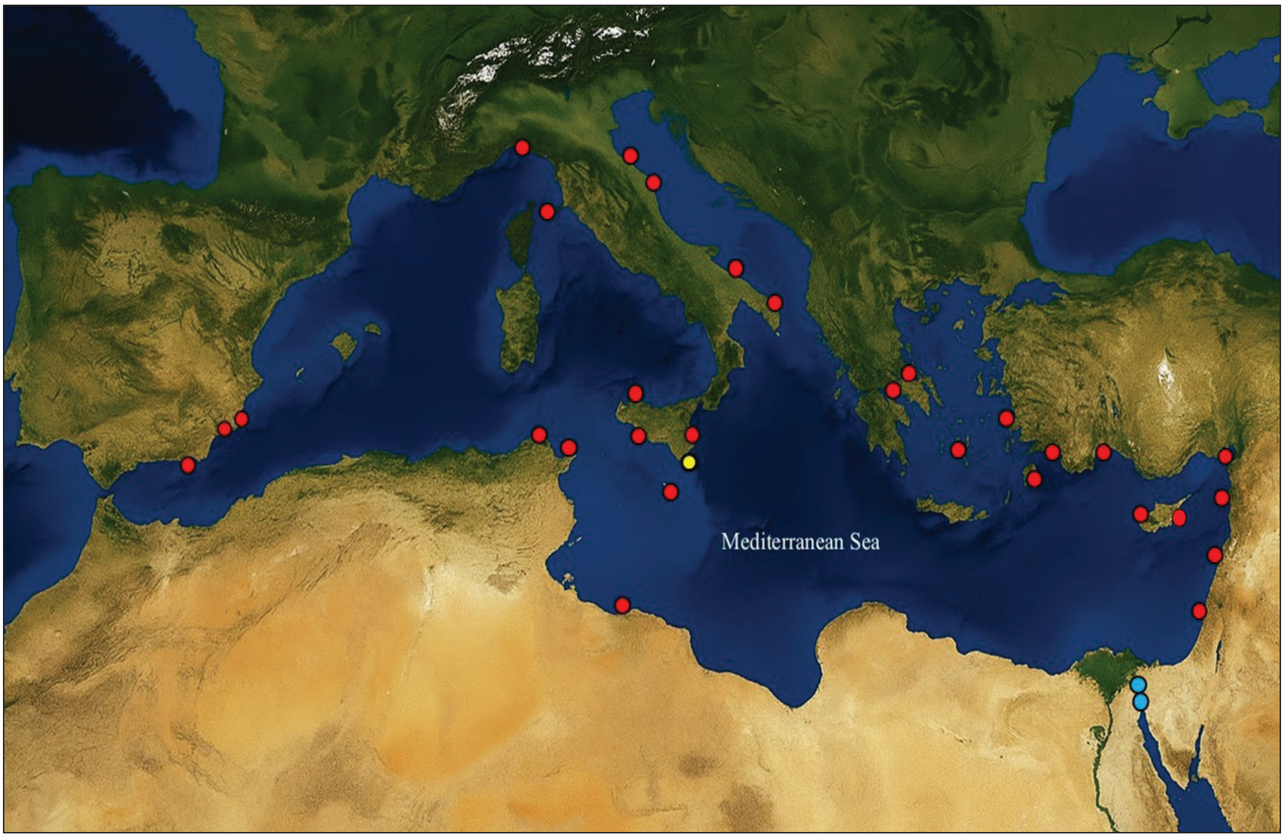

Fig. 2: Distribution map of *Cassiopea andromeda* **records in the Mediterranean Sea. In red circles historical records, in light blue historical records from the Suez Canal (Red Sea), and the yellow one represents the new record from Portopalo di Capo Passero (modified from Ramos-Pérez et al., 2025 and updated with records in Katsanevakis et al., 2020).**

Sl. 2: Zemljevid razširjenosti vrste *Cassiopea andromeda* **na podlagi zapisov o pojavljanju v Sredozemskem morju. V rdečih krogih so zgodovinski zapisi o pojavljanju, v svetlo modrih krogih zgodovinski zapisi o pojavljanju iz Sueškega prekopa (Rdeče morje), rumeni pa predstavlja nov zapis o pojavljanju iz Portopalo di Capo Passero (spremenjen po Ramos-Pérez in sod., 2025 in posodobljen z zapisi v Katsanevakis in sod., 2020).**

commercial shipping routes and its intense fishing and boating activities suggest that *C. andromeda* may have been introduced through shipping-related vectors, either via ballast water or as fouling - polyps attached to ship hulls. Alternatively, the species could have reached the area by natural dispersal or through recreational vessel traffic from already-established populations in Malta or along the eastern Sicilian coast, supported by favourable currents and rising sea temperatures that enhance larval survival and transport. The latter pathway is especially plausible given the high volumes of recreational vessel traffic between Malta and Sicily during the summer season. The ability to exploit multiple energy sources, namely photosynthates provided by symbiotic dinoflagellates and heterotrophic feeding, enables *C. andromeda* to thrive under a wide range of environmental conditions (Thé *et al.*, 2023). *Cassiopea* genus can form high-density blooms when environmental conditions are favourable and anthropogenic pressures intensive, particularly with rising sea temperatures linked to climate change and coastal development. Such blooms may exert competitive pressure on seagrass and other vegetal communities, primarily by limiting the availability of space, light, and food (Rowe *et al.*, 2025). Moreover, the trophic flexibility of *Cassiopea* genus, linked to both heterotrophic feeding and photosynthetic symbionts, can influence primary productivity, nutrient cycling, and local food web dynamics, potentially generating cascading ecological effects, as observed in other symbiotic jellyfish species (Djeghri *et al.*, 2021).

Continuous monitoring with the possibility to involve citizen science networks, will be essential to evaluate whether this population is ephemeral or self-sustaining, as well as to assess its ecological effects on local benthic communities and on dissolved oxygen dynamics. Considering the species' long history of westward expansion in the Mediterranean (Fumarola *et al.*, 2025), it remains uncertain whether its presence in Portopalo represents a recent colonization event favoured by climate warming or whether the species has remained undetected for years due to its occurrence in localised habitats and due to the lack of specific expert monitoring programs.

In the context of this study, the harbour of Portopalo di Capo Passero can be regarded as a hotspot of alien biodiversity, as evidenced by the occurrence of several alien species, including the invasive portunid crabs *Callinectes sapidus* and *Portunus segnis*. The coexistence of these taxa highlights the ecological susceptibility of this semi-enclosed coastal system to biological invasions and its potential role as an entry point and establishment site for thermophilic and Lessepsian species in the central Mediterranean. Indeed, such environments, often characterized by anthropogenic disturbance and intense maritime traffic, may act as stepping stones for the secondary dispersal of Lessepsian and thermophilic taxa along the Sicilian coast.

TUJERODNI KLOBUČNJAK *CASSIOPEA ANDROMEDA* NA NAJJUŽNEJŠI KONICI ITALIJE: NEDAVNI PRIŠLEK ALI SPREGLEDAN PREBIVALEC?

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POVZETEK

Lesepski klobučnjak Cassiopea andromeda *je invazivna vrsta klobučnjakov, ki izvira iz Rdečega morja in indo-pacifiške regije. V Sredozemskem morju so jo prvič zabeležili na začetku 20. stoletja in od takrat se je razširila po celotnem bazenu. Glavni cilj tega prispevka je bil dokumentirati prvi in dobro dokumentiran zapis te klobučnjaške meduze z območja Portopalo di Capo Passero, ki predstavlja najjužnejšo konico Italije (Sicilija, Jonsko morje). Opazovanje primerkov te vrste v oktobru 2025 prinaša nove dokaze o širjenju vrste vzdolž sicilijansko-jonske obale. Ta ugotovitev sproža vprašanja o tem, ali je vrsta nedavni kolonizator ali spregledan prebivalec, in poudarja biogeografski in ekološki pomen tega območja kot potencialne žariščne točke za spremljanje lesepskih in toploljubnih vrst.*

Ključne besede: klobučnjaki, tujerodne vrste, Jonsko morje, Sredozemsko morje, lesepska selivka

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FIRST SUBSTANTIATED RECORD OF THE GOLDEN-BANDED GOATFISH *UPENEUS MOLUCCENSIS* (OSTEICHTHYES: MULLIDAE) FROM THE COAST OF TUNISIA (CENTRAL MEDITERRANEAN SEA)

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ABSTRACT

From a lot of mullid species captured around the Kerkennah Islands, 35 specimens of the golde.n-banded goatfish Upeneus moluccensis *(Bleeker, 1855) were randomly collected. The present sample comprised 17 females, 7 males and 11 individuals of undetermined sex, with total lengths ranging between 99 and 153 mm and the total body weights between 31.2 and 65.2 g. Some morphometric measurements and meristic counts were also carried out in two specimens, preserved in an ichthyological collection. These specimens constitute the first substantiated record of the species from the Tunisian marine waters. Their occurrence suggests that a viable population of* U. moluccensis *is at present successfully established in the area.*

Key words: *Upeneus moluccensis*, substantiated record, extension range, distribution, population

PRIMO AVVISTAMENTO CONFERMATO DELLA TRIGLIA DORATA *UPENEUS MOLUCCENSIS* (OSTEICHTHYES: MULLIDAE) AL LARGO DELLA COSTA DELLA TUNISIA (MEDITERRANEO CENTRALE)

SINTESI

Da un gran numero di specie di mullidi catturate intorno alle isole Kerkennah, sono stati raccolti in modo casuale 35 esemplari della triglia dorata Upeneus moluccensis *(Bleeker, 1855). Il campione comprendeva 17 femmine, 7 maschi e 11 individui di sesso indeterminato, con lunghezze totali comprese tra 99 e 153 mm e pesi corporei totali compresi tra 31,2 e 65,2 g. Sono state inoltre effettuate alcune misurazioni morfometriche e conteggi meristici su due esemplari conservati in una collezione ittiologica. Questi esemplari costituiscono la prima segnalazione comprovata della specie nelle acque marine tunisine. La loro presenza suggerisce che una popolazione vitale di* U. moluccensis *si sia attualmente stabilita con successo nella zona.*

Parole chiave: *Upeneus moluccensis,* segnalazione comprovata, estensione dell’areale, distribuzione, popolazione

INTRODUCTION

The golden-banded goatfish, *Upeneus moluccensis* (Bleeker, 1855) is widely distributed range which extends from the Red Sea to the western Indian Ocean (Mozambique, Madagascar and Réunion), and eastward to the Caroline Islands and New Guinea. Its range extends from southern Japan to Queensland and Western Australia (Fricke *et al.*, 2018). The western Indian Ocean populations were reviewed and compared with other species by Uiblein & Heemstra (2010).

Randall & Kulbicki (2006) reported the first record of *U moluccensis* for New Caledonia, using experimental trawling over mud bottoms in bays. Since commercial trawling being banned in New Caledonia, the species is not present in fishmarkets, but occurs from depths of at least 80 m, but most often found in New Caledonia between 9 and 50 m, and conversely it has not been reported from the Chesterfield area (Randall & Kulbicki, 2006).

Upeneus moluccensis migrated from the Red Sea through Suez Canal into the Mediterranean Sea where it has been first reported off the coast of Israel by Haas & Steinitz (1947), though misidentified as *Mulloides auriflamma* (*non* Forsskål, 1775) and then by Ben-Tuvia (1953). Since then, the species was recorded around Cyprus Island (Iglésias & Frotté, 2015), in the broader Levant Basin (Gücü et *al.*, 1994; Torcu & Mater, 2000; Ali *et al.*, 2018; Barish & Fricke, 2020; Golani *et al.*, 2021), the Aegean Sea (Aydin & Akyol, 2016) and to the north in the Sea of Marmara (Artüz &Fricke, 2019). To the southern region of the Mediterranean Sea, the species was reported from the coasts of Egypt (El- Sayed *et al.* (2017) and Libya (El-Drawany, 2016).

U. moluccensis was first recorded from the Tunisian coast by Bradai *et al.* (2019), based on observations of over one hundred specimens landed at the fishing site of Teboulba, located in the southern area of the Gulf of Hammamet. Investigations conducted in the Gulf of Gabès with the assistance of local fishermen allowed to collect other specimens which are described in the present paper along with some comments on *U. moluccensis* distribution in the Mediterranean Sea.

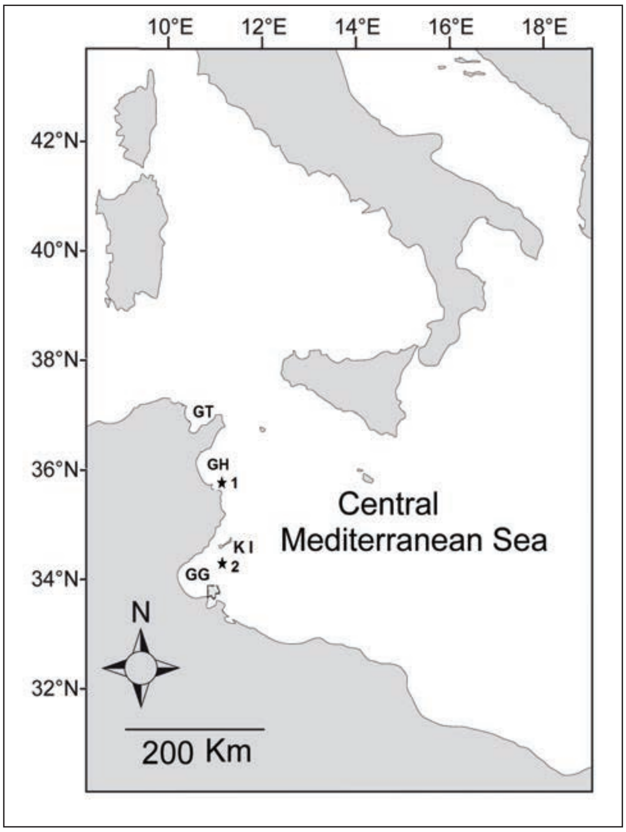

Fig. 1: Map of the Tunisian coast, in the central Mediterranean Sea, with black stars indicating the capture sites of* Upeneus moluccensis*. 1. Off the Teboulba region (Bradai* et al.*, 2019). 2. Around the Kerkennah Islands (this study). GG = Gulf of Gabès, GH = Gulf of Hammamet, GT =Gulf of Tunis, KI = Kerkennah Islands.

Sl. 1: Zemljevid tunizijske obale v osrednjem Sredozemskem morju s črnimi zvezdicami, ki označujejo mesta ulova primerkov vrste* Upeneus moluccensis*. 1. Ob regiji Teboulba (Bradai* et al.*, 2019). 2. Okoli otokov Kerkennah (ta študija). GG = Gabeški zaliv, GH = Hammametski zaliv, GT = Tuniški zaliv, KI = otoki Kerkennah.

MATERIAL AND METHODS

On 17 May 2025, numerous specimens, from the family Mullidae, were captured around Kerkennah Islands in north-eastern area of the Gulf of Gabès, southern Tunisia (34° 39′ 29″ N, 11 ° 04 ‘07″ E). The fishes were caught by trawler at a depth of approximately 20 m, over soft bottoms, and landed at a fishing site on these islands (Fig. 1). The location falls within the boundaries of GFCM geographical subarea GSA 14 (FAO, 2019).

From these fishes, 35 specimens of *U. molucensis* were randomly collected, delivered to the laboratory for examination. They were measured for total length (TL) to the nearest millimetre and weighed to the nearest decigram for total body weight (TBW), sex was determined when possible. Morphometric measurements and meristic counts were recorded in two specimens of this sample (Tab. 1) which were then photographed (Fig. 2) and preserved in 10% buffered formaldehyde. These voucher specimens were deposited in the Ichthyological Collection of the «Institut des Sciences et Technologies de la Mer of Salammbô» (Tunisia), receiving the catalogue numbers, INSTM U-mol 01 and INSTM U-mol 02, respectively. The protocol of Bello *et al.* (2014) for a first fish record and this of Salameh *et al.* (2012) for a first substantiated record were followed.

Tab. 1: Morphometric measurements in millimetre with percentages of standard length (SL), meristic counts and total body weight in gram recorded in two specimens of *Upeneus moluccensis* ***collected around the Kerkennah Islands [voucher INSTM U-mol 01 and INSTM U-mol 02].***
Tab. 1: Morfometrične meritve v milimetrih z odstotki standardne dolžine (SL), merističnimi štetji in skupno telesno težo v gramih, zabeležene pri dveh primerkih vrste *Upeneus moluccensis****, zbranih okoli otokov Kerkennah [bon INSTM U-mol 01 in INSTM U-mol 02].***

References	**INSTM U-mol 01**		**INSTM U-mol 02**	
Area	**Kerkennah Islands (Southern Tunisia)**			
Morphometric measurements	**mm**	**%SL**	**mm**	**%SL**
Total length	133	111.9	151	111.1
Length to fork	119	107.2	142	106.3
Standard length	111	100.0	134	100
Head length	26.1	23.4	33	24.6
Snout length	8	7.2	10.1	7.5
Interorbital width	8.4	7.6	10.9	8.13
Eye diameter	8.3	7.5	9.7	7.2
Barbel length	17.8	16.1	20.8	15.5
Caudal fin height	21.5	19.4	27.9	20.8
Caudal peduncle length	27.1	24.4	31.1	23.2
Caudal peduncle depth	10.2	9.2	13.2	9.85
Predorsal length	35.4	31.9	43	32.1
Pectoral fin length	21.4	19.3	26	19.4
Pectoral fin base	7.2	6.5	8.9	6.6
First dorsal fin height	18.7	16.8	22	16.4
First dorsal fin base	15.1	13.6	18	13.4
Second dorsal fin height	12.8	11.6	16	11.9
Second dorsal fin base	16.4	14.7	20.5	15.3
Pelvic fin length	17.9	16.2	23	17.1
Pelvic fin base	6.7	6.1	8	5.9
Anal fin height	17.0	15.3	21.2	15.8
Anal fin base	12.6	11.4	14.9	11.2
Meristic counts	**INSTM U-mol 01**		**INSTM U-mol 02**	
Dorsal rays	VIII+9		VIII+9	
Pelvic rays	I+5		I+5	
Anal spines	1		1	
Anal soft rays	7		7	
Gill-rakers	7+19		7+19	

A relation between TL and TBW was used as a complement following Froese *et al.* (2011) to assess if the species found sufficient resources in the wild. This relation is TBW = $a\mathrm{TL}^b$, and was converted into its linear regression, expressed in decimal logarithmic co-ordinates and correlations were assessed by least-squares regression. as: log TBW= log a + b log TL. Significance of constant b differences was assessed to the hypothesis of isometric growth if $b = 3$, positive allometry if $b > 3$, negative allometry if $b < 3$ (Pauly, 1983). Correlations were assessed by least-squares regression. and performed by using logistic model STAT VIEW 5.0.

RESULTS AND DISCUSSION

The present sample of *U. moluccensis* comprised 35 specimens and among them, 17 females, 7 males and 11 individuals of undetermined sex. The total lengths ranged between 99 and 153 mm, the total body weights ranged between 31.2 and 65.2 g. The specimens were identified as *U. moluccensis via* the combination of main morphological characters: body moderately elongated, subcylindrical at the beginning of the first dorsal fin, mouth terminal, snout rounded with a pair of small barbels attached to tip of ceratohyal, behind symphysis of lower jaw not reaching posterior part of operculum margin, two dorsal fins well separated, first dorsal spine minute, second spine the largest, second dorsal fin opposite the anal fin, dorsal and anal fins basally with scaled area, caudal fin deeply forked, color of back pinkish-reddish, belly white, dorsal part of body with golden yellow longitudinal band as wide as pupil, extending from eye to caudal-fin base, barbels whitish, 3 orange stripes on first dorsal fin, 2 on second, 6 thin red bars on upper caudal-fin lobe, lower lobe of caudal fin with a broad rose longitudinal stripe.

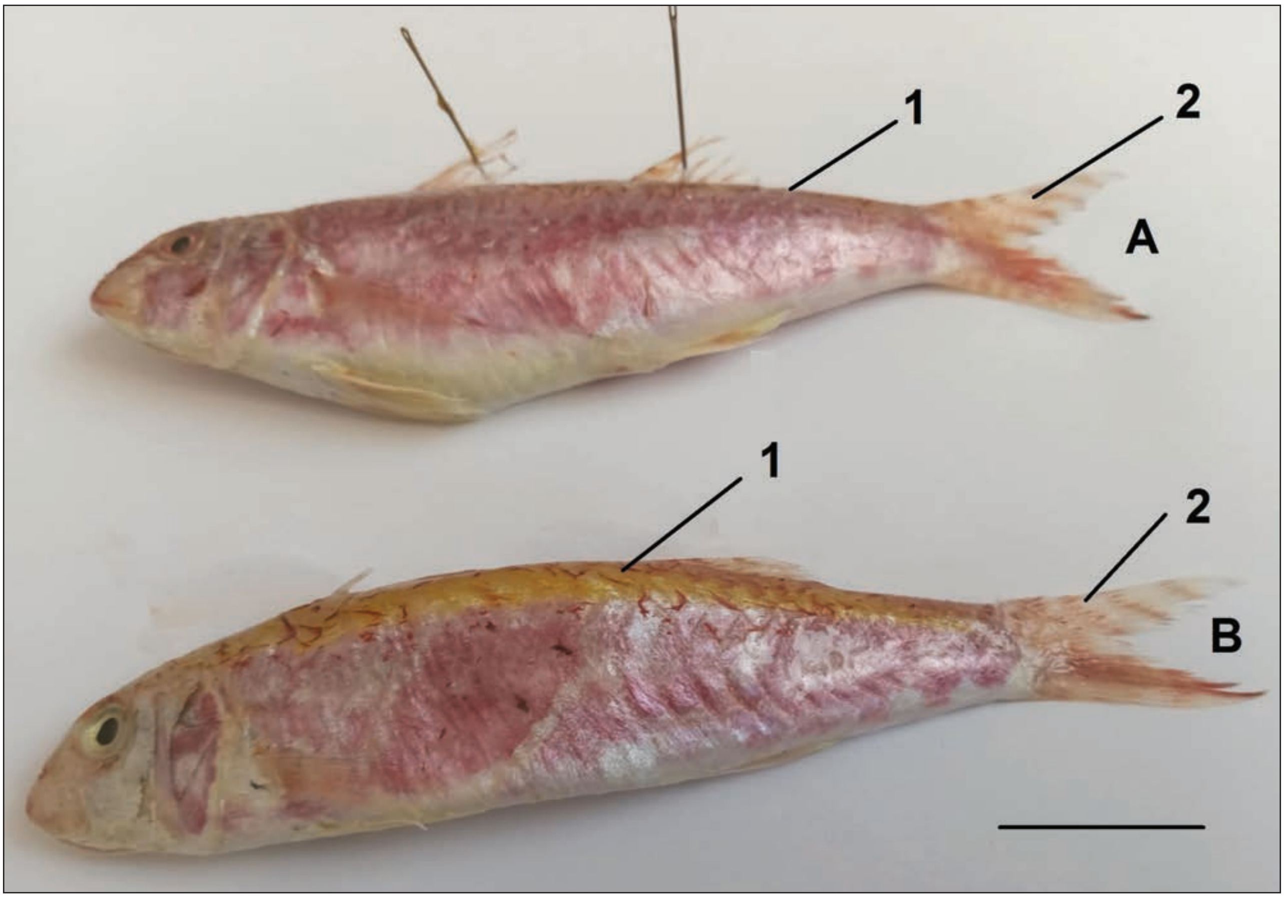

Fig. 2: Specimens of *Upeneus moluccensis* **collected from the Kerkennah Islands. A. Specimen with catalogue number INSTM U-mol 01. B. Specimen with catalogue number INSTM U-mol 02. 1. Golden-yellow longitudinal band. 2. Thin red bars on the upper caudal-fin lobe. Scale bar = 100 mm.**

Sl. 2: Primerki vrste *Upeneus moluccensis***, ulovljeni na otokih Kerkennah. A. Primerek s kataloško številko INSTM U-mol 01. B. Primerek s kataloško številko INSTM U-mol 02. 1. Zlato rumen vzdolžni pas. 2. Tanke rdeče črte na zgornjem režnju repne plavuti. Merilo = 100 mm.**

The general morphology, morphometric measurements, meristic counts, and coloration of the present *U. moluccensis* are consistent with previous descriptions of the species, provided by Hureau (1986), Golani & Darom (1997), Randall & Kulbicki (2006), Aydin & Akyol (2016), Artüz & Fricke (2019), Bariche & Fricke (2020) and Golani *et al.* (2021).

The present specimens of *U. moluccensis* [referenced INSTM U-mol 01 and INSTM U-mol 02] constitute the first substantiated records of the species from the Tunisian coast, as no voucher material was preserved from the previous record reported by Bradai *et al*. (2019). Similarly, when Salameh *et al*. (2012) reported the occurrence of the yellowbar angelfish *Pomacanthus maculosus* (Forsskål, 1775) in the Levant Basin where specifically from Lebanon, the record was based on a photographed but unpreserved specimen preventing further examination (Bariche, 2012). Therefore, the subsequent specimen recorded and described by Salameh *et al*. (2012), deposited in the Hebrew University Fish Collection, under the catalogue number HUJ 20102, became the first substantiated record of *P. maculosus* for the Mediterranean Sea.

The observations of *U. moluccensis* by Bradai *et al.* (2019) and in this study show a westward extension range of the species in the Mediterranean Sea. They also suggest that a viable population is at present successfully established in the Tunisian marine waters. It is corroborated by the fact that the TL –TBW relationship displays a positive allometry expressed in logarithmic co-ordinates as follows $\log TBW = -5.375 + 3.292 * \log TL$; $r = 0.994$, $n = 35$. This positive allometry, indicates that the species found in the wild sufficient resources to develop and likely reproduce. Similar observations were reported by Bengil (2019) who noted a positive allometry of length-weight relationships in specimens of *U. moluccensis* collected from different regions of the Mediterranean Sea.

In addition, Tikochinski *et al.* (2013) showed no significant genetic differences between populations of *U. moluccensis* from the Mediterranean Sea, Red Sea and Japan. Conversely, Pazhayamadom *et al.* (2017) noted significant differences in the body shape of the fish, reflecting their adaptations to swim and improve visibility in their respective environments indicating that the *U. moluccensis* populations in the Red Sea and the Mediterranean Sea represent two separate fish stocks. These observations explain the wide distribution and abundance of the species everywhere, allowing to study some aspects of its life history in the Mediterranean, concerning age determination, growth, spawning season, and diet (Kaya *et al.*, 1999; Saad, 2001; Torku-Koç & Erdogan, 2025).

Hureau (1986), Kaya *et al*. (1999) and Golani *et al*. (2021) noted that *U mluccensis* feeds on benthic organisms, primarily crustacean species are the main preys and teleost species appear in the stomach of larger specimens. The diet of *U. moluccensis* is clearly like that of the red mullet *Mullus barbatus* Linnaeus, 1758 as reported from the Tunisian coast by Chérif *et al*. (2011).

Galil (2007) and Aydin & Akyol (2016) suggested that an interspecific competition pressure for food between *U. moluccensis* and native *Mullus barbatus* cannot be totally ruled out in the Mediterranean regions where both species inhabit on soft bottoms, at depths between 50 and 200 m maximum. Aydin & Akyol (2016) reported that in the Levant Basin, the global warming of waters has been accompanied by an increase in captures of *U. moluccensis* and a concomitant decline in those of *M. barbatus*. Aydin & Akyol (2016) also noted that in the concerned areas this phenomenon can be the cause of financial losses of fishermen, as the native *M. barbatus* commands a higher market value than *U. moluccensis*.

The occurrence of *U. moluccensis* in Tunisian waters is relatively recent and at present no reports are available that detailing the abundance of the species and its economic contribution to local fisheries. Interviews conducted with fishermen indicate that local consumers do not distinguish between the two species, which are sold at similar prices. Further investigations are needed to quantify the number and the abundance of the indigenous and non-indigenous mullid species in the Tunisian marine waters, as these species should be monitored to prevent declines in captures and their potential depletion. The implementation of a management plan in collaboration with local fishermen would help to preserve and ensure the sustainability of viable populations in the area.

PRVI POTRJEN ZAPIS O ZLATOPROGEM BRADAČU *UPENEUS MOLUCCENSIS* (OSTEICHTHYES: MULLIDAE) Z OBALE TUNIZIJE (OSREDNJE SREDOZEMSKO MORJE)

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POVZETEK

Izmed številnih vrst bradačev (Mullidae), ujetih okoli otokov Kerkennah, je bilo naključno zbranih 35 primerkov zlatoprogega bradača Upeneus moluccensis *(Bleeker, 1855). Vzorec, ki je osnova temu delu, je obsegal 17 samic, 7 samcev in 11 osebkov nedoločenega spola, s skupno dolžino med 99 in 153 mm in skupno telesno težo med 31,2 in 65,2 g. Pri dveh primerkih, ki sta shranjena v ihtiološki zbirki, so bile opravljene tudi nekatere morfometrične meritve in meristična štetja. Ti primerki predstavljajo prvi potrjen zapis o vrsti iz tunizijskih morskih voda. Njihova prisotnost kaže, da je na tem območju trenutno uspešno vzpostavljena viabilna populacija vrste* U. moluccensis.

Ključne besede: *Upeneus moluccensis*, potrjeni zapis o pojavljanju, širjenje areala, razširjenost, populacija

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NEW RECORD OF THE LONG-JAWED SQUIRRELFISH, *HOLOCENTRUS ADSCENSIONIS* (OSBECK, 1765), IN THE ADRIATIC SEA

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ABSTRACT

On 16 October 2025, a specimen of the long-jawed squirrelfish, Holocentrus adscensionis *(Osbeck, 1765), was caught in the waters of Porto Montenegro, Tivat (Boka Kotorska, Montenegro). This finding represents the first record of this non-indigenous species in the inventory of Montenegrin marine fish fauna and the second record in the Adriatic Sea.*

Key words: *Holocentrus adscensionis*, Holocentridae, bioinvasion, Boka Kotorska, Adriatic Sea

NUOVO AVVISTAMENTO DEL PESCE SCOIATTOLO, *HOLOCENTRUS ADSCENSIONIS* (OSBECK, 1765), NEL MAR ADRIATICO

SINTESI

Il 16 ottobre 2025, un esemplare di pesce scoiattolo, Holocentrus adscensionis *(Osbeck, 1765), è stato catturato nelle acque di Porto Montenegro, Tivat (Boka Kotorska, Montenegro). Questa scoperta rappresenta la prima registrazione di questa specie non autoctona nell'inventario della fauna ittica marina montenegrina e la seconda registrazione nell'Adriatico.*

Parole chiave: *Holocentrus adscensionis,* Holocentridae, bioinvasione, Boka Kotorska, Adriatico

INTRODUCTION

Climate change has been recognised as a major factor influencing Mediterranean biodiversity, alongside Atlantic influx, Lessepsian migration, and the introduction of exotic species by humans (Turan *et al.,* 2016). A similar trend is evident in the Adriatic Sea, where rapid biodiversity changes are occurring due to the increasing arrival of non-indigenous fishes and other taxa (Dulčić *et al.,* 1999; Lipej & Dulčić, 2004). The number of established alien species is expected to increase further in the near future, largely through the natural spread of populations already established in the central Mediterranean (Zenetos, 2010).

This paper presents a record of a non-indigenous fish species caught in the study area and explores possible explanations for its occurrence.

MATERIAL AND METHODS

Boka Kotorska is an 87 km² fjord-like bay in the eastern part of the southern Adriatic Sea, with a coastline of 105.7 km. It comprises three distinct areas – the outer bay (Herceg Novi Bay), the middle bay (Tivat Bay), and the inner bay (Kotor-Risan Bay) – and is characterised by unique hydrological, geomorphological, climatological, and biotic factors (Gamulin-Brida, 1983) (Fig. 1). On 16 October 2025, Zoran Ćuk, a local fisherman, captured a specimen of an unknown fish while stick-float fishing at night near the Porto Montenegro marina (42.431497° N and 18.691224° E) in Tivat, located in the middle bay (Boka Kotorska, Montenegro). The catch occurred at a depth of approximately 11 m over a muddy bottom. The fisherman photographed the specimen – which had a total length of approximately 24 cm – and released it alive. The photograph was subsequently provided to the authors for analysis.

RESULTS AND DISCUSSION

The specimen (Fig. 2) exhibited all the typical characteristics that allowed it to be identified as *Holocentrus adscensionis* (Osbeck, 1765): body

Fig. 1: Map showing the location (Porto Montenegro, Tivat Bay, Montenegro) where the specimen of the long-jawed squirrelfish, *Holocentrus adscensionis****, was caught.***
Sl. 1: Zemljevid z označeno lokaliteto (lokaliteta Porto Montenegro, Tivatski zaliv, Črna gora), kjer je bil ujet primerek veveričjaka *Holocentrus adscensionis****.***

Fig. 2: Specimen of the long-jawed squirrelfish,* Holocentrus adscensionis*, caught on 16 October 2025 in the waters of Porto Montenegro (Tivat, Boka Kotorska, Montenegro) (photo: Z. Ćuk).
Sl. 2: Primerek veveričjaka,* Holocentrus adscensionis*, ujet 16. oktobra 2025 v vodah marine Porto Montenegro (Tivat, Boka Kotorska, Črna gora) (foto: Z. Ćuk).

oblong and laterally compressed, reddish with alternating red and white horizontal stripes; head pointed, with large eyes; upper jaw longer than the lower and extending beyond the centre of the eye; area between preopercle and opercle bearing rows of serrations; dorsal fin lacking the white spots behind the spine tips that are characteristic of the congeneric species *H. rufus* (Greenfield, 2003). The photograph obtained from the fisherman clearly shows the typical striped coloration, the eleven dorsal spines of subequal length lacking the white spots, and the evident preopercular spine. The caudal lobes are elongate, with the upper lobe markedly longer than the lower (*sensu* Woods, 1955).

The species *H. adscensionis* is a reef-associated fish of the family Holocentridae, occurring in the western Atlantic ranges from North Carolina (USA) and Bermuda to Brazil (Woods & Greenfield, 1978), and in the eastern Atlantic from Gabon to Ascension Island (Ben-Tuvia, 1990). It inhabits depths from shallow tide pools to 180 m, most commonly between 8 and 30 m (Wyatt, 1983). It is a typically nocturnal species, spending the day hiding in crevices and cavities, and emerging at night to feed, mainly on crabs and other small crustaceans (Greenfield, 1981). The Porto Montenegro is a large, modern marina; however, its piers, overgrown with rich epibenthic fauna, contain many crevices and cracks that offer potential shelter for squirrelfish. It is also possible that the species occurs in adjacent areas, but due to its nocturnal behaviour it could easily be overlooked.

Prior to this study, there were no records of *H. adscensionis* from Montenegrin waters. In the Mediterranean Sea, the species had previously been reported only twice: first by Vella *et al.* (2016) in Maltese waters, and later by Ciriaco *et al.* (2022) from the Gulf of Trieste in the Adriatic Sea. The arrival of *H. adscensionis* is likely related to the gradual warming of the Mediterranean Sea (Occhipinti-Ambrogi & Galil, 2010). Novel arrivals via Atlantic influx are relatively uncommon in the Adriatic Sea, since the main recognised entry route for non-indigenous fishes is the Suez Canal, through which more than 100 immigrant species have entered the Mediterranean Sea (Golani *et al.*, 2021). Vella *et al.* (2016) also considered the possibility that this species might have been introduced into Maltese waters through maritime activities in major ports. Given that *H. adscensionis* typically inhabits tropical and subtropical waters with temperatures ranging from approximately 23°C to 30°C (Reef Life Survey, 2025), we assume that winter water temperatures in Boka Kotorska are too low for the species to survive and become established.

To date, only records of seven alien fish species have been published in Montenegrin waters – including *Pterois miles* (Tomanić *et al.,* 2022) – which is relatively few compared to other Mediterranean regions. Based on the three occasional findings of the long-jawed squirrelfish in geographically disparate areas of the Mediterranean Sea (Malta, the Gulf of Trieste, and Boka Kotorska), it is too early to speculate on its spread or potential establishment in the area. However, the experience with its close relative, the redcoat, *Sargocentron rubrum* (Forsskål, 1775), first detected in the basin eighty years ago off Palestine marine waters ((Haas & Steinitz, 1947) and now considered one of the most successful colonisers in the Mediterranean Sea (Azzurro *et al.*, 2014) demonstrates that some species can rapidly find a niche in a new environment, establish themselves, and begin to spread. Furthermore, two new squirrelfish species have been reported for the first time in the Mediterranean Sea in recent years, namely *Neoniphon sammara* (Forsskål, 1775) (Deef, 2021; Mehanna & Osman, 2022) from Egyptian waters and *S. caudimaculatum* (Rüppell, 1838) from Tunisian waters (Ghanem *et al.,* 2022).

Although the specimen described here was not preserved in a formal museum collection, as recommended by best-practice guidelines (*sensu* Bello *et al.*, 2014), high-quality photographic evidence provided reliable documentation for confirming the species' presence (Dulčić *et al.*, 2006; Kovačić *et al.*, 2020). This case underscores the important role of citizen science in contributing data on alien species.

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NOVI ZAPIS O POJAVLJANJU VEVERIČJAKA VRSTE *HOLOCENTRUS ADSCENSIONIS* (OSBECK, 1765) V JADRANSKEM MORJU

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POVZETEK

Ribič je 16. oktobra 2025 ujel primerek tujerodnega veveričjaka vrste *Holocentrus adscensionis* (Osbeck, 1765) v vodah marine Porto Montenegro (Tivat, Boka Kotorska, Črna gora). Gre za prvi zapis o pojavljanju te vrste za črnogorsko morsko ribjo favno in drugi zapis o pojavljanju v Jadranu.

Ključne besede: *Holocentrus adscensionis*, Holocentridae, bioinvazija, Boka Kotorska, Jadransko morje

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NEW FINDINGS OF THE CUP-SHAPED DEMOSPONGE *CALYX NICAEENSIS* (RISSO, 1826) ON THE ROCKY OUTCROPS IN THE GULF OF TRIESTE (NORTHERN ADRIATIC SEA)

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ABSTRACT

The cup-shaped demosponge Calyx nicaeensis *(Risso, 1826) is an endemic Mediterranean species. It is considered to be a rare species, which needs to be included into international conservation protocols. Between 2023 and 2025, 17 specimens were recorded on the rocky outcrops in the Gulf of Trieste for the first time, within a Site of Community Importance (SCI) of the European Natura 2000 network.*

Key words: Cup-shaped sponge, northern Adriatic Sea, rocky outcrops, SCI, Natura 2000

NUOVE SCOPERTE DELLA SPUGNA CALICE *CALYX NICAEENSIS* (RISSO, 1826) SUGLI AFFIORAMENTI ROCCIOSI NEL GOLFO DI TRIESTE (ALTO ADRIATICO)

SINTESI

La spugna calice Calyx nicaeensis *(Risso, 1826) è una specie endemica del Mediterraneo. Viene considerata una specie rara, la quale dovrebbe essere inclusa all'interno dei protocolli internazionali per la conservazione. Tra il 2023 e il 2025, 17 esemplari di questa specie sono stati trovati per la prima volta sugli affioramenti rocciosi nel Golfo di Trieste, all'interno di un Sito di Importanza Comunitaria (SIC) della rete Natura 2000.*

Parole chiave: spugna calice, Alto Adriatico, affioramenti rocciosi, SIC, Natura 2000

INTRODUCTION

The cup-shaped demosponge *Calyx nicaeensis* (Risso, 1826) (Haplosclerida: Phloeodictyidae) is an endemic Mediterranean species, as suggested by its specific name, with the type locality in the Gulf of Nice in France. It is widely regarded as a rare species undergoing regression in the NW Mediterranean (Pronzato, 2003; Cerrano *et al.*, 2013). Within the EU Marine Strategy Framework Directive, it has been identified as an epimegazoobenthic structuring species in coralligenous habitats (Trainito et al., 2020). In some areas of the eastern Mediterranean Sea, the sponge is still fairly common, and old sponge fishermen employ a small piece of *C. nicaeensis* moistened in seawater: simply scrubbing the small piece on the inside of the mask ensures prevent mask fogging during dives (Baldacconi, 2010).

C. nicaeensis exhibits a distinctive calyx morphology (Fig. 1) that is occasionally characterised by an irregular, massive shape with several thick extensions, each measuring 1–2 cm in diameter, and has a hard, fibrous consistency. It is notable that the diameter can reach up to 20 cm. The colour varies from beige to dark brown. The skeleton consists of a network of tiny siliceous needles (spicules) that occur in two sizes: large and small (100–150 and 35–80 μm, respectively) (Baldacconi, 2010). *C. nicaeensis* shows a peculiar strategy of asexual reproduction by producing buds from the sponge base. The larval stage of this species has never been found, nor has that of any other species of this family (Maldonado, 2006). Cup-shaped sponges inevitably trap coarse sediments, and *C. nicaeensis* is thought to collapse its osculum when it is filled with sediment (Cerrano *et al.*, 2013).

C. nicaeensis occurs across a wide bathymetric range (up to 400 metres) (Vacelet, 1960), but it is most commonly found at depths between 5 and 55 m in many areas of the Mediterranean Sea. It inhabits both *Posidonia oceanica* meadows and coralligenous concretions. In shallower areas, it is found in pre-cave conditions (Cerrano *et al.*, 2013).

In the monograph on sponges of the Adriatic Sea (1862), Schmidt reported it as *Reniera calix* Nobis., although the author expressed uncertainty about the classification, as evident from the way he described the species (from the original German description): "Nardo classified it as *Esperia* but later informed me that it should form its own genus. It cannot be classified as an *Esperia* since the cupped sponge does not possess any of the characteristics

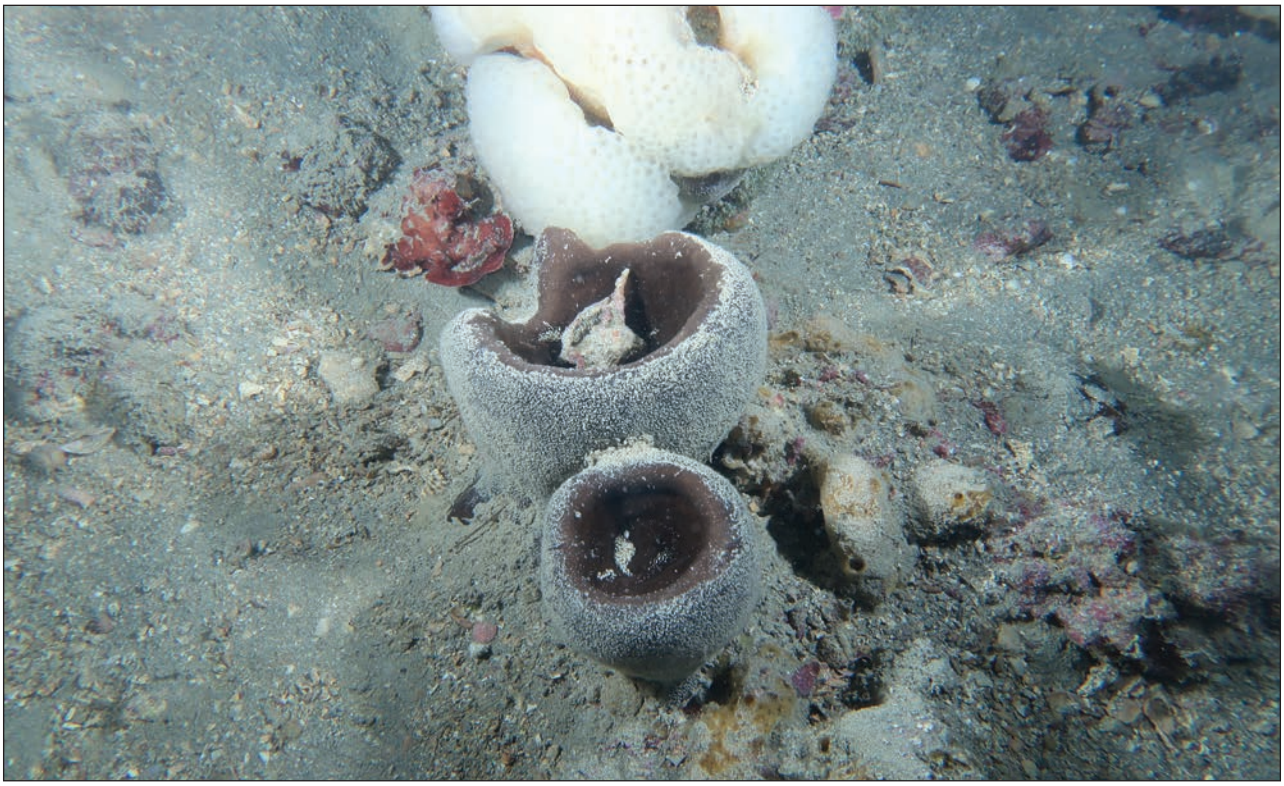

Fig. 1: *Calyx nicaeensis* ***on coarse sand in the Gulf of Trieste (photo: L. Faresi)***
Sl. 1: *Calyx nicaeensis* ***na grobem pesku v Tržaškem zalivu (foto: L. Faresi)***

Fig. 2: Study area with outcrops investigated and Sites of Community Importance (red polygons). The name of outcrops with* Calyx nicaeensis *record are reported (map adapted by Google Earth).

Sl. 2: Obravnavano območje z raziskanimi osamelci in najdišči, pomembnimi za habitatno direktivo (rdeči poligoni). Navedena so imena skalnih osamelcev z najdbami primerkov vrste* Calyx nicaeensis *(zemljevid prilagojen z Google Earth).

typical of the needle forms of that genus. However, its simple spicules, which are pointed at both ends, correspond to those of several species of *Reniera* and are connected by strong organic fibres. This mode of connection, however, is completely alien to other *Reniera*. Undoubtedly, *Reniera* is the genus to consider first, as the morphological relationship is undeniable: the large bowl cavity, into which individual outflow orifices flow, becomes a channel like that of *Reniera aquaeductus*, which, along its course, takes on the characteristics of aquifer openings". Nevertheless, he stated that this species was not rare in the Kvarner region of Croatia.

Cerrano *et al.* (2013) reported 30 localities where the species has been recorded since its description in a checklist of their findings along the Mediterranean coasts. The fragmented distribution in time and space highlights the need for closer attention to be paid to this species in order to better understand its life strategy and environmental role (Trainito *et al.*, 2020).

The rocky outcrops are regarded as one of the most peculiar features of the northern Adriatic Sea representing small-scale island-like geomorphological elements (Casellato *et al.*, 2007; Casellato & Stefanon, 2008). Since 2015, a limited number of biogenic outcrops in the Gulf of Trieste have been placed under legal protection according to the European Habitats Directive (92/43/CEE) (Bandelj et al., 2020). To our knowledge, this represents the first recorded finding of *C. nicaeensis* in the Gulf of Trieste.

MATERIAL AND METHODS

The study site, referred as "Trezze San Pietro e Bardelli" (IT3330009), is included in the European Natura 2000 network as a Site of Community Importance (SCI) under Commission Implementing Decision (EU) 2015/69 of 3 December 2014. Currently, regional legislation (D.G.R. of the Friuli Venezia Giulia Region no. 1701 of 4 October 2019) establishes conservation measures for the site, as well as monitoring the state of the habitats' conservation. Anthropic activities such as anchoring, trawling and hydraulic dredge fishing on the outcrops within the SCI are prohibited.

Since 2020, photographic monitoring of two rocky outcrops (identified as San Pietro and Sud Piastre) has been conducted seasonally using SCUBA equipment, while 8 outcrops outside and other 6 outcrops inside the SCI were monitored at least twice a year (Fig. 2). Specimens of *Calyx nicaeensis* were identified based on the morphological description provided by Desqueyroux-Faúndez and Valentine (2002). All specimens were photographed, and calyx diameter was estimated using a measuring tape. In addition, a piece of sponge was collected from specimen A (Table 1) for spicules identification. The soft tissue was dissolved using 69% nitric acid, and the isolated spicules were observed under a microscope (40x magnification).

RESULTS AND DISCUSSION

A total of 17 *Calyx nicaeensis* specimens were recorded at 4 of the 16 monitored outcrops. All individuals occurred within the SCI area (Fig. 2) at depths of 16–19.9 m (Tab. 1), either on rocky substrate or adjacent coarse sand. Sponge diameters ranged from 2.5 to 23 cm. The first record was made on 16 March 2023 (specimen A), and some specimens were observed repeatedly. This was the case for specimen L, a 23-cm massive form with nine cups, first recorded on 7 February 2024 (Fig. 3a). It was photographed again on 16 December 2024 and 5 March 2025, when the calyx appeared damaged (Fig. 3b–c) and a ghost gillnet was detected nearby. On 3 September 2025, the calyx had regenerated, although one cup was missing (Fig. 3d). Spicules were oxeas; the length of the largest oxeas ranged from 170.5 to 190.4 µm.

Tab. 1: Specimens of *Calyx nicaeensis* ***recorded on the rocky outcrops in the Gulf of Trieste.***
Tab. 1: Primerki vrste *Calyx nicaeensis****, zabeleženi na skalnih osamelcih v Tržaškem zalivu.***

date	outcrop site	depth (m)	specimens	major diameter (cm)
16.03.2023	Mina	17,5	A	8
23.03.2023	Mina	17,5	A	8
17.08.2023	Sud Piastre	19,9	B, C, D (2 cups)	B 5, C 8, D 15
17.08.2023	S. Pietro	16	E	9
7.02.2024	Sud Piastre	19,9	F, G, H, I, L (9 cups)	F 5, G 8, L 23 (n.d. for H and I)
9.07.2024	Sepa	17,7	M, N	M 13, N 6
12.08.2024	Sud Piastre	19,7	O, P	O 5, P 9
16.12.2024	Sud Piastre	19,9	L (9 cups)	23
5.03.2025	Sud Piastre	19,5	L (9 cups), O, P	L 23, O 5, P 9
19.07.2025	Mina	17	Q	4.5
3.09.2025	Sud Piastre	19,5	L (9 cups)	23
3.09.2025	Sepa	17,3	M, N, R, S	R 2.5, S 5

Tab. 2: Records of* Calyx nicaeensis *in the Adriatic Sea (note reports number of individuals and/or depth). N.B. past records are based on Trainito* et al. *(2020).

Tab. 2: Zapisi o pojavljanju vrste* Calyx nicaeensis *v Jadranskem morju (opomba navaja število osebkov in/ali globino). Opomba: pretekli zapisi o pojavljanju temeljijo na viru Trainito in sod. (2020).

Author	Year	Site	Nation	Note
Schmidt	1862	Kvarner Gulf	Croatia	
Vitale	2011	Otranto	Italy	10 m
Vitale	2011	Otranto	Italy	18 m
Molinari & Bernat	2011	Lustica Peninsula	Montenegro	14 m
Mačić & Molinari	2012	Lustica Peninsula	Montenegro	12 m
Frijsinger & Vestjens	2012	Kvarner Gulf, Selce	Croatia	
Mescalchin P.	2014	Tegnue di Chioggia	Italy	1 ind.
Mačić & Trainito	2014	Verige Strait, Boka Kotorska	Montenegro	2 ind.
Faresi	2018	Orlec, Cres	Croatia	1 ind. 18 m
Terlizzi	2019	Giovinazzo	Italy	14 m
Mačić	2019	Opatovo	Montenegro	2 ind. 18 m
Mačić	2019	Opatovo	Montenegro	1 ind. 21 m
this work	2023-2025	Gulf of Trieste	Italy	17 ind. 16-19,9 m

The *C. nicaeensis* specimens found on outcrops in the Gulf of Trieste represent the northernmost records in the Adriatic Sea and the Mediterranean. Except for the first record by Schmidt (1862) in the Kvarner Gulf, most Adriatic records come from Montenegro or the Apulia region of the southern basin (Tab. 2). Nevertheless, our findings represent the most numerous records of this species in the Adriatic Sea in recent times and probably in the Mediterranean as well.

According to Trainito *et al.* (2020), its distribution in the Mediterranean extends across the entire basin; the species shows no depth preference and appears to be ecologically versatile. The rocky outcrops in the Gulf of Trieste are mesophotic biogenic habitats (Bandelj *et al.*, 2020) that are scattered across the seafloor in a mosaic pattern (Falace et al., 2015) and are poorly connected to the different subregions of the Mediterranean Sea (Ingrosso *et al.*, 2018). A survey of benthic macrofauna on 45 outcrops between 2013 and 2015 (including those in the present study) recorded 58 Porifera species. *C. nicaeensis* was not detected, consistent with earlier surveys (Bettoso *et al.*, 2023). The occurrence of this species exclusively on protected rocky outcrops, three years after the SCI site conservation measures came into effect, is unlikely to be coincidental. Yet, effective monitoring and protection of these sites located at least 3 nautical miles offshore remains challenging due to illegal activities. Besides the risks of mechanical damage or harvesting, the species may also be preyed upon by spongivorous sea slugs. For instance, *Umbraculum umbraculum* ([Lightfoot], 1786) feeds on *C. nicaeensis* at mesophotic depths in the Aegean Sea (Özalp & Evcen, 2025). Nevertheless, *U. umbraculum* is still considered rare in the northern Adriatic (Turk, 2000; Zenetos *et al.*, 2016) and has not yet been reported in the Gulf of Trieste (Lipej *et al.*, 2025). Therefore, the data here reported confirm: i) the unpredictability of the distribution of the species and ii) its actual rarity, despite a 22.3% increase in the number of specimens known for the Mediterranean basin (90). Trainito et al. (2020) concluded that the rarity of *C. nicaeensis*, combined with

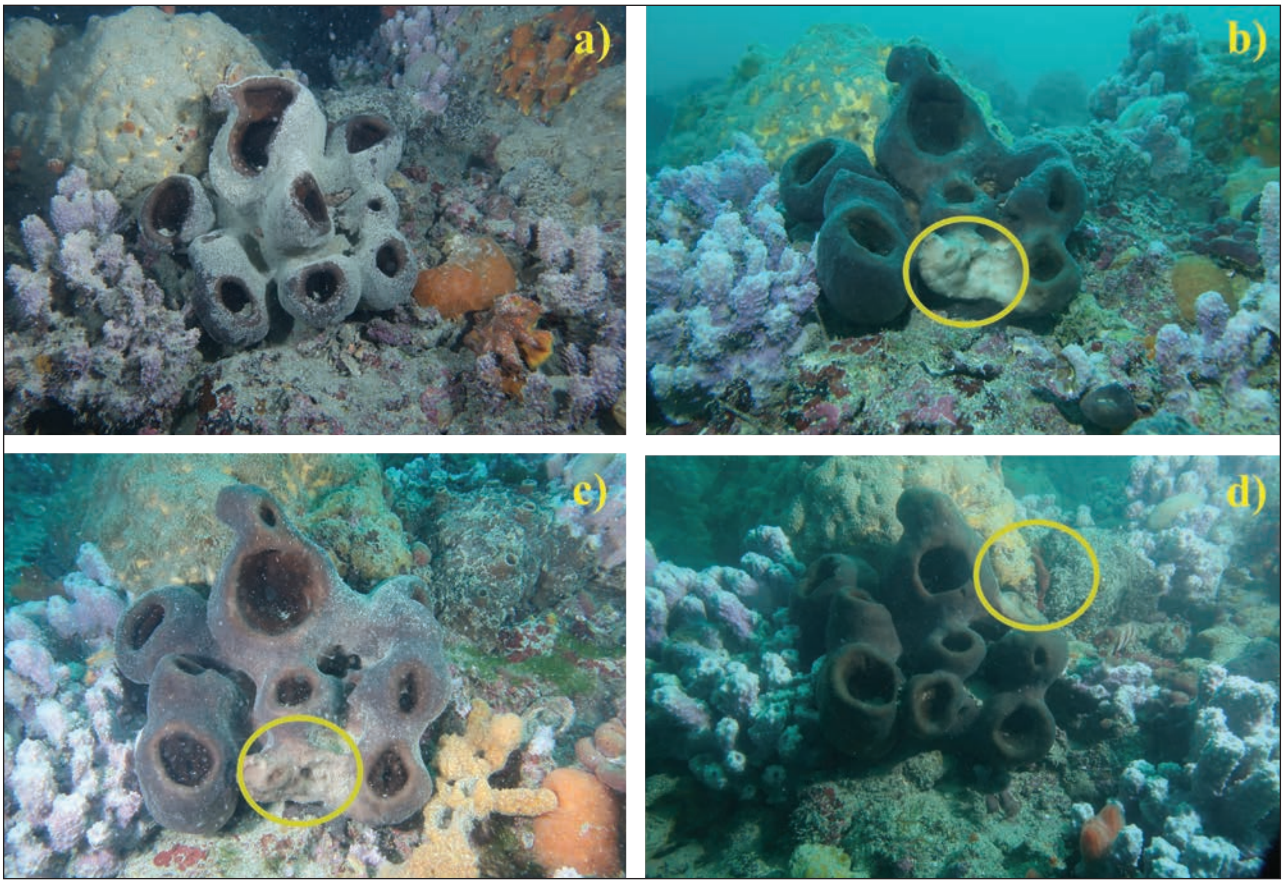

Fig. 3: A massive form of* Calyx nicaeensis *with 9 cups (specimen L): yellow circles indicate the damaged cups (Photos: L. Faresi) a) 07 February 2024; b) 16 December 2024; c) 05 March 2025; d) 03 September 2025.
Sl. 3: Masivna oblika vrste* Calyx nicaeensis *z 9 čašicami (vzorec L): rumeni krogi označujejo poškodovane čašice (fotografije: L. Faresi) a) 7. februar 2024; b) 16. december 2024; c) 5. marec 2025; d) 3. september 2025.

its unique characteristics, highlights the importance of including this species in international conservation protocols, as well as the need for further in-depth studies. Its finding on legally protected rocky outcrops in the Gulf of Trieste suggests that current measures may support habitat conservation in an area marked by unstable environmental conditions. Continued monitoring is therefore essential to better understand the species' dynamics in the whole Mediterranean Sea.

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NOVE NAJDBE MORSKEGA KELIHA *CALYX NICAENSIS* (RISSO, 1826) NA SKALNIH OSAMELCIH V TRŽAŠKEM ZALIVU (SEVERNO JADRANSKO MORJE)

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POVZETEK

Čašasta kremenasta spužva morski kelih Calyx nicaeensis *(Risso, 1826) je endemična sredozemska vrsta. Smatrajo jo za redko vrsto, ki jo je treba vključiti v mednarodne protokole za ohranjanje. Med letoma 2023 in 2025 je bilo na skalnih osamelcih v Tržaškem zalivu prvič zabeleženih 17 primerkov te vrste znotraj območja, pomembnega za habitatno direktivo (SCI) evropskega omrežja Natura 2000.*

Ključne besede: morski kelih, severni Jadran, skalni osamelci, SCI, Natura 2000

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FEATURES OF LIPID ACCUMULATION IN STRIPED VENUS CLAM *CHAMELEA GALLINA* IN THE SUBLITTORAL ZONE OF THE CRIMEAN COAST (BLACK SEA)

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ABSTRACT

Seasonal lipid studies in shellfish are critical for assessment of metabolic lipid profiles and body condition. The aim of this study was to investigate the seasonal patterns of total lipid accumulation, identify the lipid classes, and determine the fatty acid composition of the striped venus clam Chamelea gallina *from the sublittoral zone along the Crimean coast of the Black Sea. The highest levels of total lipids (TLs), including triacylglycerols (storage lipids), were observed during the winter–spring period, during which the fatty acid (FA) composition consisted of 23 species. The FA composition of* C. gallina *from the Crimean coast differed from that of populations in other regions of the World Ocean. The results can be used for a comprehensive assessment of environmental impacts on organisms in biomonitoring research and for evaluating the potential nutritional value of these clams.*

Key words: Venus clam, *Chamelea gallina*, Black Sea, lipids, fatty acids, seasonality

CARATTERISTICHE DELL'ACCUMULO DI LIPIDI NELLA VONGOLA LUPINO *CHAMELEA GALLINA* NELLA ZONA SUBLITORALE DELLA COSTA CRIMESE (MAR NERO)

SINTESI

Gli studi stagionali sui lipidi nei molluschi sono fondamentali per valutare i profili metabolici dei lipidi e le condizioni fisiche. Lo scopo di questo studio era quello di indagare i modelli stagionali di accumulo di lipidi totali, identificare le classi di lipidi e determinare la composizione degli acidi grassi della vongola lupino Chamelea gallina *proveniente dalla zona sublitorale lungo la costa crimeana del Mar Nero. I livelli più elevati di lipidi totali (TL), compresi i triacilgliceroli (lipidi di riserva), sono stati osservati durante il periodo invernale-primaverile, durante il quale la composizione degli acidi grassi (FA) era costituita da 23 specie. La composizione degli acidi grassi di* C. gallina *lungo la costa della Crimea differiva da quella delle popolazioni di altre regioni degli oceani. I risultati possono essere utilizzati per una valutazione completa dell'impatto ambientale sugli organismi nella ricerca di biomonitoraggio e per valutare il potenziale valore nutrizionale di queste vongole.*

Parole chiave: vongola lupino, *Chamelea gallina*, Mar Nero, lipidi, acidi grassi, stagionalità

INTRODUCTION

The striped venus clam, *Chamelea gallina* (Linnaeus, 1758), a marine bivalve mollusk of the family Veneridae, is widely distributed in the Mediterranean Sea, Adriatic Sea, Black Sea, and along the eastern Atlantic coasts of Europe (Öztürk & Altinok, 2021). In the Black Sea, although comparable to commercially harvested species in abundance and biomass, these clams remain understudied and unexploited (Panayotova *et al.*, 2020; Merdzhanova *et al.*, 2021). Lipids and fatty acids (FAs) are not only indicators of nutritional value but also crucial for ecological monitoring. The lipid composition of bivalves varies depending on geographical distribution (Ricardo *et al.*, 2017). For instance, differences in total lipids (TLs) and FA composition have been observed between *C. gallina* from the western Black Sea (Bulgaria) (Merdzhanova *et al.*, 2021) and the Adriatic Sea (Orban *et al.*, 2007). Similarly, variations exist between specimens from the Marmara Sea (Türkiye) (Colakoglu *et al.*, 2011) and the western Black Sea (Bulgaria) (Merdzhanova *et al.*, 2021).

Lipid composition is influenced by adaptive processes in animals, a phenomenon extensively documented in the literature (Hochachka & Somero, 2002). Lipids in mollusks respond to habitat changes, abiotic factors (e.g., salinity, temperature, recreational pressure, anoxia), and other stressors (Hochachka & Somero, 1971; Fokina *et al.*, 2018, Fokina & Chesnokova, 2021). Under stress, physicochemical modifications of cell membranes—primarily involving phospholipids and cholesterol (structural lipids)—occur to maintain optimal viscosity. During temperature drops, often accompanied by anoxia (e.g., during low tides), mollusks utilize triacylglycerols as an alternative energy source (Fokina *et al.*, 2018, Fokina & Chesnokova, 2021).

Sublittoral mollusks face greater abiotic stress, resulting in lipid profiles that are distinct from those of deeper-water counterparts or individuals from other oceanic regions. This study aimed to investigate TLs and major lipid classes – phospholipids (PLs), monoacylglycerols (MGs), diacylglycerols + sterols (DGs+st), free fatty acids (FFAs), and triacylglycerols (TAGs) – in *C. gallina* from the sublittoral zone of Sevastopol Bay (Black Sea) over an annual cycle, with a particular focus on FA composition in spring, a period of favorable feeding conditions.

MATERIAL AND METHODS

Study Object, Sample Collection, and Processing

Specimens of *Chamelea gallina* were collected monthly from December to May and September to December 2021–2022 from three stations in the sublittoral zone of Kazachya Bay, Sevastopol (Fig. 1). The sediment was sandy-silt sediment. The sampling regime covered the winter, spring, and autumn seasons; summer was excluded due to high temperatures, which compromised lipid stability during sample transport, reducing the accuracy of lipid determination. Each month, 5–7 adult clams (shell length 15–25 mm) were collected and their soft tissues pooled for analysis.

Fig. 1: Map of sampling in Kazachya Bay.
Sl. 1: Zemljevid obravnavanega območja.

Total Lipids and Thin-Layer Chromatography (TLC)

TLs were extracted using the Folch method (Folch *et al.*, 1957). Lipid classes—including PLs (phospholipids), MGs (monoacylglycerols), DGs+st (diacylglycerols + sterols), FFAs (free fatty acids), and TAGs (triacylglycerols)—were separated via two-dimensional TLC using the "chamber-in-chamber" principle (Borodina *et al.*, 2023). This technique employs a solvent polarity gradient for fractionation, utilizing a three-solvent system: Chamber 1: Chloroform; Chamber 2: Hexane: diethyl ether (9:1, v/v); Chamber 3: n-hexane. The Sorbfil Plates ПТСХ-АФ-А (Krasnodar, Russia) were used as the stationary phase. Prior to analysis, the plates were washed with ethyl acetate and activated with an alcoholic solution of phosphomolybdic acid (PMA).

Quantification of Lipid Fractions

Separated lipid bands were quantified densitometrically using an HP Scanjet 200 scanner. Acquired images (in JPEG format) were processed using TLC Manager 4.0.2.3D software for peak integration and quantitative analysis.

Preparation of Fatty Acid Methyl Esters (FAMEs)

Total lipid extracts were subjected to derivatization (Chen *et al.*, 2023; Juarez *et al.*, 2008) prior to analysis. The lipid extract was dissolved in a mixture of 180 µL dimethyl sulfoxide (DMSO; CAS 67-68-5, Panreac) and 20 µL of 25% methanolic tetramethylammonium hydroxide (TMAH; CAS 75-59-2, Sigma-Aldrich), then vortexed for 2 min. Subsequently, 30 µL of iodomethane (CAS 74-88-4, Sigma-Aldrich) was added for methylation.

The reaction mixture was incubated at room temperature for 20 min, after which n-hexane (CAS 110-54-3, Panreac) was added for liquid-liquid extraction. The mixture was vigorously agitated for 5 min using a PE-6300 laboratory shaker. The organic phase was then separated by centrifugation (10,000 RPM) using a Microspin FV-2400 vortex centrifuge. The hexane layer, containing fatty acid methyl esters (FAMEs), was carefully transferred to a gas chromatography vial for subsequent analysis.

Gas Chromatography-Mass Spectrometry (GC/MS)

The chromatographic-mass spectrometric analysis was performed at the Scientific Research Laboratory "Molecular and Cellular Biophysics" of Sevastopol State University using a Chromatec-Crystal 5000 GC/MS system equipped with a mass spectrometric detector.

Chromatographic conditions: injection volume: 1 µL; column: HP-5MS UI capillary column (Agilent; 30 m × 0.25 mm ID, 0.25 µm film thickness) containing (5%-phenyl)-methylpolysiloxane stationary phase; carrier gas: grade 6.0 helium at a constant flow rate of 1 mL/min; temperature program: initial temperature: 80°C (held for 2 min), ramp rate: 5°C/min to 280°C; injector: temperature: 280°C, split ratio: 20:1. Mass spectrometric conditions: ionization mode: electron impact (EI) at 70 eV; ion source temperature: 230°C; transfer line temperature: 280°C; mass range: 30–650 m/z. Data processing: The acquired data were processed using Chromatec Analytic 3.1 software (version 3.1.2211.3).

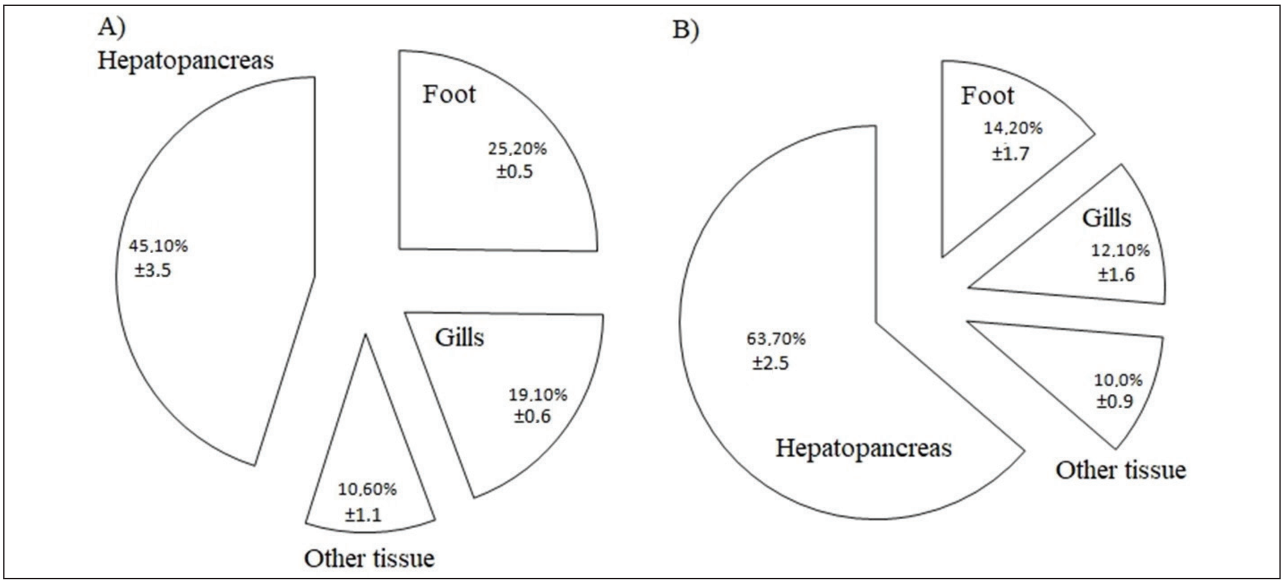

***Fig. 2: A) Organ mass distribution in* C. gallina *individuals; B) Total lipid (TL) content in* C. gallina.**
***Sl. 2: Porazdelitev mase organov pri primerkih vrste* C. gallina*; B) celokupna vsebnost lipidov (TL) pri primerkih vrste* C. gallina.**

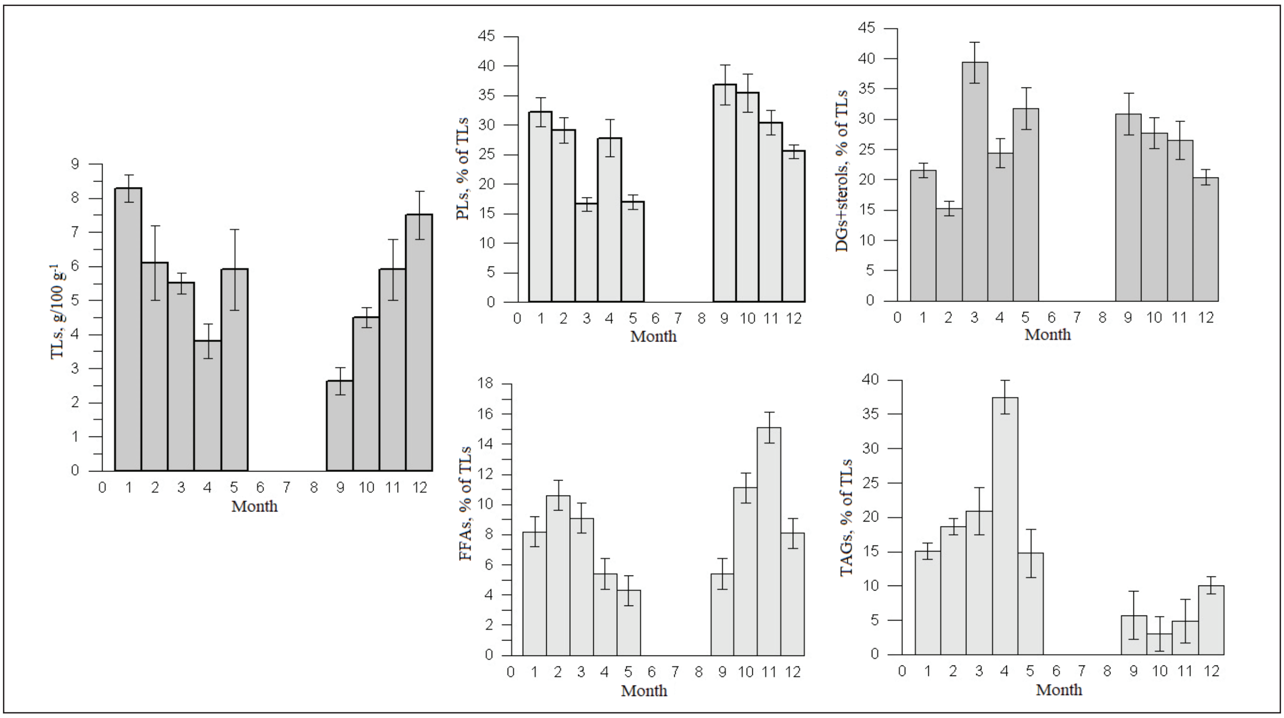

Fig. 3: Dynamics of TL and lipid classes – PLs, DGs+st, FFAs, and TAGs – in tissues of* C. gallina *clams in different periods of the annual cycle.
Sl. 3: Dinamika celokupnih lipidov in razredi lipidov – PLs, DGs+st, FFAs, in TAGs – v tkivih primerkov školjk* C. gallina *v različnih periodah letnega cikla.

Compound identification was performed using NIST MS Search v.3.0 against the NIST 2023 mass spectral library (database updated April 18, 2023).

Quantification and Statistical Analysis

Lipid fractions were quantified as percentages of total lipids (% TLs) for: PLs (phospholipids), DGs+St (diacylglycerols + sterols), FFAs (free fatty acids), and TAGs (triacylglycerols). All data are presented as mean ± standard error of mean (M±SEM). Significance threshold was established at $p \leq 0.05$. FA composition data were analyzed using the Mann-Whitney U-test (for non-parametric comparison).

RESULTS

Lipid Distribution and Seasonal Dynamics in *C. gallina*

Tissue-Specific Lipid Distribution (Early Winter)

At the beginning of winter, the distribution of total lipids across mollusk tissues was analyzed in relation to the organ mass-size characteristics (Fig. 2). The hepatopancreas emerged as the primary lipid reservoir, accounting for >50% of TL, which underscores its metabolic centrality in energy storage and mobilization.

Seasonal Dynamics of Lipids in Mollusks

Analysis of pooled tissues demonstrated marked seasonal fluctuations in TL content (Fig. 3). The highest lipid concentrations were observed during winter (6.1–8.3 g/100 g wet wt), with a secondary, more modest peak occurring in late spring (May: 5.9 g/100 g wet wt). During other sampling months, TL content fluctuated between 2.6–5.5 g per 100 g of wet tissue weight (wet wt).

The accumulation of major lipid classes—PLs, DGs+st, FFAs, and TAGs—exhibited distinct seasonal trends. Structural lipids, particularly PLs and sterols, dominated the TL pool throughout the year, accounting for 44.3% to 67.7% of TLs (in February and September, respectively), with an annual mean of 54.3 ± 2.56%.

Storage lipids (predominantly TAGs) showed a different pattern: peak accumulation: 37.5 ± 2.41% of TLs occurred in April, coinciding with plankton blooms and diversified food availability, while minimum levels (3.0 ± 0.50% of TLs) were recorded in October (autumn). The combined contribution of cholesterol (21.14 ± 1.06%) and PLs to TLs was comparable to TAG accumulation levels in April (Fig. 3, Tab. 1). This equilibrium between structural (PL+st) and storage (TAG) lipids suggests an active membrane maintenance despite seasonal resource shifts. Therefore, the FA study was conducted during the winter–spring period.

Tab. 1: Winter–spring FA and sterol composition in* C. gallina*. *Retention time - This is the time required for the substance to pass through the column (from the injector to the detector). Corresponds to the time when the peak maximum appears on the chromatogram. **Peak area, (% of the total) - his is the percentage of a given substance, which is calculated by determining the area of the corresponding peak as a percentage of the total area of all peaks detected in the sample. In this case, unmarked peaks corresponding to solvents, reagents, impurities, as well as the mobile phase or matrix of the sample are not taken into account.

Tab. 1: Zimsko-pomladna sestava maščobnih kislin in sterolov v* C. gallina*. *Retencijski čas - To je čas, ki je potreben, da snov preide skozi kolono (od injektorja do detektorja). Ustreza času, ko se na kromatogramu pojavi maksimum vrha. **Površina vrha (% od celotne površine) - To je odstotek dane snovi, ki se izračuna tako, da se površina ustreznega vrha določi kot odstotek celotne površine vseh vrhov, zaznanih v vzorcu. V tem primeru se ne upoštevajo neoznačeni vrhovi, ki ustrezajo topilom, reagentom, nečistočam, kot tudi mobilna faza ali matrica vzorca.

№	Lipid formula	Retention time* (min)	Peak area** (% of the total)
1	11:0	7.426	0.146±0.007
2	12:0	8.064	0.894±0.045
3	iso-14:0	9.028	0.400±0.020
4	14:0	9.232	3.433±0.172
5	4,8,12-tri-Me 13:0	9.512	1.140±0.057
6	anteiso-15:0	9.583	0.127±0.006
7	15:0	9.773	1.644±0.082
8	iso-16:0	10.103	1.216±0.061
9	16:0	10.289	21.459±1.073
10	iso-17:0	10.601	1.831±0.092
11	anteiso-17:0	10.648	1.423±0.071
12	17:0	10.780	1.972±0.099
13	18:0	11.250	7.923±0.396
	ΣSFAs		43.608±2.180
14	16:1ω-5	10.200	2.258±0.113
15	18:1ω-9t	11.149	7.044±0.352
16	18:1ω-9c	11.174	3.556±0.178
17	20:1ω-7	12.045	2.600±0.130
18	20:1ω-9	12.070	2.218±0.111
	ΣMUFAs		17.676±0.884
19	18:2ω-6	11.131	1.178±0.059
20	20:4ω-6	11.891	3.275±0.164
21	20:5ω-3	11.927	2.415±0.121
22	22:6ω-3	12.794	1.901±0.095
	ΣPUFAs		8.769±0.438
23	22:4ω-6,9,12,18	12.801	2.346±0.117
	ΣNMIFAs		2.346±0.117
24	22-Dehydrocholesterol	18.700	1.707±0.085
25	Cholesterol	19.313	21.136±1.057
26	Brassicasterol	20.101	4.758±0.238
	ΣSterols		27.601±1.380

FA Composition

In the winter–spring samples (collected from February through March), a total of 23 FAs and 3 sterols were detected (Tab. 1). In total, 13 saturated fatty acids (SFAs) were identified, with the major contributors—together comprising over one-third of all FAs)—being 16:0 (21.5%), 18:0 (7.9%), and 14:0 (3.4%). Five monounsaturated FAs (MUFAs) were identified, collectively accounting for less than one-fifth of total FAs. Among the MUFAs, the ω-9 FAs were of particular interest: 18:1ω-9c (3.6%) and 20:1ω-9 (2.2%), as well as the ω-7 FA 20:1ω-7 (2.6%). Four polyunsaturated FAs (PUFAs) were present, with the highest contributions from 20:4ω-6 (3.3%) and 20:5ω-3 (2.4%). Notably, one non-methylene-interrupted fatty acid (NMI FA)—22:4ω-6,9,12,18—was detected in appreciable quantity (2.4%). Quantitatively, PUFAs constituted one-tenth of the total FA and sterol content. Among the sterols, cholesterol was the most abundant (21.1%), with smaller quantities of 22-dehydrocholesterol (1.7%) and brassicasterol (4.8%) also detected and identified.

DISCUSSION

The primary factors governing the seasonal dynamics of lipid composition in bivalve mollusks include water temperature, salinity, food resource availability and quality, as well as reproductive cycle stages (Hochachka & Somero, 1971; Fokina *et al.*, 2018). Of particular interest is the adaptation of mollusks inhabiting the sublittoral zone, where they experience significant fluctuations in temperature, salinity, and periodic hypoxia induced by wave action during low tides. Biochemical adaptation mechanisms to such conditions are primarily mediated through lipid metabolism (Hochachka & Somero, 1971; Fokina *et al.*, 2018). PLs, cholesterol, SFAs, and PUFAs play pivotal roles in this process, as the primary response to environmental stressors involves modification of the cell membrane structure, whose main component is the lipid bilayer (Fokina *et al.*, 2018). One of the most significant adaptive mechanisms is homeoviscous adaptation, which maintains optimal membrane fluidity (Hochachka & Somero, 2002). This process entails remodeling of the membrane lipid composition, including adjustments to the cholesterol-to-phospholipid ratio and modifications of the fatty acid profile within phospholipids (Fokina *et al.*, 2018).

In *C. gallina*, seasonal variations in total lipid (TL) content demonstrate a predominance of structural lipids (PLs and cholesterol) consistent with this adaptation mechanism. The reduction in TAGs (storage lipids) can be explained not only by adaptive responses to peak coastal temperatures, anthropogenic pressure, and hypoxia events, but also by active reproductive phases. In bivalves (Bivalvia), storage lipids are primarily accumulated in the gonads; thus, their significant decrease during autumn–winter coincides with completion of the reproductive cycle (Fokina *et al.*, 2018). Against the background of PL dynamics (the quantitatively dominant structural lipid class), increased storage lipids may indicate either greater food diversity or reduced metabolic expenditure. As shown in Fig. 3, TAG accumulation begins in late winter with increasing daylight and gradual warming of coastal waters. During the winter–spring period, a natural reduction in coastal anthropogenic pressure occurs alongside phytoplankton succession, which enriches the dietary spectrum for filter-feeding mollusks. Concurrently, the onset of the reproductive cycle involves active TAG accumulation in generative tissues. The combined effect of these factors likely explains the comparable proportions of structural and storage lipids observed in *C. gallina* in April, though TL content did not peak during this period. Maximum TL values occurred in winter, coinciding with dormancy and tissue restoration. A distinct TL peak in May tissues likely reflects spring dietary diversification. Our prior research on seasonal carotenoid dynamics supports this: significant carotenoid ester accumulation in spring months (Borodina *et al.*, 2021) indicates diverse food resources. The amplitude of seasonal TL fluctuations in *C. gallina* populations from the Crimean coast was 1.5–3.5 times greater than in specimens from the Mediterranean and the Bulgarian Black Sea (Orban *et al.*, 2007; Panayotova *et al.*, 2020; Merdzhanova *et al.*, 2021). These differences may stem from more pronounced seasonal abiotic variations and distinct trophic conditions in the northwestern Black Sea.

Elevated TLs during colder seasons may be driven by food availability (diatoms, dinoflagellates), as indicated by the predominance of palmitic acid (16:0), eicosapentaenoic acid (20:5n-3, EPA), and docosahexaenoic acid (22:6n-3, DHA) in the lipid profile (Table 1)—established biomarkers for these algal groups (Zhukova, 2019). Similar FA assimilation patterns occur in mussels during upwelling (Irisarri *et al.*, 2014). These biomarker FAs constituted 27.39% of TLs. The FA analysis period coincided with elevated levels of structural lipids (PLs and sterols). stearic acid (18:0; 7.9% of total FA pool) and arachidonic acid (20:4ω-6; 3.3%) were particularly significant for membrane formation. FA profiling identified multiple sources:

Zooplankton: 20:1ω-9, 20:4ω-6, 20:5ω-3
Bacteria/detritus: 15:0, 17:0, 18:1ω-9(t)
Endogenous biosynthesis: 16:0, 18:0, 16:1ω-5, 20:1ω-9 (Zhukova, 2019).

High SFA content (especially 16:0 and 18:0) may reflect accumulation for conversion into 20:1ω-9, 18:2ω-6, prostaglandin precursor 20:4ω-6, and 22:6ω-3 (Brett *et al.*, 1997). Key PUFAs—EPA and DHA—indicate specific adaptive mechanisms maintaining membrane functionality under temperature and salinity shifts (Copeman & Parrish, 2004; Zhukova, 2019). Notably, 22:6ω-3 may originate from dietary sources or endogenous synthesis from 20:5ω-3 (1.9% of FA pool) (Pollero *et al*., 1979). The presence of 22:4ω-6,9,12,18 (2.4% of FA pool), classified as an NMI FA (non-methylene-interrupted fatty acid), demonstrates enhanced oxidative stress resistance due to isolated double bonds (Fokina *et al*., 2018), indicating effective protective mechanisms against environmental challenges (Fokina *et al*., 2018; Zakhartsev *et al*., 1998). Methylene-interrupted fatty acids (MI-FAs) derived from mollusks hold significant potential for applications in the food and pharmaceutical industries due to their unique structure and bioactivity. In the food industry, they can be used: in developing functional foods enriched with PUFAs (omega-3: EPA, DHA) and other rare MI-FAs, such as yogurts, bread, and sports nutrition products; as an alternative to fish oil, thus reducing dependence on traditional fisheries; for lipid stabilization in food products, as some MI-FAs possess antioxidant properties that can extend shelf life; in formulating dietary foods that support cardiovascular and cognitive health, leveraging their low saturated fat content and high levels of DHA. In the pharmaceutical industry, they can be utilized: as anti-inflammatory and cardioprotective agents in combating chronic inflammation, since MI-FAs can modulate cyclooxygenase (COX) and lipoxygenase (LOX) activity, reducing the production of pro-inflammatory eicosanoids, and mitigate atherosclerosis risks by regulating lipid profiles; to shield against neurodegenerative diseases through influences on synaptic plasticity and exert antidepressant effects by modulating serotonergic and dopaminergic systems; to suppress certain pathogenic bacteria, with specific MI-FAs exhibiting activity against *Helicobacter pylori* and *Staphylococcus aureus*; to induce apoptosis in cancer cells (e.g., in leukemia and breast cancer); in developing dietary supplements (DSs) with enhanced bioavailability and creating novel lipid-based nanocarriers for targeted drug delivery. Thus, these mollusk-derived methylene-interrupted fatty acids possess multifunctional potential, ranging from the creation of enriched foods to the development of novel anti-inflammatory, neuroprotective, and anti-tumor drugs. Their application can drive advancements in these industrial sectors and personalized medicine.

22-Dehydrocholesterol in sterol composition may reflect phytoplankton-related dietary specificity. Brassicasterol—a product of sterol metabolism in animals and microorganisms (Costa, 2025)—may also enter this hydrobiont through diet (Leblond, 2023).

MUFA/SFA and PUFA/SFA ratios were 0.41±0.04 and 0.25±0.02, respectively. The ω-3/ω-6 ratio (0.63) in *C. gallina* exceeds the health-beneficial threshold (>0.25; Raes *et al*., 2004) and is substantially higher than in Western diets (Simopoulos, 2003), highlighting its nutritional value.

CONCLUSIONS

In the sublittoral zone, the striped venus clam *Chamelea gallina*—subjected to elevated anthropogenic pressure—exhibited year-round dominance of structural lipids (PLs and sterols) over storage lipids (TAGs). Significant peaks in TL dynamics occurred during late winter and early spring. The fatty acid profile comprised 23 distinct compounds: 13 SFAs, 5 MUFAs (including one NMI FA), and 4 PUFAs. The sterol profile included three compounds, with cholesterol predominating (21.14±1.06%).

Thus, *C. gallina* holds significant potential as a source of specific lipids (unique NMI FAs, cholesterol) and due to its favorable ω-3/ω-6 ratio. Primary applications include nutraceuticals (production of dietary supplements), pharmaceuticals (cholesterol utilization and NMI FA extraction), and specialized PUFA-enriched foods (using raw materials harvested during optimal seasons). Realizing this potential requires ensuring the environmental safety of raw materials (considering anthropogenic pressure), developing efficient processing technologies, and validating biological activity of target components in clinical studies.

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ZNAČILNOSTI KOPIČENJA LIPIDOV V NAVADNI VENERICI (*CHAMELEA GALLINA*) V OBREŽNEM PASU KRIMSKE OBALE (ČRNO MORJE)

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POVZETEK

*Sezonske študije lipidov pri školjkah so ključne za oceno presnovnih lipidnih profilov in telesnega stanja. Cilj te študije je bil raziskati sezonske vzorce skupnega kopičenja lipidov, identificirati razrede lipidov in določiti sestavo maščobnih kislin navadne venerice (*Chamelea gallina*) iz obrežnega pasu vzdolž krimske obale Črnega morja. Najvišje ravni skupnih lipidov (TL), vključno s triacilgliceroli (zaloge lipidov), so bile opažene v zimsko-pomladnem obdobju, v katerem je sestava maščobnih kislin (FA) obsegala 23 vrst. Sestava maščobnih kislin navadne venerice se je razlikovala od sestave populacij v drugih regijah svetovnega oceana. Rezultate je mogoče uporabiti za celovito oceno vplivov okolja na organizme v raziskavah biomonitoringa in za oceno potencialne hranilne vrednosti teh školjk.*

Ključne besede: navadna venerica, *Chamelea gallina*, Črno morje, lipidi, maščobne kisline, sezonskost

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RECENT OBSERVATIONS ON *MONACHUS MONACHUS* (PHOCIDAE) AT SEA-CAGE FISH FARMS IN IZMIR (TURKISH AEGEAN SEA)

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ABSTRACT

On 8 February, 3 May, and 9 May 2025, three specimens of Monachus monachus *were photographed by a staff diver at two fish farms rearing sea bass and sea bream in Gerence Bay, Izmir, in the Aegean Sea. A comprehensive set of behavioural data on Mediterranean monk seals was obtained from the diver via an interview. The findings confirm the near-permanent presence of monk seals in the study area. The paper also suggests that excessive dependence on fish farms could alter the monk seals' feeding behaviour and potentially even lead to their domestication.*

Key words: Mediterranean monk seal, feeding behaviour, interaction, Mediterranean Sea

OSSERVAZIONI RECENTI SU *MONACHUS MONACHUS* (PHOCIDAE) PRESSO IMPIANTI DI ACQUACOLTURA IN GABBIE A MARE NELL'AREA DI IZMIR (MAR EGEO TURCO)

SINTESI

L'8 febbraio, il 3 maggio e il 9 maggio 2025, tre esemplari di Monachus monachus *sono stati fotografati da un subacqueo del personale presso due impianti di allevamento di spigole e orate situati nella baia di Gerence, a Izmir, nel Mar Egeo. Un ampio insieme di dati comportamentali sulle foche monache del Mediterraneo è stato raccolto dal subacqueo tramite un'intervista. I risultati confermano la presenza quasi permanente di foche monache nell'area di studio. L'articolo suggerisce inoltre che una dipendenza eccessiva dagli impianti di acquacoltura potrebbe modificare il comportamento alimentare delle foche e persino portare, potenzialmente, a una loro domesticazione.*

Parole chiave: foca monaca, comportamento alimentare, interazione, Mediterraneo

INTRODUCTION

The Mediterranean monk seal (*Monachus monachus*) is regarded to be one of the rarest marine mammals in the world, with a current global population estimated at no more than 800 individuals (Dendrinos *et al.*, 2022). The species has registered a marked recovery over the past decade and is now classified as Vulnerable by the International Union for Conservation of Nature (IUCN). The largest subpopulation – estimated at 444–600 mature individuals – is currently found in the eastern Mediterranean Sea (Karamanlidis *et al.,* 2023; Karamanlidis, 2024). Other groups in the eastern Mediterranean consist of small, loosely structured aggregations, usually comprising fewer than 20 individuals. A recent study reported thirty-four sightings along the Syrian coast between 2001 and 2023 (Ibrahim *et al.*, 2024).

The Mediterranean monk seal is the sole resident pinniped species in the Mediterranean Sea (Karamanlidis, 2024). Sporadic sightings have been recorded primarily in the eastern part of the basin, including the islands of the Ionian and Aegean Seas, the mainland coast of Greece, the western and southern coasts of Türkiye, and the coasts of Cyprus (Dendrinos *et al.,* 2022). A recent study reported a total of 361 monk seal sightings in Cyprus between 2009 and 2018, with the vast majority (95%) involving juvenile and adult individuals, and only 18 sightings being of newborn pups (Nicolaou *et al.*, 2021). Additionally, Mediterranean monk seals were monitored in caves along the northern coast of Cyprus between November 2016 and May 2019, and seven individuals were confirmed: three pups and four juvenile-subadult-adult seals (Beton *et al.*, 2021).

The extirpation of the Mediterranean monk seal from the Black Sea is believed to have occurred as recently as 1997, though a small population persists in the Sea of Marmara (Dendrinos *et al.,* 2022), including two individuals recorded near Karabiga (Inanmaz *et al.*, 2014). Despite sporadic observations reported from this region, the only known active breeding populations are located in the Aegean Sea, the northeastern Mediterranean Sea, the Greek Ionian Sea, Madeira, and off the coast of Mauritania (Bundone *et al.,* 2019; Panou *et al.*, 2023).

The monk seal is strictly protected under Turkish law, European Directives, and International Conventions. In Türkiye, a national strategy for the conservation of the species was adopted in 1991, followed by the establishment of a national seal committee to coordinate conservation activities (Güçlüsoy *et al.*, 2004). In spite of these measures, the primary threats to the species in the Mediterranean persist and can be categorised as follows: terrestrial and marine habitat loss and degradation resulting from increased human pressure, including tourism and pollution; negative interactions with fisheries and aquaculture, which occur even in countries and regions where the species is legally protected; and other unpredictable threats (Karamanlidis, 2024).

The Mediterranean monk seal spends most of its life at sea, primarily foraging for food (Dendrinos *et al.*, 2022). It is widely considered an opportunistic predator that feeds mostly on the continental shelf, with a diet dominated by fish, crustaceans, and cephalopods (Karamanlidis, 2024). Recent studies have confirmed that Mediterranean monk seals can successfully forage independently in the wild from as early as five months of age (Kıraç & Ok, 2019). Since the 1980s, the widespread expansion of mariculture in the Mediterranean has provided the species with a new and abundant food source, rivalling the availability of wild fish (Akyol & Ceyhan, 2020). This has led to monk seal attacks on sea-cages at fish farms, which have been documented. Güçlüsoy & Savaş (2003), for instance, reported 40 such attacks at 11 fish farms in the Turkish Aegean Sea between 1992 and 2000, which caused cage net damage and the escape of farmed fish. Similarly, Gerovasileiou *et al*. (2017) captured photographic evidence of seven Mediterranean monk seals at four different fish farms in the Aegean Sea.

This study provides further photographic evidence of *M. monachus* at two sea-cage fish farms in the Aegean Sea, thereby expanding our knowledge on the adapting feeding behaviour of this rare species.

MATERIAL AND METHODS

On 8 February, 3 May, and 9 May 2025, three *M. monachus* individuals (Fig. 1) were photographed by a staff diver using GoPro Hero 8 at two fish farms rearing sea bass and sea bream in Gerence Bay, Izmir (1st farm: 38.440312°N, 26.481155°E; 2nd farm: 38.449723°N, 26.417067°E, Fig. 2). The diver works at both fish farms, which are owned by the same company. The fish farms were deployed at depths of 70 m and 89 m, respectively, and are both located approximately 1 km from the mainland. They lie within the Chios and Turkish Coast IMMA (Important Marine Mammal Area) in the central eastern Aegean Sea, which encompasses an area bounded by Chios, Psarra, Çeşme, the Karaburun Peninsula, the Gulf of Izmir, and Foça, extending offshore towards the 200 m isobath (IUCN-MMPATF, 2017).

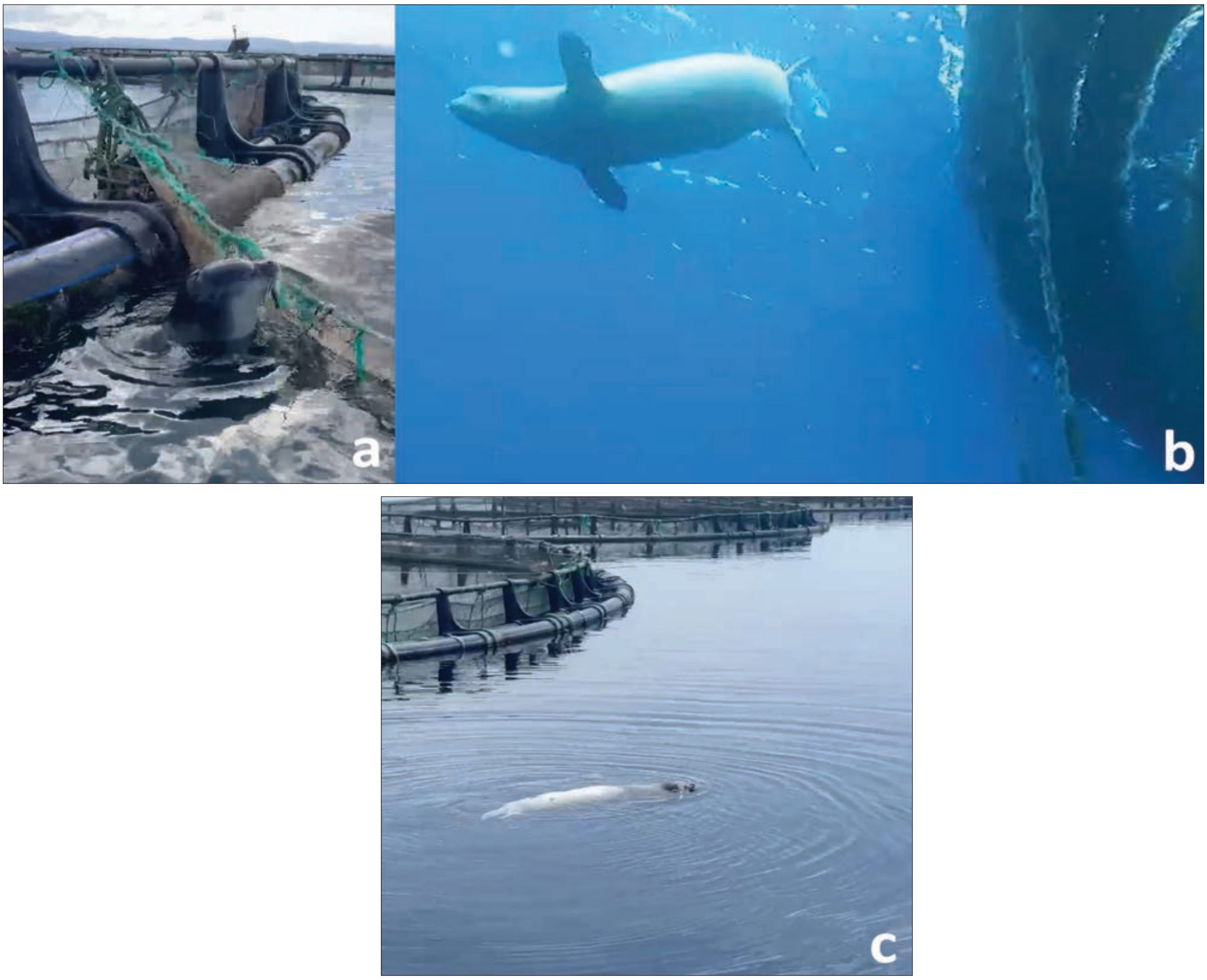

Fig. 1: Recent observations of *Monachus monachus* ***at sea-cage fish farms in Gerence Bay (i.e., Chios and the Turkish coast of the IMMA) include the following: (a) an adult female with a fish in its mouth, recorded on 8 February 2025 at the first fish farm; (b) an underwater view of a subadult specimen captured on 3 May 2025 at the second fish farm; and (c) an adult female observed eating fish at the sea surface on 9 May 2025 at the second fish farm (all courtesy of Davut Aydın).***

Sl. 1: Nedavna opažanja vrste *Monachus monachus* ***v ribogojnicah v kletkah v zalivu Gerence (tj. Hios in turška obala IMMA) vključujejo naslednje: (a) odrasla samica z ribo v ustih, posneta 8. februarja 2025 v prvi ribogojnici; (b) podvodni pogled na mladostni primerek, posnet 3. maja 2025 v drugi ribogojnici; in (c) odrasla samica, opažena pri prehranjevanju z ribami na morski gladini 9. maja 2025 v drugi ribogojnici (vse z dovoljenjem Davuta Aydına).***

The sex of Mediterranean monk seals was estimated based on their coloration across different life stages (Samaranch & González, 2000; Quintana MartínMontalvo & Muñoz Cañas, 2025).

RESULTS AND DISCUSSION

According to the diver we interviewed, the Mediterranean monk seals appeared occasionally during the harvest period, especially in summer. This occurred when a fish transfer bridge – made of a net and ropes – was installed between a large cage containing reared fish (50 m in diameter) and a small, empty cage (20 m in diameter). The seals were observed entering the open-top net and stealing fish (Fig. 1a). In general, they would be seen reposing on the cage floats, exhibiting a curious but timid attitude, often observing people from a distance. Sightings increased in frequency in the spring and summer months, typically during daylight hours. The diver also reported that the seals did not display any aggressive behaviour and were never seen entering the cages themselves (D. Aydın, pers. comm.).

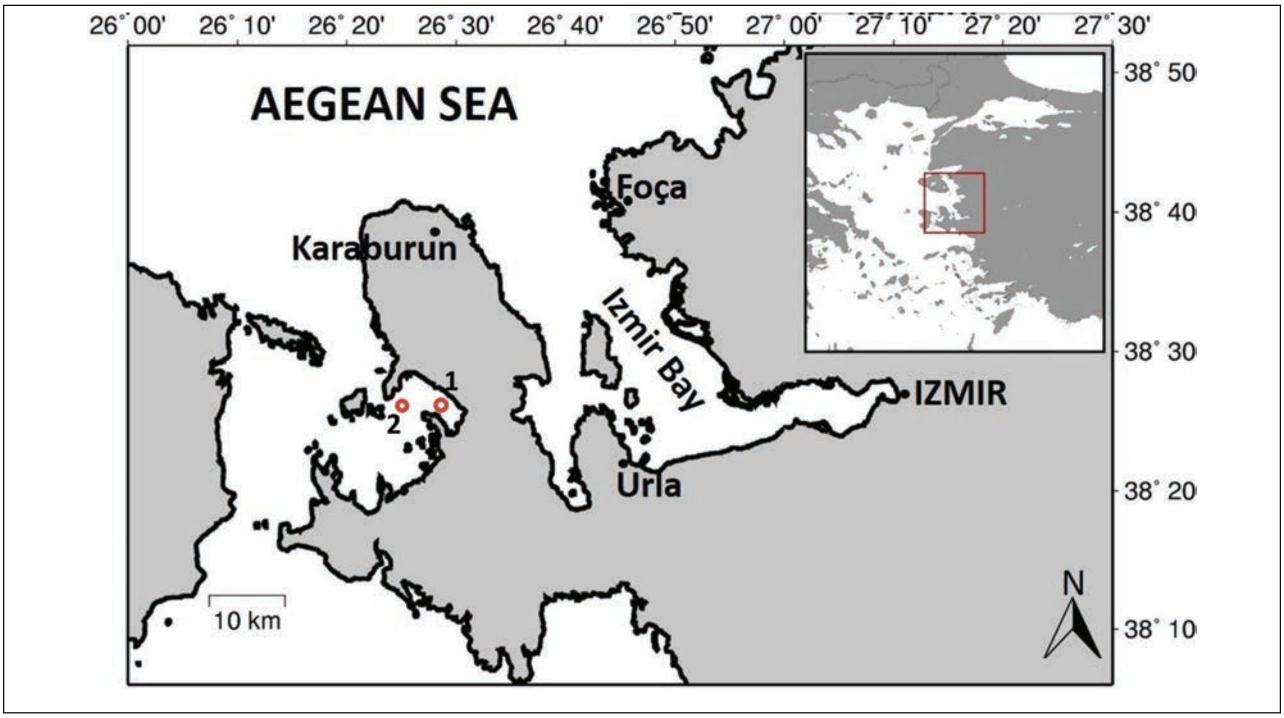

Fig. 2: Map showing the locations of the sea-cage fish farms (1: first fish farm, 2: second fish farm) in the Aegean Sea.
Sl. 2: Zemljevid obravnavanega območja z ribogojnicami s kletkami (1: prva ribogojnica, 2: druga ribogojnica) v Egejskem morju.

Gerovasilieou *et al*. (2017) documented an individual of *M. monachus* attacking a sea-cage fish farm in Izmir on 15 December 2016, further confirming the behaviour previously observed by Güçlüsoy & Savaş (2003). It is evident that Mediterranean monk seals are able to locate ample sustenance in the vicinity of fish farms, which act as Fish Aggregating Devices (FADs), and in the fish bridges formed during harvesting operations. This trend is problematic as it fosters negative interactions between the seals and man-made structures. Potential adverse consequences include Mediterranean monk seals abandoning open-sea foraging, increased attacks on fish farms, or harm inflicted upon the seals by unscrupulous fishers. It is therefore imperative that fishers, including fish farm employees, understand the behaviour exhibited by Mediterranean monk seals. To support the conservation of this species, human interaction, such as feeding, should be actively discouraged. Moreover, since Mediterranean monk seals represent an important component of our natural heritage, their populations should be continuously monitored.

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NEDAVNA OPAŽANJA PRIMERKOV *MONACHUS MONACHUS (PHOCIDAE)* V RIBOGOJNICAH Z MORSKIMI KLETKAMI V IZMIRJU (TURŠKO EGEJSKO MORJE)

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POVZETEK

Potapljač je 8. februarja, 3. maja in 9. maja 2025 fotografiral tri primerke vrste Monachus monachus *na dveh ribogojnicah, kjer gojijo brancine in orade v zalivu Gerence v Izmirju v Egejskem morju. S pomočjo intervjujev je pridobil obsežen nabor vedenjskih podatkov o sredozemskih medvedkah. Ugotovitve potrjujejo, da je na preučevanem območju sredozemska medvedka skoraj stalno prisotna. Poleg tega prispevek tudi nakazuje, da bi lahko pretirana odvisnost od ribogojnic spremenila prehranjevalne navade sredozemskih medvedk in morda celo privedla do njihove udomačitve.*

Ključne besede: sredozemska medvedka, prehranjevalno vedenje, interakcije, Sredozemsko morje

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FLORA

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LA FLORA DI PALENA (PARCO NAZIONALE DELLA MAJELLA): AGGIORNAMENTO FLORISTICO

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SINTESI

Il presente lavoro segue un altro del 2012 ed è finalizzato a riportare un elenco floristico aggiornato dei taxa presenti nell'ambito di studio. La compilazione di una nuova check-list è indispensabile poiché i recenti studi hanno portato a rimaneggiamenti tassonomici, nuove segnalazioni e l'esclusione di altri considerati presenti. L'elenco floristico attuale comprende 1535 taxa tra cui 162 specie endemiche che accrescono l'importanza fitogeografica dell'area di studio. Lo spettro corologico mostra che i taxa censiti appartengono a 47 diversi corotipi, ripartiti in 9 contingenti geografici.

Parole chiave: Palena, Abruzzo, flora, fiume Aventino

THE FLORA OF PALENA (MAJELLA NATIONAL PARK): FLORISTIC UPDATE

ABSTRACT

This work follows another from 2012 and aims to provide an updated floristic list of the taxa present in the study area. The compilation of a new checklist is essential as recent studies have led to taxonomic reorganizations, new reports of other taxa and the exclusion considered to be present. The current floristic list includes 1535 taxa including 162 endemic species which increase the phytogeographic importance of the study area. The chorological spectrum shows that the recorded taxa belong to 47 different chorotypes, divided into 9 geographical contingents.

Key words: Palena, Abruzzo, flora, Aventino river

INTRODUZIONE

Nel territorio di Palena Pezzetta *et al.* (2012) segnalarono 1201 taxa. In seguito, i rimaneggiamenti tassonomici e le nuove ricerche hanno ampliato le conoscenze esistenti con l'aggiunta di nuove entità e l'esclusione di altre che si consideravano presenti. Alla luce di questi fatti si rende necessario compilare un nuovo elenco floristico che riporti tutte le novità riscontrate. Di conseguenza con il presente articolo presenta una nuova check-list comprendente tutte le specie di piante vascolari presenti nel territorio comunale di Palena e un saggio analitico e di discussione con i seguenti aspetti fitogeografici: 1) l'insieme dei corotipi a cui appartengono i taxa rinvenuti; 2) quali sono endemici, rari, invasivi, rappresentanti di importanti migrazioni floristiche avvenute in epoche passate e/o al limite del loro areale di distribuzione. Queste conoscenze nel loro insieme: dimostrano l'importanza naturalistica dell'ambito di studio e risultano fondamentali per una corretta gestione del territorio. Esse permettono di tutelare le specie vulnerabili e di favorire il turismo naturalistico, poiché la presenza di boschi, pascoli, prati e altri ambienti ricchi di specie vegetali accresce il valore paesaggistico, l'attrattiva turistica, oltre all'importanza scientifica e ricreativa del territorio.

Inquadramento dell'area d'indagine

Palena è un Comune abruzzese della Provincia di Chieti (Fig. 1) ubicato nell'alta valle del fiume Aventino e sulle pendici del versante sud-orientale del massiccio della Majella. Il suo centro abitato sorge su un pianoro leggermente ondulato situato all'altitudine media di 767 metri ed è costituito da un nucleo d'origine medioevale che si sviluppò attorno a un castello e in seguito si allargò nelle zone circostanti. Ad esso si arriva percorrendo la Strada Statale Frentana n° 84 che collega Roccaraso (Prov. L'Aquila) con Lanciano (prov. Chieti).

Il territorio comunale copre la superficie di 91.61 Kmq e si estende lungo l'asse NO-SE, tra la quota minima di 603 metri e quella massima di 2565.

In un ambito locale detto "Capo Di Fiume" affiorano le sorgenti dell'Aventino che attraversa il centro abitato e dopo circa 40 km s'immette nel Sangro, il secondo fiume d'Abruzzo.

Il versante palenese settentrionale, situato sulla sinistra orografica del fiume Aventino, presenta una morfologia accidentata e raggiunge la quota massima di 2.575 metri. Esso si estende dal massiccio della Majella fino alle alture che circondano il vallone di Femmina Morta e comprende il Monte Porrara (2.136 m; Fig. 2) e la Tavola Rotonda (2.402 m), separati tra loro dal Guado di Coccia. In particolare, il Monte Porrara rappresenta l'estremità meridionale del massiccio della Majella. Ha un andamento longitudinale nord-sud e culmina con l'ultima dorsale, che termina alla quota di 1.260 m presso Forchetta Palena. La sua lunga cresta segna inoltre il confine tra le province di Chieti e L'Aquila.

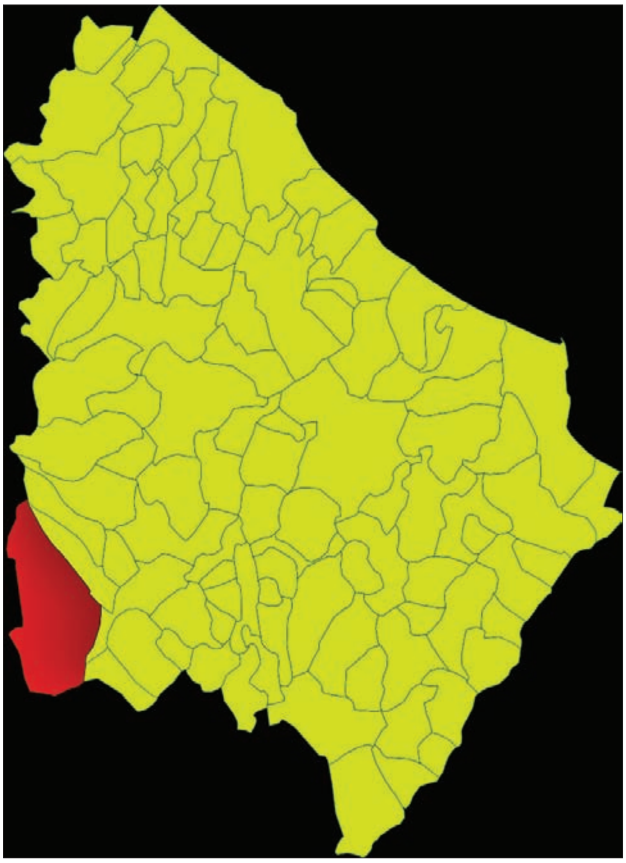

Fig. 1: La Provincia di Chieti con il territorio di Palena (in rosso).
Sl. 1: Provinca Chieti z ozemljem Palena (v rdeči barvi).

Al territorio palenese appartiene anche l'altopiano di Quarto Santa Chiara, una conca endoreica di origine tettonico-carsica che fa parte dei cosiddetti "Altipiani Maggiori d'Abruzzo" e si trova alla quota media di 1250 metri. Esso è attraversato da vari rivoli superficiali e dal torrente La Vera che nell'ultima parte del suo percorso forma una serie di meandri e defluisce in un inghiottitoio presente nel punto più depresso del piano (Fig. 3). Una volta infiltrate, le acque attraversano il sistema carsico del Monte Porrara, e dopo circa tre ore fuoriescono a Capo di Fiume nelle sorgenti dell'Aventino (portata media 1.200 l/s).

Dopo il disgelo primaverile l'altopiano si allaga e si forma un laghetto con dimensioni e profondità variabili. Con il ritiro delle acque il pianoro ritorna asciutto, tranne nelle vicinanze dei vecchi meandri del torrente ove l'acqua ristagna anche nella stagione estiva.

Fig. 2: Il Monte Porrara.
Sl. 2: Monte Porrara.

Fig. 3: L'inghiottitoio dell'altipiano di Quarto Santa Chiara.
Sl. 3: Vrtača na planoti Quarto Santa Chiara.

Dal punto di vista geologico il territorio palenese è molto eterogeneo. La parte a ridosso del Monte Porrara e della Majella è costituita in prevalenza da rocce calcaree del Meso-Cenozoico. Nel versante orografico destro della valle dell'Aventino prevalgono depositi marini mio-pliocenici costituiti da formazioni argillose e arenacee. L'altipiano di Quarto di Santa Chiara, a sua volta è costituito da depositi fluvio-lacustri plio-pleistocenici: argille, sabbie, ghiaie e conglomerati poco cementati intercalati a livelli torbosi.

Per quanto riguarda il clima, a causa dell'elevata escursione altitudinale, nell'ambito in esame sono individuabili diverse tipologie climatiche.

I dati termo-pluviometrici relativi al centro abitato evidenziano che Palena presenta un clima di transizione tra il mediterraneo e il temperato-fresco, con le seguenti caratteristiche (Pezzetta, 1998): precipitazioni medie annue pari a 990 mm; massime precipitazioni in inverno (301 mm) e minime in estate (151 mm); valore massimo mensile a novembre con 127 mm. La temperatura media annua giornaliera è di 11,5 °C, con una media di 20,9 °C nel mese più caldo (luglio) e di 4 °C nel mese più freddo (gennaio). L'escursione termica media annua è pari a 17 °C.

La porzione territoriale che va sino 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.

La fascia altitudinale compresa tra 900 e 1500 metri d'altitudine rientra nel termotipo Collinare-Montano e nell'ombrotipo Umido con le seguenti caratteristiche: precipitazioni di oltre 1000 mm annui; temperatura media annua di circa 10 °C; due mesi annui con temperature medie inferiori a 0°C. La fascia altitudinale oltre 2200 metri appartiene al termotipo Orotemperato inferiore e all'ombrotipo Iperumido inferiore con le seguenti caratteristiche locali: precipitazioni medie superiori a 1200 mm; temperatura media annua di circa 2°C; copertura media nevosa da 5 a 8 mesi annui.

Alcune particolari caratteristiche climatiche del piano alpino magellense che interessano anche parte dell'ambito in esame sono fornite dalle intense nebbie e dai forti venti che facilmente raggiungono velocità superiori a 100 Km/h.

Il territorio palenese è caratterizzato anche da una notevole eterogeneità floro-vegetazionale. Nel suo complesso è costituito da boschi (54 %), pascoli (21 %), estesi prati stabili (15%) e, il resto (circa il 10% della superficie territoriale), da ambiti coltivati, aree urbanizzate e terreni incolti.

Le particolari formazioni vegetali locali osservabili nel luogo cambiano con l'altitudine, il tipo di substrato, l'esposizione solare e la pressione antropica esercitata con il pascolo e il taglio degli alberi.

Alle quote inferiori della Majella e negli ambiti molto riparati dalle correnti fredde e favorevolmente esposti alla luce solare attecchiscono specie tipiche di ambienti caldi e soleggiati tra cui *Quercus ilex*, *Osyris alba*, *Anemone hortensis* ed altre entità termofile appartenenti a diverse famiglie vegetali, tra cui le cistacee, hypericacee, leguminose, brassicacee e crassulacee. Lungo il fiume Aventino si sviluppa una vegetazione ripariale con varie specie di salici, pioppi e ontani (*Alnus glutinosa*, *Populus nigra*, *Salix alba*, etc.). Alla sinistra idrografica, si rinvengono alcuni querceti misti con varie specie arboree. Il piano montano è dominato dalla faggeta che costituisce oltre il 70 % dei boschi locali. Nell'altopiano del Quarto di S. Chiara attecchiscono diverse formazioni erbacee tipiche di ambienti umidi che comprendono entità molto rare. Nella fascia subalpina al limite della vegetazione arborea, sono presenti piccoli nuclei di *Pinus mugo* Turra subsp. *mugo* e arbusteti con *Juniperus communis* L. e *Arctostaphylos uva-ursi* (L.) Spreng. Alle quote più elevate si alternano le praterie primarie e secondarie con gli ambienti rocciosi e glareicoli sommitali in cui si rinvengono importantissime specie vegetali relittiche, endemiche e rare che sono incluse nelle liste rosse e protette.

Le ricerche botaniche a Palena

Le esplorazioni floristiche dell'ambito di studio iniziarono nel XIX secolo con Michele Tenore che nel 1831, durante le sue ricerche sulla flora della Majella lo visitò. Altrettanto fecero nella seconda metà del XIX secolo Cesati (1872) e all'inizio del nuovo secolo Abbate (1901) che segnalarono entrambi nuovi ritrovamenti floristici.

Tuttavia, le segnalazioni più consistenti si ebbero agli inizi degli anni 80 del secolo scorso, con la pubblicazione di due ricerche di Feoli-Chiapella (1981, 1982) e una di Baltisberger (1981). Qualche anno dopo Tammaro (1986a) in un saggio citò oltre 250 specie presenti a Palena. Altre notizie sulla flora e/o vegetazione di tale località sono riportate nei saggi dei seguenti autori: Tammaro (1986b, 1998), Conti (1987, 1997, 1998), Conti *et al*. (1990, 2008, 2019, 2020), Manzi (1993, 1999, 2006), Conti & Manzi (1997), Conti & Pellegrini (1988, 1990), Galetti (1995, 2002, 2008), Daiss & Daiss (1997), Pirone (1997), Di Cecco (1999), Hennecke & Hennecke (1999), Di Renzo (2004), Blasi *et al*. (2005 Di Fabrizio (2006), Di Pietro *et al*. (2008), Gottschlich (2009), Griebl (2010), Wagensommer *et al*. (2011) Di Cecco & Pezzetta (2012), Gallo (2012), Ciaschetti *et al*. (2015), Bartolucci *et al*. (2019).

All'incremento delle conoscenze floristiche ha contribuito anche il personale dei Giardini Botanici Michele Tenore e Daniela Brescia che annualmente pubblicano in rete un index seminum in cui riportano i semi delle piante coltivate negli stessi e spontanee di varie località tra cui Palena.

Tab. 1: Corotipi della flora di Palena.
Tab. 1: Horotipi flore Palene.

Contingenti geografici	Numero taxa	%	Contingenti geografici	Numero taxa	%
Endemico e Subendemico	**162**	**10,5**	Orof. Europeo	1	
Endemico	149		Orof. Sud-Europeo	47	
Subendemico	13		Orof. Sud-Est-Europeo	22	
Mediterraneo	**410**	**26,7**	Orof. Sud-Ovest-Europeo	8	
Eurimediterraneo	225		Ovest-Europeo	3	
Stenomediterraneo	76		Sud-Est-Europeo	21	
Mediterraneo-Macaronesico	3		Sud-Europeo	16	
Mediterraneo-Montano	56		Sud-Ovest-Europeo	4	
Mediterraneo-Orientale	8		**Atlantico**	**28**	**1,8**
Mediterraneo-Occidentale	14		Atlantico	5	
Nord-Mediterraneo	13		Mediterraneo-Atlantico	8	
Nord-Est-Mediterraneo	7		Subatlantico	15	
Nord-Ovest-Mediterraneo	3		**Nordico**	**103**	**6,7**
Sud-Mediterraneo	4		Artico-Alpino	23	
Sud-Ovest-Mediterraneo	1		Circumboreale	80	
Eurasiatico	**414**	**27**	**Cosmopolita**	**87**	**5,7**
Eurasiatico s. s.	158		Cosmopolita	38	
Europeo-Caucasico	50		Subcosmopolita	49	
Eurosiberiano	51		**Avventizio ed Extraeuropeo**	**29**	**1,9**
Mediterraneo-Turaniano	20		Avventizio	9	
Orof. Eurasiatico	6		Asiatico	3	
Paleotemperato	78		Asiatico-Orientale	3	
Pontico	40		Sud-Ovest-Asiatico	1	
Sud-Europeo-Sud-Siberiano	11		Americano	1	
Europeo	**302**	**19,7**	Nord-Americano	3	
Appennino-Balcanico	75		Sud-Americano	4	
Centro-Europeo	28		Paleosubtropicale	4	
Europeo s. s.	73		Pantropicale	1	
Orof. Centro-Europeo	4				

MATERIALI E METODI

L'elenco floristico attuale con tutti i suoi aggiornamenti è stato realizzato considerando: le ricerche sul campo degli autori effettuate dopo il 2012; i dati ricavati della rilettura di vari saggi precedentemente consultati e dalla nuova letteratura; le segnalazioni inedite fornite da Centurione Nicola e Mirella Di Cecco. Esso comprende le specie, le sottospecie e alcuni ibridi che sono stati riconosciuti. Non sono state considerate le varietà cromatiche e morfologiche.

Nell'elenco floristico sono stati adottati i simboli che seguono con i seguenti significati:

** specie nuova per Palena non riportata in Pezzetta et al., 2012;*

specie nuova per il Parco Nazionale della Majella;

°° Il taxon raggiunge nel Parco della Majella il limite meridionale di distribuzione geografica in Italia.

La nomenclatura adottata e l'ordine di elencazione delle famiglie e specie presenti seguono Conti *et al.* (2020) con l'eccezione di alcuni taxa per i quali essa è stata rivista recentemente. Accanto ad ogni taxon sono riportati: il tipo corologico, le sigle degli autori che l'hanno segnalato, eventuali note e/o osservazioni. Per le entità alloctone si riportano le definizioni secondo Celesti-Grapow *et al.* (2010). Per l'assegnazione dei tipi corologici si è tenuto conto di quanto riportato nel sito internet di Acta Plantarum (https://www.actaplantarum.org) 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 state assegnate le specie contraddistinte da un areale limitato comprendente l'Abruzzo, talvolta altre regioni italiane e qualche stato europeo confinante con l'Italia;
- 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 tenendo conto del 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., Orofita Centro-Europeo, Orofita Europeo, Orofita Sud- Europeo, Orofita Sud-Est-Europeo, Orofita 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 i seguenti tre raggruppamenti di corotipi:
- macrotermico costituito da piante tipiche di ambienti caldo-temperati con temperature medie annue di oltre 20 °C;
- mesotermico che comprende piante che hanno bisogno di una temperatura media annuale di 15-20°C;
- 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.

Per specie nuova per il territorio di Palena s'intende un taxon che in precedenza non è stato riportato nella letteratura botanica consultata.

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 riportate dopo la nomenclatura e il corotipo di ogni taxon. Esse hanno i seguenti significati: AH: Tenore, 1831; AK: Cesati, 1872; AX: Abbate, 1903; AY: Feoli-Chiapella, 1981; AW: Baltisberger, 1981; BH:

Feoli-Chiapella, 1982; BK: Feoli-Chiapella, 1983; BQ: Conti *et al.,* 1986; BX: Tammaro, 1986a; BY: Conti, 1987; CH: Kalteisen & Reinhard, 1987; CX: Conti & Pellegrini, 1988; CY: Petriccione, 1988; CW: Conti *et al.,* 1990; DH: Conti & Pellegrini, 1990; DX: Manzi, 1992; DY: Manzi & Pellegrini, 1992; DW: Galetti, 1995; DZ: Manzi, 1993; EH: Daiss & Daiss, 1996; EK: Conti, 1997; EX: Pirone, 1997; EY: Conti, 1998; EW: Tammaro, 1998; FH: Di Cecco, 1999; FK: Hennecke &. Hennecke, 1999; FX: Manzi, 1999; FY: Galetti, 2002; FW: Di Renzo, 2004; HH: Blasi *et al.,* 2005; HY: Di Fabrizio, 2005; HW: Bongiorni *et al*., 2005; GH: Simeone *et al.,* 2006; IK: Galetti, 2008; IX: Gottschlich, 2009; IY: Hertel & Presser, 2009; IW: Griebl, 2010; JH: Conti *et al.,* 2011; JK: Romolini & Soca, 2011; JW: Wagensommer *et al.,* 2011; JX: Di Cecco & Pezzetta, 2012; JY: Gallo, 2012; KH: Index seminum Giardino Botanico Daniela Brescia, 2012; KK: Peccenini, 2012; KX: Index seminum Giardino Botanico M. Tenore, 2012; KY: Pezzetta *et al.,* 2012; LH: Romolini & Souche, 2012; LK: Tandè, 2012; LW: Index seminum Giardino Botanico Daniela Brescia, 2013; LX: Index seminum Giardino Botanico M. Tenore, 2013; LY: Peruzzi *et al.,* 2013; MH: Index seminum Giardino Botanico Daniela Brescia, 2014; MK: Index seminum Giardino Botanico M. Tenore, 2014; MW: Ciaschetti *et al.,* 2015; MX: Hertel & Presser, 2015; MY: Index seminum Giardino Botanico Daniela Brescia, 2015; NH: Index seminum Giardino Botanico M. Tenore, 2015, NK: Pirone, 2015; NW: Peccenini & Polatschek, 2016; NX: Index seminum Giardino Botanico M. Tenore, 2016; NY: Ciaschetti *et al.,* 2017; OH: Index seminum Giardino Botanico Daniela Brescia, 2017; OK: Index seminum Giardino Botanico M. Tenore, 2017; OW: Soca, 2017a; OX: Soca, 2017b; OY: Bergfeld; PH: Ciaschetti *et al.,* 2018; PK: Index seminum Giardino Botanico Daniela Brescia, 2018; PW: Index seminum Giardino Botanico M. Tenore, 2018; PX: Ricceri *et al.,* 2018; PY: Ciaschetti *et al.,* 2019; QH: Conti *et al.,* 2019; QK: Index seminum Giardino Botanico Daniela Brescia, 2019; QW: Index seminum Giardino Botanico M. Tenore, 2019; QX: Pezzetta, 2019; QY: Conti *et al.,* 2020; RH: Index seminum Giardino Botanico Daniela Brescia, 2020; RK: Index seminum Giardino Botanico M. Tenore, 2020; RW: Index seminum Giardino Botanico Daniela Brescia, 2021; RX: Index seminum Giardino Botanico M. Tenore, 2021; RY: Biagioli *et al.,* 2022; SH: Index seminum Giardino Botanico M. Tenore, 2022; SK: Index seminum Giardino Botanico Daniela Brescia, 2022; SW: Paolucci, 2022; SX: Pezzetta *et al.,* 2022; SY: Souche, 2022; SY: Ciaschetti & Di Cecco, 2023; TH: Index seminum Giardino Botanico Daniela Brescia, 2023; TK: Index seminum Giardino Botanico M. Tenore, 2023; TW: Pica *et al.,* 2023; UK; Index seminum Giardino Botanico M. Tenore, 2024; UX: Index seminum Giardino Botanico Daniela Brescia, 2024; VB: Aspettando l'evento; VH: Centurione oss. pers.; VK: Di Cecco oss. pers.; VX: Pezzetta oss. pers.; VY: Paolucci oss. pers.; ZH: Naturgucker.De.

RISULTATI E DISCUSSIONE

L'elenco floristico del territorio di Palena riportato in appendice è costituito da 1535 taxa di cui 371 nuovi per l'area (Appendice 1). L'area esaminata nonostante rappresenti solo lo 0,014% dell'intero territorio italiano, ospita il 15,3% della sua flora che in base alle ricerche più recenti (Bartolucci *et al.,* 2024, Galasso *et al.,* 2024) raggiunge il valore di 10023 taxa. Questo semplice dato è un importante indice che conferma l'elevata ricchezza floristica e biodiversità del territorio palenese.

La flora locale costituisce il 65,8% della flora del Parco Nazionale della Majella che ammonta complessivamente a 2331 taxa (Ciaschetti & Di Cecco 2023) e il 42,6% della flora abruzzese che a sua volta annovera 3604 entità (Bartolucci *et al.,* 2024). La densità floristica è di circa17 taxa per km².

***Fig. 4:** Ophrys passioni* **subsp.** *majellensis.*
***Sl. 4:** Ophrys passioni* **subsp.** *majellensis.*

Le famiglie vegetali più rappresentate sono le seguenti: Asteraceae (183 taxa). Fabaceae (121), Poaceae (109), Orchidaceae (95; nel conteggio dei taxa sono compresi anche gli ibridi; Figg. 4-6), Brassicaceae (76), Caryophyllaceae (66), Lamiaceae (65), Apiaceae (62), Rosaceae (58), Ranunculaceae (52) e Plantaginaceae (44).

Tra esse merita una particolare menzione la famiglia delle orchidacee a cui appartengono 63 entità distinte tra specie e sottospecie e numerosi ibridi. Tale numero è superiore a quello osservato in alcune regioni italiane e, ha portato a definire Palena "Il paese delle orchidee", facendo di questa famiglia di piante un importante emblema locale.

Sono nuove per il Parco Nazionale della Majella le seguenti entità: *Chaerophyllum nodosum* (L.) Crantz. *Euphorbia dulcis* L. e *Trigonella gladiata* Steven ex M.Bieb.

Fig. 5: *Dactyllorhiza incarnata.*
Sl. 5: *Dactyllorhiza incarnata.*

Fig. 6: *Neotinea x dietrichiana.*
Sl. 6: *Neotinea x dietrichiana.*

Le specie alloctone, avventizie, coltivate, naturalizzate e/o utilizzate per rimboschimenti, nel loro complesso ammontano a 51, pari al 3,3 % della flora locale, un valore molto piccolo che dimostra la bassa contaminazione floristica del territorio in esame.

Dalla Tabella 1 si osserva come i taxa considerati si ripartiscono in 47 diversi corotipi raggruppati in 9 contingenti geografici, un dato che conferma che il massiccio della Majella e l'Abruzzo costituiscono un importante crocevia di flussi floristici che ha ricevuto ondate migratorie di diversa origine geografica.

Dalla tabella si rileva come tra i corotipi domini il contingente Eurasiatico con 414 taxa. Esso è seguito dai contingenti Mediterraneo con 410 taxa, Europeo con 302, Endemico con 162, Nordico con 103, Cosmopolita con 87, Avventizio-Extraeuropeo con 29 e Atlantico con 28 taxa.

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

Alla particolare configurazione arealica descritta nella tabella hanno contribuito: 1) le vicende geologiche passate che hanno concorso a formare i ponti terrestri attraversati da 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 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.

A testimoniare l'importanza fitogeografica del territorio in esame concorrono anche i taxa endemici, rari, relittuali o al limite del loro areale di distribuzione geografica.

Le entità endemiche e subendemiche sono 162, corrispondenti a poco meno dell'11% della flora censita. Alcune di esse hanno una distribuzione più ampia lungo la penisola italiana, mentre altre occupano un areale più ristretto, limitato solo all'Appennino Centrale, all'Abruzzo o addirittura sono esclusive del massiccio magellense.

Un altro gruppo di specie di particolare interesse è costituito dalle entità a carattere relittuale. In tale ambito si possono distinguere:

- i relitti terziari costituiti dai taxa sopravvissuti alle glaciazioni e ampiamente diffusi durante l'Era Terziaria;
- relitti glaciali, costituiti da entità microtermiche che raggiunsero l'Abruzzo durante le fasi culminanti delle glaciazioni e al ritirarsi della calotta contrassero il loro areale e rimasero accantonate in ambiti idonei alla loro sopravvivenza. Il loro areale comprende le regioni temperato-fredde dell'emisfero boreale e ambiti in genere montani dell'Europa centro-meridionale. Molti di essi in Abruzzo raggiungono il limite meridionale di distribuzione geografica lungo la penisola italiana.
- i relitti xerotermici, costituti da piante tipiche di ambienti termofili, che dopo essere state confinate in stazioni di rifugio durante le glaciazioni, al loro termine risalirono lungo la Penisola e ora sono presenti in ambiti molto caldi e soleggiati.
- Alcune importanti specie del primo gruppo presenti nel territorio di Palena sono:
- *Daphne laureola*, un piccolo arbusto a distribuzione subatlantica, tipico dei boschi di latifoglie e degli aspetti più freschi della macchia mediterranea;
- *Ilex aquifolium*, una pianta a portamento arboreo-arbustivo, anch'essa a distribuzione subatlantica, presente nei boschi di latifoglie, soprattutto faggete e cerrete;
- *Taxus baccata*, una conifera a distribuzione paleotemperata che è presente nei boschi freschi, soprattutto faggete, ed è protetta dalle leggi regionali.

Nel secondo gruppo, particolarmente interessanti sono le entità artico-alpine che nel territorio di studio sono presenti con 23 taxa e sopravvivono solo alle quote più elevate, in habitat molto simili alla tundra artica.

Un gruppo di particolare interesse fitogeografico è costituito dalle entità appennino-balcaniche diffuse in modo esclusivo sui territori delle due penisole circumadriatico-ioniche che a loro volta sono le testimonianze vegetali di movimenti migratori tra le penisole italiane e balcaniche avvenuti coincidenza di ponti terrestri che si formarono durante le ere geologiche passate e che favorirono gli scambi di piante e animali. Ad avviso di Petriccione (1988) nella fascia mediterraneo-altomontana del massiccio della Majella, le specie orientali raggiungono le presenze massime tra tutti i gruppi montuosi dell'Appennino Centrale. La flora di Palena, come è visibile dalla tabella 1, comprende 75 taxa appennino-balcanici.

Il quarto gruppo di piante interessanti è costituito dalle entità occidentali atlantiche e subatlantiche che a loro volta rappresentano esempi di migrazioni floristiche da ovest verso est avvenute in coincidenza di climi umidi con distribuzione delle precipitazioni più uniformi durante le varie stagioni.

Alcuni relitti xerotermici presenti nella flora palenese sono: *Phillyrea latifolia*. *Quercus ilex*, *Teucirum flavum* subsp. *flavum* e *Viburnum tinus* subsp. *tinus*.

Il sesto gruppo di piante dal profilo fitogeografico molto interessante è costituito dalle entità al limite del loro areale di distribuzione geografica che sono presenti nell'area in esame, un fatto che accresce l'importanza naturalistica dell'ambito di studio. In particolare, i seguenti taxa presenti nel territorio palenese, raggiungono nel Parco della Majella il limite meridionale di distribuzione geografica in Italia: *Anemonastrum narcissiflorum*, subsp. *narcissiflorum*, *Aster alpinus* L. subsp. *alpinus*, *Astragalus australis*, *A. danicus*, *Centranthus angustifolius* subsp. *angustifolius*, *Carex capillaris* subsp. *capillaris*, *Cherleria capillacea*, *Crepis pygmaea*, *Epilobium alsinifolium*, *Gentiana orbicularis*, *G. verna* subsp. *tergestina*, *Hieracium murorum* subsp. *amaurocymum*, *H. murorum* subsp. *pleiotrichum*, *Iberis saxatilis* L. subsp. *saxatilis*, *Isatis apennina*, *Leontodon hispidus* subsp. *dubius*, *Linaria alpina*, *Malcolmia orsiniana* subsp. *orsiniana*, *Oreomecon alpina* subsp. *alpina*, *Pilosella anchusoides*, *Primula intricata*, *Ranunculus polyanthemoides*, *R. seguieri* subsp. *seguieri, Saponaria bellidifolia*, *S. ocymoides* subsp. *ocymoides, Teucrium botrys* e *Valeriana saliunca*.

A loro volta i taxa presenti nel territorio palenese che aggiungono in Abruzzo il limite settentrionale di distribuzione geografica sono i seguenti: *Athamanta sicula*, *Erysimum majellense* e *Saxifraga adscendens* subsp. *parnassica*.

I tre raggruppamenti che in accordo con Poldini (1991) tengono conto delle esigenze termiche delle entità rilevate 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 463 taxa (30,2%). Questo raggruppamento dimostra che nella flora palenese è presente un'importante 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 660 taxa (43%) ed è il più rappresentato, a dimostrazione della prevalenza di piante mesofile tipiche di ambienti temperato-freschi.

Il raggruppamento microtermico in cui sono stati inclusi i corotipi Subatlantico, Circumboreale, Artico-Alpino, Mediterraneo-Montano, Orofita Centro-Europeo, Orof. Europeo, Orof. Eurasiatico, O. Sud-Europeo, O. Sud-Est-Europeo e O. Sud-Ovest-Europeo è rappresentato da 263 taxa (17,1%). Questo raggruppamento è caratterizzato dal minor numero di taxa, a dimostrazione che nel territorio palenese 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.

RINGRAZIAMENTI

Per le informazioni fornite si ringraziano Centurione Nicola, Mirella Di Cecco.

Appendice 1: L'elenco floristico del territorio di Palena riporta 1535 taxa di cui 371 nuovi per l'area. * Specie nuova per Palena non riportata in Pezzetta** et al.* ***(2012). ## Specie nuova per il Parco Nazionale della Majella. °° Il taxon raggiunge nel Parco della Majella il limite meridionale di distribuzione geografica in Italia.
Priloga 1: Floristični seznam območja Palena poroča o 1535 taksonih, od katerih jih je 371 novih za to območje. * Vrste, ki so nove za Paleno in niso bile opisane v Pezzetta in sod. (2012). ## Vrste, ki so nove v narodnem parku Majella. °° Takson doseže južno mejo svoje geografske razširjenosti v Italiji v parku Majella.

	Elenco floristico	**TIPO COROLOGICO**	**AUTORI E OSSERVAZIONI**
	PTERIDOPHYTA		
	EQUISETACEAE		
1	*Equisetum arvense* L. ssp. *arvense*	Circumboreale	FX, KY, VY
2	*Equisetum fluviatile* L.	Circumboreale	CW, JH, KY, QH, QY
3	*Equisetum hyemale* L.	Circumboreale *	JH, QY, VY
4	*Equisetum ramosissimum* Desf.	Circumboreale	KY, VY
5	*Equisetum palustre* L.	Circumboreale	JH, KY. VY
6	*Equisetum telmateia* Ehrh	Circumboreale	JH, KY, VY
	OPHIOGLOSSACEAE		
7	*Botrychium lunaria* (L.) Sw	Subcosmopolita	BX, HY, HH, KY
8	*Ophioglossum vulgatum* L.	Circumboreale *	JH
	DENNSTAEDTIACEAE		
9	*Pteridium aquilinum* (L.) Kuhn ssp. *aquilinum*	Cosmopolita	JH, KY, VY
	PTERIDACEAE		
10	*Adiantum capillus-veneris* L.	Pantropicale	KY
	CYSTOPTERIDACEAE		
11	*Cystopteris alpina* (Lam.) Desv	Cosmopolita	KY
12	*Cystopteris fragilis* (L.) Bernh.	Cosmopolita	KY, VY
	ASPLENIACEAE		
13	*Asplenium ceterach* L. ssp. *bivalens* (D.E.Mey.) *Greuter & Burdet*	Eurimediterraneo	FW, JH, KY, VY. ZH
14	*Asplenium fissum* Kit. ex Willd.	Orof. Sud-Est-Europeo	KY, VY
15	*Asplenium lepidum* C. Presl ssp. *lepidum*	Orof. Sud-Est-Europeo	KY
16	*Asplenium onopteris* L.	Mediterraneo-Macaronesico *	VY
17	*Asplenium ruta-muraria* L. ssp. *ruta-muraria*	Circumboreale	FW, JH, KY, VY
18	*Asplenium trichomanes* L. ssp. *quadrivalens* D.E. Mey	Cosmopolita	FW, JH, KY, VY
19	*Asplenium viride* Huds.	Circumboreale	KY
	ATHYRIACEAE		
20	*Athyrium filix-femina* (L.) Roth	Subcosmopolita	KY
	DRYOPTERIDACEAE		
21	*Dryopteris dilatata* (Hoffm) A. Gray, Manual (Gray)	Europeo-Caucasico *	JH
22	*Dryopteris filix-mas* (L.) Schott	Cosmopolita	BX, JH, KY, VY
23	*Polystichum aculeatum* (L.) Roth	Eurimediterraneo *	KY
24	*Polystichum lonchitis* (L.) Roth	Circumboreale	KY, VY
25	*Polystichum setiferum* (Forssk.) T.Moore ex Woyn.	Circumboreale	KY
	POLYPODIACEAE		
26	*Polypodium cambricum* L.	Eurimediterraneo *	JH
27	*Polypodium vulgare*	Circumboreale	KY, VY
	PINACEAE		
28	*Abies alba* Mill.	Orof. Sud-Europeo	KY, VY. Alloctona naturalizzata.
29	*Abies cephalonica* Loudon	Avventizio	KY. Alloctona naturalizzata.
30	*Picea abies* (L.) H.Karst.	Eurosiberiano *	VY. Alloctona naturalizzata.
31	*Pinus halepensis* Mill. ssp. *halepensis*	Stenomediterraneo *	VX
32	*Pinus mugo* Turra ssp. *mugo*	Eurasiatico	CY, HH, KY
33	*Pinus nigra* J. F. Arnold ssp. *nigra*	Sud-Europeo	FW, KY, VY, ZH
	CUPRESSACEAE		
34	*Cupressus sempervirens* L.	Mediterraneo-Orientale	KY. Alloctona naturalizzata.
35	*Juniperus communis* L.	Circumboreale	BX, CY, KX, KY, LX, MK, OH, PK, QK
36	*Juniperus deltoides* R.P.Adams	Eurimediterraneo *	BX, KY, VY.In accordo con Conti et al. (2020) sono state assegnate al taxon le segnalazioni di Juniperus oxycedrus L.

37	*Juniperus sabina* L.	Circumboreale	KY
38	*Platycladus orientalis* (L.) Franco	Asiatico-Orientale *	VY. Utilizzato per alberature ornamentali.
	TAXACEAE		
39	*Taxus baccata* L.	Paleotemperato	BX, EX, FH, KY, NK, SK
	ANGIOSPERMAE		
	LAURACEAE		
40	*Laurus nobilis* L.	Stenomediterraneo *	VY. Coltivato e spontaneizzato.
	ARISTOLOCHIACEAE		
41	*Aristolochia lutea* Desf.	Eurimediterraneo	BX, KY, VY
42	*Aristolochia pallida* Willd.	Eurimediterraneo	FK, KY, ZH
43	*Aristolochia rotunda* L. ssp. *rotunda*	Eurimediterraneo *	VY
	ARACEAE		
44	*Arum italicum* Mill. ssp. *italicum*	Stenomediterraneo	KY, VY
45	*Arum maculatum* L.	Europeo	KY, VY
46	*Lemna minor* L.	Subcosmopolita *	DY, VY
47	*Zamioculcas zamiifolia* (G.Lodd.) Engl.	Avventizio	SY
	ALISMATACEAE		
48	*Alisma plantago-aquatica* L.	Subcosmopolita	EX, KY
	JUNCAGINACEAE		
49	*Triglochin palustre* L.	Subcosmopolita	KY, VY
	POTAMOGETONACEAE		
50	*Potamogeton berchtoldii* Fieber	Subcosmopolita	KY, QH, QY
51	*Potamogeton gramineus* L.	Circumboreale *	VX
52	*Potamogeton lucens* L.	Circumboreale *	VX
53	*Potamogeton natans* L.	Subcosmopolita	KY, VY
	DIOSCOREACEAE		
54	*Dioscorea communis* (L.) Caddick & Wilkins	Eurimediterraneo	IY, KH, KY, LW, NX, OK, VY
	COLCHICACEAE		
55	*Colchicum alpinum* DC.	Nord-Ovest-Mediterraneo	AH, BX, KY, VH
56	*Colchicum lusitanum* Brot.	Mediterraneo-Occidentale	KY, VH, VY
57	*Colchicum neapolitnum* (Ten.) Ten. ssp. *neapolitanum*	Endemico *	KY
	MELANTHIACEAE		
58	*Paris quadrifolia* L.	Eurasiatico.	IY, KY, VY
59	*Veratrum album* L.	Eurasiatico.	KY
60	*Veratrum nigrum* L.	Eurasiatico.	KY
	SMILACACEAE		
61	*Smilax aspera* L.	Paleosubtropicale *	VY
	LILIACEAE		
62	*Lilium bulbiferum* L. ssp. *croceum* (Chaix) Jan	Orof. Centro-Europeo	BX, DW, FH, KY, VY
63	*Lilium candidum* L.	Eurimediterraneo *	VY
64	*Lilium martagon* L.	Eurasiatico	DW, FH, IY, KH, KY, LW, LX, OK, PW, RK, VY
65	*Streptopus amplexifolius* (L.) DC.	Circumboreale	IK, KY
	ORCHIDACEAE		
66	*Anacamptis berica* Doro	Subendemico *	SX, TW
67	*Anacamptis coriophora* (L.) R.M.Bateman, Pridgeon & M.W.Chase ssp. *fragrans*	Eurimediterraneo *	QX, SX
68	*Anacamptis laxiflora* (Lam.) R.M.Bateman, Pridgeon & M.W.Chase	Eurimediterraneo	IY, LQ, KY, PH, QH, QH, QX, QY, SX, VY
69	*Anacamptis morio* (L.) R.M. Bateman, Pridgeon & M.W. Chase	Europeo-Caucasico	DH, FK, IY, LQ, KY, NY, PH, QX, RY, SX, TW, ZH
70	*Anacamptis pyramidalis* (L.) Rich.	Eurimediterraneo.	FK, IY, LQ, KY, PH, QX, RY, SX, TW, VY, ZH
71	*Anacamptis xalata* (Fleury) H. Kretzschmar, Eccarius & H. Dietr.	Nord-Mediterraneo *	QX, SX
72	*Cephalanthera damasonium* (Mill.) Druce	Eurimediterraneo	FK, IY, LQ, KY, OK, PW, QX, RK, RY, SX, VY
73	*Cephalanthera longifolia* (L.) Fritsch	Eurasiatico	DW, IY, LQ, KY, QX, RY, SX, VY, ZH
74	*Cephalanthera rubra* (L.) Rich.	Eurasiatico	DW, IY, LQ, KY, QX, RY, SX, VY, ZH
75	*Coeloglossum viride* (L.) Hartm.	Circumboreale	LQ, KY, PH, QX, RY, SX, TW, VY
76	*Corallorhiza trifida* Châtel.	Circumboreale *	QX, SX
77	*Dactylorhiza incarnata* (L.) Soó	Eurosiberiano	EH, IY, LQ, QH, QX, QY, RY, SX, VY
78	*Dactylorhiza maculata* (L.) Soó ssp. *fuchsii* (Druce) Hyl.	Eurasiatico *	SX, ZH

79	*Dactylorhiza maculata* ssp. *saccifera* (Brongn.) Diklić	Paleotemperato	AY, BX, DW, IY, LQ, KY, PH, QX, RY, SX, TW, VY, ZH
80	*Dactylorhiza sambucina* (L.) Soó	Europeo	DW, IY, LQ, KY, NY, QX, SX, VY, ZH
81	*Dactylorhiza ×guillaumeae* Chr.Bernard	Subendemico *	QX, SX
82	*Dactylorhiza ×serbica* (H.Fleischm.) Soó	Sud-Est-Europeo	QX, SX
83	*Epipactis atrorubens* (Hoffm.) Besser	Europeo	IY, LQ, KY, QX, SX
84	*Epipactis exilis* P. Delforge	Pontico	DH, LQ, KY, QH, QH, QX, QY, RY, SX
85	*Epipactis helleborine* ssp. *helleborine* (L.) Crantz	Paleotemperato	DW, IK, IY, LQ, KY, QX, SX, VY
86	*Epipactis lucana* Presser, S.Hertel & V.A.Romano	Endemico *	MX, PY, QY, SX. Il taxon raggiunge nel Parco il limite settentrionale di distribuzione geografica.
87	*Epipactis microphylla* (Ehrh.) Sw.	Europeo-Caucasico	IY, LQ, KY, SX
88	*Epipactis muelleri* Godfery	Centro-Europeo	DH, EX, IK, LQ, KY, QH, QH, QY, SX, VY
89	*Epipactis palustris* (L.) Crantz	Circumboreale *	SX
90	*Epipactis purpurata* Sm.	Subatlantico *	HW, PY, QH, QX, QY, RY, SX, VH, vy
91	*Epipogium aphyllum* Sw.	Eurosiberiano	DH, LQ, KY, OY, QX, QY, RY, SX, VH, VY
92	*Gymnadenia conopsea* (L.) R. Br. in W.T. Aiton	Eurasiatico	FK, IY, LQ, KY, OY, PH, QH, QX, RY, SK, SX, TH, TW, VY, ZH
93	*Himantoglossum adriaticum* H. Baumann	Eurimediterraneo	AY, BX, FK,FW, IY, LQ, KY, PH, QX, RY, SX, VY, ZH
94	*Limodorum abortivum* (L.) Sw.	Eurimediterraneo	FK, EH, IY, LQ, KY, QX, SX, SX, VY, ZH
95	*Neotinea maculata* (Desf.) Stearn	Mediterraneo-Atlantico	EH, IY, LQ, KY, PH, QX, RY, SX, VY, ZH
96	*Neotinea tridentata* (Scop.) R.M. Bateman, Pridgeon & M.W. Chase	Eurimediterraneo	FK, FW, IY, LQ, KY, NY, PH, QX, RY, SX, VY
97	*Neotinea ustulata* (L.) R.M. Bateman, Pridgeon & M. W. Chase	Europeo-Caucasico	LQ, KY, NY, PH, QX, RY, SX, TW, VY, ZH
98	*Neotinea ×dietrichiana* (Bogenh.) H.Kretzschmar, Eccarius & H.Dietr.	Sud-Est-Europeo *	QX, PH, SX, VY
99	*Neottia nidus-avis* (L.) Rich.	Eurasiatico	IY, LQ, KY, PK, QK, QX, RY, SX, UX, VY, ZH
100	*Neottia ovata* (L.) Bluff & Fingerh.	Eurasiatico	IY, LQ, KY, PH, QX, SX, TW, VY, ZH
101	*Ophrys apifera* Huds.	Eurimediterraneo	IY, LQ, KY, PH, QX, SX, VY, ZH
102	*Ophrys apifera ×O. majellensis*	Endemico *	QX, SX
103	*Ophrys apifera ×O. molisana*	Endemico *	QX, SX
104	*Ophrys bertolonii* ssp. *bertolonii* Moretti	Appennino-Balcanico	FK, IY, LQ, KY,PH, QX, RY, SX, TW, VY, ZH
105	*Ophrys bertolonii* Moretti ssp. *bertoloniiformis* (O.Danesch & E.Danesch) H.Sund	Endemico	FH, LQ, KY, QY, SX, ZH. Ad avviso di Conti et al. (2019) il taxon non è presente in Abruzzo.
106	*Ophrys fusca* Link ssp. *lucana* (P.Delforge, Devillers-Tersch. & Devillers) Kreutz	Endemico	IY, LQ, KY, PH, QX, RY, SX, TW, VH, ZH
107	*Ophrys holosericea* (Burm. f.) Greuter ssp. *appennina* (Romolini & Soca) Kreutz	Endemico	KY, LH, LQ, PH, QX, SX, TW
108	*Ophrys holosericea* (Burm. f.) Greuter ssp. *dinarica* (Kranjcev & P. Delforge)	Appennino-Balcanico	DH, LQ, KY, PH, QX, RY, SX, TW, VY, ZH
109	*Ophrys holosericea* ssp. *gracilis* (Büel, O. Danesch & E. Danesch) Büel, O. Danesch & E. Danesch	Endemico	KY, LH, LQ, LK, QX, SX
110	*Ophrys holosericea* (Burm. f.) Greuter ssp. *pinguis* (Romolini & Soca) Kreutz	Endemico	JK, LH, LQ, KY, LK, QX, RY, SX
111	*Ophrys holosericea* ssp. *tetraloniae* (W.P. Teschner) Kreutz	Appennino-Balcanico	IY, LQ, KY, PY, QH, QH, QX, QY, RY, SX. Sono state ricondotte al taxon le segnalazioni di Ophrys serotina Rolli & Cortesi.
112	*Ophrys dinarica ×O. gracilis*	Endemico *	QX, SX, SY
113	*Ophrys dinarica ×O. promontorii*	Endemico *	QX, SX
114	*Ophrys illyrica* S. Hertel & K. Hertel	Appennino-Balcanico *	QX, RY, SX. Sono state ricondotte al taxon le segnalazioni di Ophys ausonia.
115	*Ophrys illyrica × O. majellensis*	Endemico *	MX, SX, SY, VB
116	*Ophrys incubacea* Bianca ssp. *brutia* (P.Delforge) Kreutz	Endemico *	PY, QH, QX, QY, RY, SX, ZH
117	*Ophrys incubacea* Bianca ssp. *incubacea*	Stenomediterraneo	IY, KH, KY, QX, RY, SX
118	*Ophrys incubacea ×O. majellensis*	Endemico *	QX, SX
119	*Ophrys insectifera* L.	Europeo	DH, LQ, KY, PY, QH, QX, QY, SX
120	*Ophrys lutea* Cav. ssp. *corsica* (Soleirol ex G.Foelsche & W.Foelsche) Kreutz	Stenomediterraneo *	VY
121	*Ophrys molisana* Delforge	Endemico *	OX, QX, RY, SX, ZH
122	*Ophrys molisana × O. promontorii*	Endemico *	OX, QX,SX
123	*Ophrys passionis* Sennen ssp. *majellensis* (Helga Daiss & Herm. Daiss) Romolini & Soca	Endemico	EH, IY, LH, LQ, KY, LK, PH, PY, QH, QX, QY, RY, SX, ZH
124	*Ophrys passionis* Sennen ssp. *passionis*	Endemico	FK, QH, QX, QY, SX, ZH
125	*Ophrys majellensis × O. promontorii*	Endemico *	IW, QX, SX
126	*Ophrys majellensis* × O. sphegodes	Endemico *	LH, QX, SX
127	*Ophrys promontorii* O. Danesch & E. Danesch	Endemico	FW, IY, LQ, KY, PH, QX, RY, SX, VY, ZH
128	*Ophrys sphegodes* ssp. *minipassionis* (Romolini & Soca) Biagioli & Grünanger	Endemico	SX
129	*Ophrys sphegodes* ssp. *sphegodes* Mill.	Eurimediterraneo	DH, FK, IY, LH, LQ, KY, QX, SX, SX, VY, ZH
130	*Ophrys sphegodes* ssp. *tommasinii* (Vis.) Soó	Appennino-Balcanico	FK, IY, LQ, KY, QX, SX, ZH
131	*Ophrys ×bilineata* Barla	Appennino-Balcanico *	FW, QX, SX

132	*Ophrys ×brunamontei* Soca	Endemico *	LH, NY, OW, SX, SY
133	*Ophrys ×couloniana* P. Delforge	Endemico *	IW, QX, SX, VB
134	*Ophrys ×dekegheliana* P. Delforge	Endemico *	IW, PH, QX, SX
135	*Ophrys ×fucinis* Soca	Endemico *	OX, QX, SX
136	*Ophrys ×lociceroi* Soca	Endemico *	LH, OW, QX, SX, SY
137	*Ophrys ×marcoi Benigni, Mandozzi, Monaldi, Barigelli & Petroselli*	Endemico *	SX
138	*Ophrys ×marsilii Rempicci, Buono, Gransinigh, Antonj & Magrini*	Endemico *	GK, SX
139	*Ophrys ×metellae (Benigni, Barigelli & Petroselli) Soca*	Endemico *	SX
140	*Ophrys ×palenae* Soca	Endemico *	OW, PX, PH, QX, SX, SY, VB
141	*Ophrys ×piconei* Soca	Endemico *	OW, PX, PH, QX, SX, SY, VB
142	*Ophrys ×terrae laboris* W. Rossi & Minutillo	Endemico *	QX, SX
143	*Ophrys ×valparmensis* J.J. Wood	Endemico *	QX, SX
144	*Ophrys ×vernacchiae* Soca	Endemico *	OW, SX, SY
145	*Orchis anthropophora* (L.) All.	Mediterraneo-Atlantico	FK, FW, IY, LQ, KY, PH, QX, RY, SX, TW, VY
146	*Orchis italica* Poir.	Stenomediterraneo	EH, LQ, KY, QX, SX, VY
147	*Orchis mascula* (L.) L. ssp. *mascula*	Europeo-Caucasico	PH, QX, SX
148	*Orchis mascula* (L.) L. ssp. *speciosa* (Mutel) Hegi	Centro-Europeo	IY, LQ, KY, QX, RY, SX, TW, VY
149	*Orchis militaris* L.	Eurasiatico	LQ, KY, QX, SX, ZH
150	*Orchis pallens* L.	Europeo-Caucasico *	RY, SX, VK
151	*Orchis pauciflora* Ten.	Stenomediterraneo	FK, IY, LQ, KY, QX, RY, SX, VY, ZH
152	*Orchis provincialis* Balb. ex Lam.	Stenomediterraneo *	SX, VK, ZH
153	*Orchis purpurea* Huds.	Eurasiatico	FK, IY, LQ, KY, PH, QX, RY, SX, TW,VY, ZH
154	*Orchis simia* Lam.	Eurimediterraneo	EH, LQ, KY, QX, SX, ZH
155	*Orchis ×colemanii Cortesi*	Nord-Mediterraneo *	IW, QX, SX
156	*Platanthera bifolia* (L.) Rchb. ssp. *bifolia*	Paleotemperato	EH, IY, LQ, KY, PH, QX, SX, TW, VY
157	*Platanthera chlorantha* (Custer) Rchb.	Eurosiberiano	AY, BX, DW, LQ, KY, PH, QX, SX, VY, ZH
158	*Serapias cordigera* L.	Stenomediterraneo	EH, KY, QX, SX
159	*Serapias parviflora* Parl.	Stenomediterraneo	DH, FK, IY, LQ, KY, QX, RY, SX, VY, ZH
160	*Serapias vomeracea* (Burm.f.) Briq. ssp. *vomeracea*	Eurimediterraneo	EH, IY, LQ, KY, QX, RY, SX, VY
	IRIDACEAE		
161	*Crocus neapolitanus* (Ker Gawl.) Loisel.	Eurimediterraneo	DW, FH, KY, VY
162	*Gladiolus dubius* Guss.	Sud-Europeo *	PY, QH, QY
163	*Gladiolus italicus* Mill.	Eurimediterraneo	IY, KY, VY
164	*Iris florentina* L.	Avventizio	KY
165	*Iris germanica* L.	Avventizio	KY, VY
166	*Iris marsica I.* Ricci & Colas.	Endemico	QK, KY, QY
167	*Limniris pseudacorus* (L.) Fuss	Eurasiatico	BY, FH, KY, , VY
	ASPHODELACEAE		
168	*Asphodeline lutea* (L.) Rchb.	Mediterraneo-Orientale	AX, BX, IY, KY, LX, VY
169	*Asphodelus macrocarpus* Parl. ssp. *macrocarpus*	Mediterraneo-Montano	FH, KY, MY, OH, OW, SW, VY
	AMARYLLIDACEAE		
170	*Allium calabrum* (N.Terracc.) Brullo, Pavone & Salmeri	Endemico *	QH, QY. Il taxon raggaiunge in Abruzzo il limite settentrionale di diistribuzione geografica.
171	*Allium lusitanicum* Lam.	Eurasiatico	AY, KY
172	*Allium ochroleucum* Waldst. & Kit.	Europeo *	VH
173	*Allium oleraceum* L. ssp. *oleraceum*	Eurasiatico	BX, KY
174	*Allium pendulinum* Ten.	Mediterraneo-Occidentale *	VK, VY
175	*Allium polyanthum* Schult. & Schult.f.	Sud-Ovest-Europoo *	VY
176	*Allium sphaerocephalon* L.	Paleotemperato	IY, KX, KY, VY
177	*Allium tenuiflorum* Ten.	Stenomediterraneo	AY, KY, VY
178	*Allium triquetrum* L.	Stenomediterraneo	KY
179	*Allium ursinum* L.	Eurasiatico	IY, KY, VY
180	*Allium vineale* L.	Eurimediterraneo	IY, KY, VY
181	*Galanthus nivalis* L.	Europeo-Caucasico	FH, GH, KY, OH, PK, QY, VY
182	*Narcissus poeticus* L.	Orof. Sud-Europeo	DW, FH, FK, KX, KY, OH, PK, QK, VY
183	*Narcissus x medioluteus* Mill.	Ovest-Europeo *	VY. Alloctona naturalizzata

	ASPARAGACEAE		
184	*Anthericum liliago* L.	Subatlantico	KY, VY, ZH
185	*Asparagus acutifolius* L.	Stenomediterraneo	KY
186	*Bellevalia romana* (L.) Sweet	Eurimediterraneo	KY, SK, TH, VY
187	*Convallaria majalis* L.	Circumboreale	IY, KY, QY
188	*Hyacinthus orientalis* L.	Mediterraneo-Orientale *	VY. Alloctona naturalizzata:
189	*Loncomelos brevistylum* (Wolfner) Dostál	Centro-Europeo *	VY
190	*Loncomelos pyrenaicum* (L.) L. D. Hrouda	Eurimediterraneo	AY, BX, IK, IY, KY, VY
191	*Muscari comosum* (L.) Mill.	Eurimediterraneo	DW, KY, VY
192	*Muscari neglectum* Guss. ex Ten. & Sangiovanni	Mediterraneo-Turaniano	DW, FW, IY, KX, KY, VY, ZH
193	*Ornithogalum comosum* L.	Mediterraneo-Montano	BX, IK, KY
194	*Ornithogalum divergens* Boreau	Sud-Europeo	FW, KY, VY
195	*Ornithogalum exscapum* Ten.	Endemico *	QH, QY
196	*Polygonatum multiflorum* (L.) All.	Eurasiatico	DW, FK, IY, KX, KY, MK, NH, VY
197	*Polygonatum odoratum*	Circumboreale	FW, IY, KY, VY
198	*Polygonatum verticillatum* (L.) All.	Eurasiatico	IK, IY, KY, QY
199	*Prospero autumnale* (L) Speta ssp. *autumnale*	Eurimediterraneo	KY
200	*Ruscus aculeatus* L.	Eurimediterraneo	BX, KY, ZH
201	*Scilla bifolia* L.	Europeo	BX, FH, KY, VY
	TYPHACEAE		
202	*Sparganium emersum Rehmann*	Eurasiatico *	IK, QH, QY, SW, VY
203	*Sparganium erectum* L.	Eurasiatico	DY, KY, VY
204	*Sparganium neglectum Beeby*	Eurasiatico *	EX
205	*Typha latifolia* L.	Cosmopolita	DY, KY, VY
	JUNCACEAE		
206	*Juncus acutiflorus* Ehrh. ex Hoffm.	Europeo *	VX
207	*Juncus articulatus* L.	Circumboreale	EX, KY, VY
208	*Juncus bufonius* L.	Cosmopolita *	QH, QY
209	*Juncus compressus* Jacq.	Eurasiatico	KY, VY
210	*Juncus effusus* L. ssp. *effusus*	Cosmopolita	KY
211	*Juncus fontanesii* J.Gay ssp. *fontanesii*	Paleousubtropicale *	VY
212	*Juncus inflexus* L.	Paleotemperato	EX, KY, VY
213	*Luzula campestris* (L.) DC.	Europeo	KY, VY
214	*Luzula forsteri* (Sm.) DC.	Eurimediterraneo *	VY
215	*Luzula multiflora* (Ehrh.) Lej ssp. *multiflora*	Appennino-Balcanico	KY
216	Luzula spicata (L.) DC. ssp. bulgarica (Chrtek & Křísa) Gamisans	Orof. Sud-Est-Europeo *	BX, HY, SK. Sono state ricondotte al taxon le segnalazioni di Luzula spicata (L.) DC. ssp. italica (Parl.) Arcang.
217	*Luzula sylvatica* (Huds.) Gaudin ssp. *sieberi* (Tausch) K. Richt.	Orof. Sud-Europeo *	RH, RW, SK, VY
218	*Oreojuncus monanthos* (Jacq.) Záv.Drábk. & Kirschner	Artico-Alpino *	BX, HH
219	*Oreojuncus trifidus* (Jacq.) Záv.Drábk. & Kirschner	Artico-Alpino	KY
	CYPERACEAE		
220	*Blysmus compressus* (L.) Panz. ex Link	Eurosiberiano *	SW, VY
221	*Carex acuta* L.	Eurasiatico	CW, DY, EX, KY, MH, MY, QK, RH, SK
222	*Carex buxbaumii* Wahlenb.	Circumboreale	CW, DY, EX, IK, KY, OH, PK, QH, QY
223	*Carex canescens* L. ssp. *canescens*	Cosmopolita	KY, QH, QY
224	*Carex capillaris* L. ssp. *capillaris*	Artico-Alpino °°	KY, QH, QY
225	*Carex caryophyllea* Latourr.	Eurasiatico	KY, VY
226	*Carex digitata* L.	Eurasiatico *	VY
227	*Carex distans* L.	Eurimediterraneo	BX, KY, VY
228	*Carex disticha* Huds.	Eurosiberiano	CW, DY, EX, KY, QH, QY, VY
229	*Carex divisa* Huds.	Atlantico	KY, QH, QY
230	*Carex divulsa* Stokes	Eurimediterraneo *	VY
231	*Carex elata* All. ssp. *elata*	Europeo-Caucasico	KY
232	*Carex flacca* Schreb. ssp. *flacca*	Europeo	KY, VY
233	*Carex halleriana* Asso	Eurimediterraneo *	FW, VY
234	*Carex hirta* L.	Europeo-Caucasico	EX, KY, QK, RH, SK, TH, VY
235	*Carex humilis* Leyss.	Eurasiatico	HH, KY

236	*Carex kitaibeliana* Degen ex Beck.	Appennino-Balcanico	HY, KY, OH
237	*Carex leporina* L.	Eurosiberiano *	OH, PK, QH, QY, SK, TH, VY
238	*Carex liparocarpos* Gaudin ssp. *liparocarpos*	Sud-Est-Europeo *	QH, QY
239	*Carex macrolepis* DC.	Appennino-Balcanico	BX, HY, KY, VY
240	*Carex muricata* L.	Europeo *	RH, RW
241	*Carex nigra* (L.) Reichard	Subcosmopolita *	SWY, VY
242	*Carex otrubae* Podp.	Atlantico	DY, KYY, VY
243	*Carex pallescens* L.	Circumboreale *	OH, PK, VY
244	*Carex panicea* L.	Eurosiberiano *	IK, IK, IK, OH, PK, QK
245	*Carex paniculata* L. ssp. *paniculata*	Europeo-Caucasico	BX, DY, KY, QH, QY
246	*Carex pendula* Huds.	Eurasiatico	KY, VY
247	*Carex sylvatica* Huds.	Eurasiatico	BX, KY, RH, RW, VY
248	*Carex tomentosa* L.	Eurosiberiano	CW, EX, KY, QH, QY
249	*Carex vesicaria* L.	Circumboreale	KY, MH, QH, QY, RW, SK
250	*Carex vulpina* L.	Eurosiberiano *	MH, MW, QH, QK, QY, RH, SK, TH
251	*Eleocharis palustris* (L.) Roem. & Schult.	Subcosmopolita	DY, EX, KYY, VY
252	*Scirpoides holoschoenus* (L.) Soják	Eurimediterraneo *	VY
	POACEAE		
253	*Achnatherum bromoides* (L.) P. Beauv.	Stenomediterraneo *	VY
254	*Agrostis canina* L.	Eurosiberiano	KY
255	*Agrostis capillaris* L. ssp. *capillaris*	Circumboreale	BX, KY
256	*Agrostis castellana* Boiss. & Reut.	Mediterraneo-Occidentale *	QH, QY
257	*Agrostis stolonifera* L. ssp. *stolonifera*	Circumboreale	BX, KY
258	*Agrostis viridis* Gouan	Paleosubtropicale *	VY
259	*Alopecurus aequalis* Sobol.	Eurasiatico	EK, KY, VY
260	*Alopecurus geniculatus* L.	Subcosmopolita	KY
261	*Alopecurus myosuroides* Huds. ssp. *myosuroides*	Paleotemperato	KY
262	*Alopecurus pratensis* L. ssp. *pratensis*	Eurosiberiano *	QK, RH, SW, VY
263	*Alopecurus rendlei* Eig	Eurimediterraneo *	SW
264	*Anisantha diandra* (Roth) Tzvelev	Eurimediterraneo *	VY
265	*Anisantha madritensis* (L.) Nevski	Eurimediterraneo *	VY
266	*Anisantha sterilis* (L.) Nevski	Mediterraneo-Turaniano	BX. KY. VY
267	*Anisantha tectorum* (L.) Nevski	Paleotemperato	KY, QK, VY
268	*Anthoxanthum odoratum* L.	Eurasiatico	KY, MH, MY, RW,SK, TH, VY
269	*Arrhenatherum elatius* (L.) P. Beauv. Ex J. & C. Presl ssp. *elatius*	Paleotemperato	KY, MH, MY, RH, RW,SK, TH, VY
270	*Arundo donax* L.	Subcosmopolita	KY
271	*Avena barbata* Pott ex Link	Eurimediterraneo	KY, VY
272	*Avena fatua* L. ssp. *fatua*	Eurasiatico	KY
273	*Avena sativa* L.	Avventizio	KY
274	*Avena sterilis* L.	Eurimediterraneo	KY, VY
275	*Bothriochloa ischaemum* (L.) Keng	Subcosmopolita *	VY
276	*Brachypodium distachyon* (L.) P.Beauv.	Stenomediterraneo *	VY
277	*Brachypodium genuense* (DC.) Roem. & Schult.	Orof. Sud-Europeo	CY, KY, PK, QK, VY
278	*Brachypodium retusum* (Pers.) P.Beauv.	Mediterraneo-Occidentale	KY
279	*Brachypodium rupestre* (Host) Roem. & Schult.	Subatlantico	KY, VY
280	*Brachypodium sylvaticum* (Huds.) P.Beauv. ssp. *sylvaticum*	Paleotemperato	EX, KY, NX, VY
281	*Briza media* L.	Eurosiberiano	KY, LX, MH, MY
282	*Bromopsis erecta* (Huds.) Fourr.	Paleotemperato	FH, KY, OH, PK, QK, RH, TW, VY
283	*Bromopsis inermis* (Leyss.) Holub ssp. *inermis*	Eurasiatico	CX, KY
284	*Bromopsis ramosa* (Huds.) Holub ssp. *ramosa*	Eurasiatico	KY,VY
285	*Bromus arvensis* L. ssp. *arvensis*	Eurosiberiano	BX, KY
286	*Bromus commutatus* Schrad. ssp. *commutatus*	Europeo *	VY
287	*Bromus hordeaceus* L. ssp. *hordeaceus*	Cosmopolita	KY, VY
288	*Bromus racemosus* L. ssp. *racemosus*	Europeo-Caucasico *	TH. VY
289	*Calamagrostis varia* (Schrad.) Host	Orof. Eurasiatico *	VY
290	*Catapodium rigidum* (L.) C. E. Hubb. ex Dony ssp. *rigidum*	Eurimediterraneo	KY, VY

291	*Cynodon dactylon* (L.) Pers.	Cosmopolita	KY, VY
292	*Cynosurus cristatus* L.	Europeo-Caucasico	KY, TW, VY
293	*Cynosurus echinatus* L.	Eurimediterraneo	BX, KY, VY
294	*Dactylis glomerata* L. ssp. *glomerata*	Paleotemperato	EX, KY, VY
295	*Danthonia decumbens* (L.) DC. ssp. *decumbens*	Europeo *	QH, QY, VY
296	*Dasypyrum villosum* (L.) P. Candargy	Mediterraneo-Turaniano *	VY
297	*Deschampsia cespitosa* (L.) P.Beauv.	Subcosmopolita	KX, KY, MH, OH, QK, RH, RW, SK, UX, VY
298	*Deschampsia parviflora* (Thuill.) P.Beauv.	Appennino-Balcanico *	
299	*Digitaria sanguinalis* (L.) Scop.	Cosmopolita	HY, KY, VY
300	*Echinochloa crus-galli* (L.) P.Beauv. ssp. *crus-galli*	Subcosmopolita *	VY
301	*Elymus caninus* L.	Circumboreale	EX, VY
302	*Elymus repens* (L.) Gould ssp. *repens*	Circumboreale	BH, FH, KY, VY
303	*Festuca alfrediana* Foggi & Signorini ssp. *ferrariniana Foggi,* Parolo & Gr. Rossi	Endemico	HY, KY
304	*Festuca bosniaca* Kumm. & Sendtn. ssp. *bosniaca*	Appennino-Balcanico	KY
305	*Festuca circummediterranea* Patzke	Eurimediterraneo	BX, KY, TW, VY
306	*Festuca heterophylla* Lam.	Europeo-Caucasico	KY, RH, RW,SK
307	*Festuca inops* De Not.	Subendemico	HY, KY
308	*Festuca jeanpertii* (St.-Yves) Markgr.-Dann. subsp. jeanpertii Dann.	Appennino-Balcanico	KY
309	*Festuca laevigata* Gaudin	Orof. Sud-Ovest-Europeo	HH, KY. Sono state riferite al taxon le precedenti segnalazioni di Festuca robustifolia Markgr. -Dann.
310	*Festuca myuros* L. ssp. *myuros*	Subcosmopolita *	VY
311	*Festuca rubra* L. ssp. *commutata* (Gaudin) Markgr. -Dann.	Circumboreale	BX, KY, QY
312	*Festuca violacea* Ser. ex Gaudin ssp. *italica* Foggi, Gr. Rossi & Signorini	Endemico	HY, HH, KY
313	*Glyceria notata* Chevall.	Subcosmopolita	BX, DY, KY, VY
314	*Helictochloa praetutiana* (Parl. ex Arcang.) Bartolucci, F. Conti, Peruzzi & Banfi ssp. *praetutiana*	Endemico	BX, KY
315	*Holcus lanatus* L.	Circumboreale	EX, KY, VY
316	*Hordelymus europaeus* (L.) Harz.	Europeo-Caucasico	BX, KY, VY
317	*Hordeum murinum* L. ssp. *murinum*	Circumboreale	BX, KY, VY
318	*Hordeum secalinum* Schreb.	Subatlantico *	EX
319	*Koeleria splendens* C. Presl	Mediterraneo-Montano	KY, VY
320	*Lagurus ovatus* L.	Eurimediterraneo *	VY
321	*Leucopoa dimorpha* (Guss.) H. Scholz & Foggi	Subendemico	FH, KY
322	*Lolium arundinaceum* (Schreb.) Darbysh.	Paleotemperato	EX, KY, VY
323	*Lolium giganteum* (L.) Darbysh.	Eurasiatico	KY
324	*Lolium perenne* L.	Circumboreale *	MH, MY
325	*Lolium pratense* (Huds.) Darbysh	Eurasiatico	BX, KY
326	*Macrobriza maxima* (L.) Tzvelev	Paleosubtropicale	BX, KY, VY
327	*Melica ciliata* L. ssp. *ciliata*	Eurimediterraneo	BX, KY, VY
328	*Melica transsilvanica* Schur	Europeo *	FW
329	*Melica uniflora* Retz	Paleotemperato	KY, VY
330	*Milium effusum* L.	Circumboreale	KY
331	*Molinia caerulea* (L.) Moench	Circumboreale *	VX
332	*Nardus stricta* L.	Eurosiberiano	BX, HY, HH, KY, MH, MY, OH, VY
333	*Phalaris arundinacea* L.	Circumboreale	DX, DY, KY, MH, MY, OH,QK, RH,SK, TH
334	*Phalaris brachystachys* Link	Stenomediterraneo	DZ, KY
335	*Phleum hirsutum* Honck. ssp. *ambiguum* (Ten.) Tzvelev	Centro-Europeo *	KY, QK, RH, RW,SK, VY
336	*Phleum pratense* L. ssp. *pratense*	Centro-Europeo *	QK, QY, RW,SK, TH, UX, VY
337	*Phleum rhaeticum* (Humphries) Rauschert	Sud-Europeo	HY, HH, KY
338	*Phragmites australis* (Cav.) Trin. ex Steud. ssp. *australis*	Cosmopolita	KY
339	*Poa alpina* L. ssp. *alpina*	Circumboreale	HY, HH, KY
340	*Poa annua* L.	Cosmopolita	KY, QH, QY, VY
341	*Poa badensis* Haenke ex Willd.	Mediterraneo-Montano	BX, KY
342	*Poa bulbosa* L. ssp. *bulbosa*	Paleotemperato	KY, VY
343	*Poa compressa* L.	Circumboreale	BX
344	*Poa molinerii* Balb.	Orof. Sud-Est Europeo	HH, KY
345	*Poa nemoralis* L. ssp. *nemoralis*	Circumboreale	KY

346	*Poa palustris* L.	Circumboreale	BX, KY, QH, QY
347	*Poa pratensis* L. ssp. *pratensis*	Circumboreale	BX, KY, VY
348	*Poa sylvicola* Guss.	Eurimediterraneo *	QH, QY
349	*Poa trivialis* L.	Eurasiatico	EX, KY
350	*Rostraria cristata* (L.) Tzvelev	Subcosmopolita *	VY
351	*Sclerochloa dura* (L.) P. Beauv.	Eurimediterraneo *	VY
352	*Sesleria juncifolia* Suffren ssp. *juncifolia*	Appennino-Balcanico	FW, HH, KY, PK, QK
353	*Sesleria nitida* ssp. *nitida* Ten.	Endemico	CY, FW, KY, PK, QK
354	*Setaria italica* (L.) P. Beauv. ssp. *viridis* (L.) Thell.	Subcosmopolita	KY,VY
355	*Setaria pumila* (Poir.) Roem. & Schult.	Subcosmopolita *	VY
356	*Stipa dasyvaginata* Martinovsky ssp. *apenninicola* Martinovsky & Moraldo	Endemico	KY, SW, VY
357	*Tragus racemosus* (L.) All.	Cosmopolita	KY
358	*Trisetaria aurea* (Ten.) Pignatti ex Kerguélen	Mediterraneo-Orientale *	QH, QY
359	*Trisetum bertolonii* Jonsell	Endemico	KY
360	*Trisetum flavescens* (L.) P.Beauv. ssp. *flavescens*	Eurasiatico	KY, MH, MY, QH, QY, SK, THY, VY
361	*Triticum vagans* (Jord. & Fourr.) Greuter	Mediterraneo-Turaniano *	VY
	RANUNCULACEAE		
362	*Aconitum lycoctonum* L. emend. Koelle	Orof. Sud-Europeo	KY
363	*Actaea spicata* L.	Eurasiatico	IY. KX, KY, VY
364	*Adonis distorta* Ten.	Endemico *	BX, HY
365	*Anemonastrum narcissiflorum* (L.) Holub, ssp. *narcissiflorum*	Artico-Alpino °°	BX, KY
366	*Anemone apennina* L. ssp. *apennina*	Sud-Est-Europeo	KY, VY
367	*Anemone hortensis* L. ssp. *hortensis*	Nord-Mediterraneo	KY, VY
368	*Anemonoides nemorosa* (L.) Holub	Circumboreale	BY, KY, VY
369	*Anemonoides ranunculoides* (L.) Holub	Europeo-Caucasico	DW, FW, KY, VY
370	*Aquilegia dumeticola* Jord.	Orof. Sud-Europeo *	BK, BX, DW,IK, IY, KX, KY, QW, RH, RW, SK
371	*Caltha palustris* L.	Circumboreale	AH, EX, EY, FH, IK, KY
372	*Clematis flammula* L.	Eurimediterraneo	KY, VY
373	*Clematis vitalba* L.	Europeo	FX, KY, VY
374	*Delphinium consolida* L.	Eurimediterraneo	KY, VY
375	*Delphinium fissum* Waldst. & Kit. ssp. *fissum*	Eurasiatico	BX, KY, RW,SK, SW, VH, VY
376	*Eranthis hyemalis* (L.) Salisb.	Sud-Europeo	KY, VY
377	*Ficaria verna* Huds. ssp. *verna*	Europeo	KY, VY
378	*Helleborus foetidus* L. ssp. *foetidus*	Subatlantico	BX, IY, KY, ZH
379	*Hepatica nobilis* Mill.	Circumboreale	FH, IY, VY
380	*Nigella damascena* L.	Eurimediterraneo	KY, VY
381	*Pulsatilla alpina* (L.) Delarbre ssp. *millefoliata* (Bertol.) D.M. Moser	Circumboreale	DW, FH, HY, FY, HH, KY, OK
382	*Ranunculus acris* L. ssp. *acris*	Cosmopolita	KY, QK, RH, VY
383	*Ranunculus apenninus* (Chiov.) Pignatti	Endemico	BX, DW, FY, KY
384	*Ranunculus arvensis* L.	Paleotemperato	KY
385	*Ranunculus breyninus* Crantz	Orof. Sud-Europeo	CY, HY, KY
386	*Ranunculus brevifolius* Ten.	Appennino-Balcanico	BX, HY, HH, IY, KY
387	*Ranunculus bulbosus* L.	Eurasiatico	IY, KY, VY
388	*Ranunculus garganicus* Ten.	Nord-Mediterraneo *	BX, KY
389	*Ranunculus illyricus* L.	Appennino-Balcanico	BX, KY
390	*Ranunculus lanuginosus* L.	Europeo-Caucasico	KY, VY
391	*Ranunculus lateriflorus* DC.	Paleotemperato	EX, EY, KY. QH, QY
392	*Ranunculus magellensis* Ten.	Endemico *	HH
393	*Ranunculus marsicus* Guss. & Ten.	Endemico	BX, EY, FH, KY, OH, PK, SW
394	*Ranunculus millefoliatus* Vahl	Mediterraneo-Montano	BX, FW, KY, VY
395	*Ranunculus monspeliacus* L.	Nord-Ovest-Mediterraneo	KY, SW, VY
396	*Ranunculus multidens* Dunkel	Endemico *	QH, QY
397	*Ranunculus neapolitanus* Ten.	Nord-Est-Mediterraneo	KY
398	*Ranunculus polyanthemoides* Boreau	Sud-Europeo °°	AW, KY
399	*Ranunculus repens* L.	Eurasiatico	EX, KY, VY
400	*Ranunculus sardous* Crantz	Eurimediterraneo	KY

401	*Ranunculus sartorianus* Boiss. & Heldr.	Appennino-Balcanico	HH, IY, KY
402	*Ranunculus seguieri* Vill. ssp. *seguieri*	Mediterraneo-Montano °°	BX, HY, IY, KY
403	*Ranunculus thora* L.	Orof. Sud-Europeo	KY, VY
404	*Ranunculus thomasii* Ten.	Endemico *	QH, QY, VY
405	*Ranunculus trichophyllus* Chaix	Europeo	BY, IY, KY, VY
406	*Ranunculus tuberosus* Lapeyr.	Europeo	HH, IY, KY
407	*Ranunculus velutinus* Ten.	Nord-Mediterraneo	KY, QH, QY
408	*Thalictrum aquilegiifolium* L. ssp. *aquilegiifolium*	Europeo	FK, IY, KY, LX, MY, NH, RW,SK, SW, VY
409	*Thalictrum flavum* L.	Eurasiatico *	VY
410	*Thalictrum foetidum* L. ssp. *foetidum*	Orof. Eurasiatico	IK, IY, KY
411	*Thalictrum minus* L. ssp. *minus*	Eurasiatico	IY, KY
412	*Thalictrum simplex* L. ssp. *simplex*	Eurosiberiano	CW, DY, EX, EY, KX, KY, LX, MK, NH, QK, RW,SK, SW, VY
413	*Trollius europaeus* L. ssp. *europaeus*	Artico-Alpino	DW, EX, EY, FH, IY, KX, KY, LX, MK, MY, NH, VY, ecc.
	PAPAVERACEAE		
414	*Chelidonium majus* L.	Eurasiatico	FW, HY, KY, LX, MK, NH, VY
415	*Corydalis cava* (L.) Schweigger & Kōrte ssp. *cava*	Europeo	DW, KY, VY
416	*Corydalis pumila* (Host) Rchb.	Centro-Europeo *	FW
417	*Fumaria capreolata* L. ssp. *capreolata*	Eurimediterraneo *	VY
418	*Fumaria officinalis* L. ssp. *officinalis*	Paleotemperato	KY, VY
419	*Oreomecon alpina* (L.) Banfi, Bartolucci, J. M. Tison & Galasso ssp. *alpina*	Endemico °°	DW, FH, FY, KY, SW
420	*Papaver dubium* L. ssp. *dubium*	Mediterraneo-Turaniano	KY, VY
421	*Papaver rhoeas* L. ssp. *rhoeas*	Mediterraneo-Orientale	FW, KY, VY
422	*Pseudofumaria alba* (Mill.) Lidén ssp. *alba*	Appennino-Balcanico	IY, KY
423	*Roemeria apula* (Ten.) Banfi, Bartolucci, J.-M.Tison & Galasso	Nord-Est-Mediterraneo	KY
424	*Roemeria argemone* (L.) C.Morales, R.Mend. & Romero García	Mediterraneo-Turaniano *	VX
	PAEONIACEAE		
425	*Paeonia officinalis* L. ssp. *italica* N.G.Passal. & Bernardo	Endemico	DW, FH, KY, MY, OH, SW, VY
	CRASSULACEAE		
426	*Hylotelephium maximum* (L.) Holub	Centro-Europeo	IY, KY, VY
427	*Petrosedum montanum* (Songeon & E.P. Perrier) Grulich	Mediterraneo-Montano	VH, VY
428	*Petrosedum rupestre* (L.) P.V. Heath	Europeo	IY, KX, KY, LX, MK, SK, VY, ZH
429	*Petrosedum sediforme* (Jacq.) Grulich	Stenomediterraneo	KY
430	*Sedum acre* L.	Europeo	HY, IY, KY, VY
431	*Sedum album* L. s. l.	Eurimediterraneo	BX, DW, IY, KY, VY
432	*Sedum atratum* L.	Mediterraneo-Montano	HY, HH, KY, QH, QY, VY
433	*Sedum dasyphyllum* L. ssp. *dasyphyllum*	Eurimediterraneo	DW, FK, IY, KY, VY
434	*Sedum hispanicum* L.	Pontico	KY, VY
435	*Sedum magellense* Ten. ssp. *magellense*	Endemico	BX, IY, KX, KY, LX, VY
436	*Sedum monregalense* Balb.	Subendemico	FK. Ad avviso di Conti et al. (2019) la segnalazione è dubbia.
437	*Sedum rubens* L.	Eurimediterraneo *	VY
438	*Sedum sexangulare* L.	Europeo	EY, KY, VY
439	*Sempervivum arachnoideum* L.	Orof. Sud-Europeo	FH, HY, HH, KY
440	*Sempervivum riccii* Iberite & Anzal.	Endemico	AY, EY, JY, KY, VY
441	*Sempervivum tectorum* L.	Mediterraneo-Montano	KY, PK, RW
442	*Umbilicus horizontalis* (Guss.) DC.	Stenomediterraneo	KY, VY
	HALOGARACEAE		
443	*Myriophyllum spicatum* L.	Subcosmopolita	CW, EX, KY
	GROSSULARIACEAE		
444	*Ribes alpinum* L.	Eurosiberiano	BX, FH, FX, KY, NK
445	*Ribes multiflorum* Kit. ex Roem. & Schult.	Nord-Est-Mediterraneo	EY, FH, KY, NK, UX
446	*Ribes uva-crispa* L.	Eurasiatico	FH, KY, VY
	SAXIFRAGACEAE		
447	*Saxifraga adscendens* L. ssp. *adscendens*	Mediterraneo-Montano	BX, HY, HH, KY, VY
448	*Saxifraga adscendens* L. ssp. *parnassica* (Boiss. & Heldr.) Hayek	Orof. Sud-Ovest-Europeo *	BX,TH
449	*Saxifraga bulbifera* L.	Sud-Est-Europeo	IY, KY, VY

450	*Saxifraga caesia* L.	Mediterraneo-Montano	BX, IY, KY
451	*Saxifraga callosa* Sm. ssp. *callosa*	Orof. Sud-Ovest-Europeo	IY, KY, VY
452	*Saxifraga exarata* Vill. ssp. *ampullacea* (Ten.) D. A. Webb	Endemico	BX, DW, KY, VY
453	*Saxifraga granulata* L. ssp. *granulata*	Subatlantico	FW, KY, VY
454	*Saxifraga italica* D. A. Webb	Endemico	BX,KY
455	*Saxifraga oppositifolia* L. ssp. *oppositifolia*	Artico-Alpino	BX, KY
456	*Saxifraga oppositifolia* L. ssp. *speciosa* (Dörfl. & Hayek) Engl. & Irmsch.	Endemico *	HH
457	*Saxifraga paniculata* Mill.	Artico-Alpino	BX, HH, KX, RH, RW, VY
458	*Saxifraga porophylla* Bertol. ssp. *porophylla*	Endemico	DW, FW, FY, IY, KY, VY
459	*Saxifraga rotundifolia* L. ssp. *rotundifolia*	Mediterraneo-Montano	IY, KY, VY
460	*Saxifraga sedoides* L. ssp. *sedoides*	Orof. Sud-Ovest-Europeo	KY\
461	*Saxifraga tridactylites* L.	Eurimediterraneo	IY, KY, VY
	VITACEAE		
462	*Vitis vinifera* L. ssp. *vinifera*	Avventizio	FH, VY. Coltivato e spontaneizzato
	FABACEAE		
463	*Anthyllis montana* L. susbp. *jacquinii* (A Kern.) Rohlena	Orof. Sud-Est-Europeo	AY, BX, CY, HH, KY, VY
464	*Anthyllis vulneraria* L. ssp. *maura* (Beck) Maire	Sud-Ovest-Mediterraneo	HY, IY, KY
465	*Anthyllis vulneraria* L. ssp. *nana* (Ten.) Tammaro	Endemico *	BX
466	*Anthyllis vulneraria* L. ssp. *pulchella* (Vis.) Bornm.	Sud-Est Europeo	FW, HH, KY
467	*Anthyllis vulneraria* L. ssp. *rubiflora* (DC.) Arcang.	Eurimediterraneo	BX, IY, KY, ZH
468	*Argyrolobium zanonii* (Turra) P.W.Ball ssp. *zanonii*	Mediterraneo-Occidentale *	VY
469	*Astragalus australis* (L.) Lam.	Eurasiatico °°	HY, KY
470	*Astragalus danicus* Retz.	Eurosiberiano * °°	MW
471	*Astragalus depressus* L. ssp. *depressus*	Eurasiatico	HH, IY, KY, VY
472	*Astragalus glycyphyllos* L.	Eurasiatico	BX, KY, RH, RW, VX, VY
473	*Astragalus hamosus* L.	Mediterraneo-Turaniano *	VY
474	*Astragalus monspessulanus* L. ssp. *monspessulanus*	Eurimediterraneo	KY, VY, ZH
475	*Astragalus sempervirens* Lam.	Mediterraneo-Montano	BX, KY, OH, PK, VY
476	*Astragalus sesameus* L.	Stenomediterraneo *	VY
477	*Bituminaria bituminosa* (L.) C. H. Stirt	Eurimediterraneo	KY, VY
478	*Colutea arborescens* L.	Eurimediterraneo	KY, VY
479	*Coronilla minima* L. ssp. *minima*	Mediterraneo-Occidentale	IY, KY, VY
480	*Coronilla scorpioides* (L.) W. D. J. Koch	Eurimediterraneo	KY, VY, ZH
481	*Coronilla vaginalis* Lam.	Sud-Est-Europeo.	AY, BX, KY
482	*Cytisophyllum sessilifolius* (L.) O. Lang	Sud-Ovest-Europeo	HY, IY, KX, KY, MK, NH, VY
483	*Cytisus decumbens* (Durande) Spach	Sud-Europeo	IY, KY
484	*Cytisus hirsutus* L.	Eurosiberiano	BX, DW, KY, SK, TH, Vy
485	*Cytisus spinescens* Sieber ex Spreng.	Appennino-Balcanico	BX, FW, KY, TH, UX,VY, ZH
486	*Cytisus villosus* Pourr.	Stenomediterraneo	BX, KY
487	*Emerus major* Mill. ssp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti	Pontico	KY, VY
488	*Emerus major* Mill. ssp. *major*	Centro-Europeo *	IY
489	*Ervilia hirsuta* (L.) Opiz	Paleotemperato *	FW, VY
490	*Ervilia loiseleurii* (M.Bieb.) H.Schaef., Coulot & Rabaute	Eurimediterraneo *	VY
491	*Ervilia sativa* Link	Eurimediterraneo	KY
492	*Ervum gracile* DC.	Eurimediterraneo *	VY
493	*Galega officinalis* L.	Pontico	BX, KY
494	*Genista sagittalis* L.	Europeo	KY, VY
495	*Genista tinctoria* L.	Eurasiatico	IY, KY, VH, ZH
496	*Hippocrepis biflora* Spreng.	Eurimediterraneo *	VY
497	*Hippocrepis comosa* L. ssp. *comosa*	Europeo	BX, FW, HY, IY, KY
498	*Laburnum anagyroides* Medik. ssp. *anagyroides*	Sud-Europeo	FH, IY. KY, MK, PK, QK, VY, ZH
499	*Lathyrus annuus L.*	Eurimediterraneo	KY, VY
500	*Lathyrus aphaca* L. ssp. *aphaca*	Eurimediterraneo	VY
501	*Lathyrus cicera* L.	Eurimediterraneo	KY, VY
502	*Lathyrus hirsutus* L.	Eurimediterraneo *	VY
503	*Lathyrus digitatus* (M.Bieb.) Fiori	Pontico	KY

504	*Lathyrus latifolius* L.	Sud-Europeo	KY
505	*Lathyrus nissolia* L.	Eurimediterraneo *	VY
506	*athyrus ochrus* (L.) DC.	Stenomediterraneo *	VY
507	*Lathyrus pannonicus* (Jacq.) Garcke ssp. *asphodeloides* (Gouan) Bässler	Sud-Europeo-Sud-Siberiano	BX, FH, IY, KY, OH, PK, SW, VY
508	*Lathyrus pratensis* L.	Paleotemperato	BX, KY, LW, MH, VY
509	*Lathyrus setifolius* L.	Eurimediterraneo *	VY
510	*Lathyrus sphaericus* Retz.	Eurimediterraneo	FW, KY, VY
511	*Lathyrus sylvestris* L. ssp. *sylvestris*	Europeo	IY, KY,VY
512	*Lathyrus venetus* (Mill.) Wohlf.	Pontico	EY, IY, KX, KY, LX, OH, VY
513	*Lathyrus vernus* (L.) Bernh.	Eurasiatico	FW, KX, KY, MK, NH, VY
514	*Lotus corniculatus* L. ssp. *alpinus* (DC.) Rothm.	Orof. Sud-Europeo	CY, KY
515	*Lotus corniculatus* L. ssp. *corniculatus*	Paleotemperato	FH, IY, KY, VY
516	*Lotus dorycnium* L. ssp. *herbaceus* (Vill.) Kramina & D.D.Sokoloff	Pontico	IY, KY, VY
517	*Lotus hirsutus* L.	Eurimediterraneo	KY
518	*Lotus pedunculatus* Cav.	Paleotemperato	EX
519	*Lotus tenuis* Waldst. & Kit. ex Willd.	Paleotemperato *	QH, QY, VY
520	*Medicago arabica* (L.) Huds.	Eurimediterraneo	KY, VY
521	*Medicago falcata* L. ssp. *falcata*	Eurasiatico	IY, KY,VY
522	*Medicago lupulina* L.	Paleotemperato	IY,KY,VY
523	*Medicago minima* (L.) L.	Eurimediterraneo	KY, VY
524	*Medicago orbicularis* (L.) Bartal.	Eurimediterraneo	KY, VY
525	*Medicago polymorpha* L.	Eurimediterraneo	BX, KY, VY
526	*Medicago prostrata* Jacq. ssp. *prostrata*	Pontico	KY, VY
527	*Medicago rigidula* (L.) All.	Eurimediterraneo *	VY
528	*Medicago sativa* L.	Eurasiatico	KY, VY, ZH
529	*Onobrychis alba* (Waldst. & Kit.) Desv. ssp. *alba*	Appennino-Balcanico	FW, IY, KY, VY
530	*Onobrychis viciifolia* Scop.	Mediterraneo-Montano	BY, IY, KY, VY, ZH
531	*Ononis cristata* MIll. ssp. *apennina* Tammaro & Catonica	Endemico	IY, KY, QH
532	*Ononis pusilla* L. ssp. *pusilla*	Eurimediterraneo	IY, KY, VY
533	*Ononis reclinata* L.	Mediterraneo-Turaniano *	VY
534	*Ononis spinosa* L. ssp. *spinosa*	Europeo *	BX, VY
535	*Ononis viscosa* L. ssp. *breviflora* (DC.) Nyman	Sud-Mediterraneo *	VY
536	*Oxytropis campestris* (L.) DC. ssp. *campestris*	Circumboreale	BX, HY, HH, KY, SW
537	*Oxytropis neglecta* Ten.	Orof. Sud-Europeo	HY, KY
538	*Pisum sativum* L. ssp. *biflorum* (Raf.) Soldano	Eurimediterraneo	IY, KY, VY, ZH
539	*Robinia pseudacacia* L.	Nord-Americano	KY, VY
540	*Scorpiurus muricatus* L.	Eurimediterraneo *	VY
541	*Securigera varia* (L.) Lassen	Sud-Est Europeo	IY, KY, VY, ZH
542	*Spartium junceum* L.	Eurimediterraneo	IY, KY, MY, VY
543	*Sulla coronaria* (L.) Medik.	Mediterraneo-Occidentale	BX, KY.
544	*Trifolium alpestre* L.	Europeo	KY, VY
545	*Trifolium angustifolium* L. ssp. *angustifolium*	Eurimediterraneo *	VY
546	*Trifolium arvense* L. ssp. *arvense*	Paleotemperato	KY, VY
547	*Trifolium aureum* Pollich ssp. *aureum*	Europeo *	QH, QY
548	*Trifolium campestre* Schreb.	Paleotemperato	IY, KY, VY
549	*Trifolium fragiferum* L. ssp. *fragiferum*	Paleotemperato	BX, KY, VY
550	*Trifolium hybridum* L. ssp. *hybridum*	Atlantico *	QH, QK, RH, VY
551	*Trifolium incarnatum* L. ssp. *molinerii* (Balb. ex Hornem.) Ces.	Eurimediterraneo *	QH, VY
552	*Trifolium medium* L. ssp. *medium*	Eurasiatico	KY
553	*Trifolium montanum* L. ssp. *rupestre* (Ten.) Nyman	Mediterraneo-Montano	IY, KY, VY
554	*Trifolium nigrescens* Viv. ssp. *nigrescens*	Eurimediterraneo	BX, KY
555	*Trifolium ochroleucon* Huds.	Pontico *	VX, VY
556	*Trifolium pratense* L. ssp. *pratense*	Subcosmopolita	BX, EX, KY, VY
557	*Trifolium pratense* L. ssp. *semipurpureum* (Strobl) Pignatti	Endemico	HH, HY, KY, SW
558	*Trifolium repens* L. ssp. *repens*	Paleotemperato	HY, KY, VY
559	*Trifolium resupinatum* L.	Paleotemperato	BX, VX, VY

560	*Trifolium scabrum* L . ssp. *scabrum*	Eurimediterraneo *	VY
561	*Trifolium stellatum* L.	Eurimediterraneo	FW, KY, VY
562	*Trifolium thalii* Vill.	Orof. Sud-Europeo	BX, HY, HH, KY
563	*Trifolium tomentosum* L.	Paleotemperato *	VY
564	*Trigonella alba* (Medik.) Coulot & Rabaute	Eurasiatico	KY, VY
565	*Trigonella gladiata* Steven ex M.Bieb.	Stenomediterraneo * ##	VY
566	*Trigonella officinalis* (L.) Coulot & Rabaute	Eurasiatico	KY, VY
567	*Trigonella sulcata* (Desf.) Coulot & Rabaute	Sud-Mediterraneo *	VY
568	*Trigonella wojciechowskii* Coulot & Rabaute	Stenomediterraneo *	VY
569	*Vicia angustifolia* L.	Stenomediterraneo	IY, VY
570	*Vicia bithynica* (L.) L.	Eurimediterraneo *	VY
571	*Vicia cracca* L.	Eurasiatico	KY, ZH
572	*Vicia dasycarpa* Auct. an Ten.	Eurimediterraneo	KY, VY
573	*Vicia ervoides* (Brign.) Hampe	Pontico *	VK, VY
574	*Vicia hybrida* L.	Eurimediterraneo *	VY
575	*Vicia incana* Gouan	Eurimediterraneo *	SK, VY
576	*Vicia lathyroides* L.	Eurimediterraneo *	VY
577	*Vicia lutea* L.	Eurimediterraneo *	VY
578	*Vicia narbonensis* L.	Eurimediterraneo	KY, VY
579	*Vicia onobrychioides* L.	Mediterraneo-Montano	KY
580	*Vicia peregrina* L.	Mediterraneo-Turaniano *	VY
581	*Vicia sativa* L. ssp. *sativa*	Eurimediterraneo	KY, VY
582	*Vicia sepium* L.	Eurosiberiano	FW, KY, VY
583	*Vicia tenuifolia* Roth ssp. *tenuifolia*	Eurasiatico *	IY, VY
	POLYGALACEAE		
584	*Polygala alpestris* Rchb. ssp. *angelisii* (Ten.) Nyman	Endemico	BX, HH, KY
585	*Polygala amarella* Crantz	Europeo	FY, KY
586	*Polygala major* Jacq.	Pontico	FW, IY, KY, VY
587	*Polygala nicaensis* W. D. J. Koch ssp. *mediterranea* Chodat	Eurimediterraneo	FW, KY, VY
588	*Polygala vulgaris* L. ssp. *vulgaris*	Europeo	DW, KY
	ROSACEAE		
589	*Agrimonia eupatoria* L. ssp. *eupatoria*	Subcosmopolita	KY, VY
590	*Alchemilla alpina* L.	Artico-Alpino	BX, KY
591	*Alchemilla colorata* Buser	Eurasiatico	BX, KY
592	*Amelanchier ovalis* Medik. ssp. *ovalis*	Mediterraneo-Montano	BX, IY, VY
593	*Aremonia agrimonoides* (L.) DC. ssp. *agrimonoides*	Sud-Europeo	IY, KY, VY
594	*Cotoneaster integerrimus* Medik.	Eurasiatico	FW, KY, VY
595	*Crataegus laevigata* (Poir.) DC.	Centro-Europeo	FW, KY, OK, PK, QK, QW, RH, RW, TH, VY
596	*Crataegus monogyna* Jacq.	Paleotemperato	FH, FW, FX, KY, LX, MK, VY
597	*Dryas octopetala* L. ssp. *octopetala*	Artico-Alpino	BX, DW, FH, KY, VY
598	*Filipendula ulmaria* (L.) Maxim.	Eurosiberiano	DY, IK, KY, LX, SW, VY
599	*Filipendula vulgaris* Moench	Centro-Europeo	KY, LX, MK, MY, NH, OH, PK, QK, VY, ZH
600	*Fragaria vesca* L. ssp. *vesca*	Cosmopolita	BX, FH, FW, IY, KY, VY
601	*Fragaria viridis* Weston ssp. *viridis*	Eurosiberiano	KY
602	*Geum molle* Vis. & Pančić	Appennino-Balcanico *	QH, QY, VY
603	*Geum rivale* L.	Circumboreale	EX, IK, KY, LX, MK, NH, QY, VY
604	*Geum urbanum* L.	Circumboreale	BX, FW, KY, VY
605	*Malus domestica* (Borkh.) Borkh.	Asiatico	KY. Alloctona naturalizzata
606	*Malus sylvestris* (L.) Mill.	Centro-Europeo	BX, FH, KY, PK, QK, VY
607	*Potentilla apennina* Ten. ssp. *apennina*	Appennino-Balcanico	KY, VY
608	*Potentilla caulescens* L. ssp. *caulescens*	Mediterraneo-Montano	IY, KY
609	*Potentilla crantzii* (Crantz) Beck ex Fritsch ssp. *crantzii*	Artico-Alpino	HY, HH, IY,KY
610	*Potentilla detommasii* Ten.	Appennino-Balcanico *	VY
611	*Potentilla erecta* (L.) Raeusch.	Eurasiatico	KX, KY, LX, MK, NH
612	*Potentilla micrantha* Ramond ex DC.	Eurimediterraneo	BX, KY,VY
613	*Potentilla pedata* Willd. ex Hornem	Eurimediterraneo	KY, VY

614	*Potentilla recta* L. ssp. *recta*	Pontico	KY
615	*Potentilla reptans* L.	Paleotemperato	EX, KY, VY
616	*Potentilla rigoana* Th. Wolf	Endemico	EY, KY, VY
617	*Poterium sanguisorba* L. ssp. *balearicum* (Bourg. ex Nyman) Stace	Europeo	IY, KY, VY
618	*Prunus avium* L. ssp. *avium*	Pontico	KY, VY
619	*Prunus cerasifera* Ehrh. – Pontico	Pontico	KY. Alloctona naturalizzata
620	*Prunus cerasus* L.	Pontico	KY. Alloctona naturalizzata
621	*Prunus domestica* L.	Europeo-Caucasico	KY, VY. Alloctona naturalizzata
622	*Prunus dulcis* (Mill.) D. A. Webb	Eurimediterraneo	KY. Alloctona naturalizzata
623	*Prunus mahaleb* L.	Pontico	BX, VY
624	*Prunus persica* (L.) Batsch	Asiatico-Orientale *	VY. Alloctona naturalizzata
625	*Prunus spinosa* L. ssp. *spinosa*	Europeo	BX, FX, FW, KY, LX, SK, VY
626	*Pyracantha coccinea* M. Roem.	Stenomediterraneo	BX, KX, KY, LX
627	*Pyrus communis* L. ssp. *communis.*	Avventizio	FW, GK, KY, LX, MK. Alloctona naturalizzata
628	*Pyrus communis* L. ssp. *pyraster* (L.) Ehrh.	Eurasiatico	BX, FH, FX, KY, VY
629	*Rosa arvensis* Huds.	Mediterraneo-Atlantico	BX, KY, SK, VY
630	*Rosa canina* L.	Paleotemperato	FH, KY, TK, UK
631	*Rosa dumalis* Bechst.	Europeo-Caucasico	BX, DW, KY
632	*Rosa gallica* L.	Centro-Europeo *	SK, SY
633	*Rosa pendulina* L.	Orof. Sud-Europeo	KY
634	*Rosa montana* Chaix	Mediterraneo-Montano	KY, QH, QY
635	*Rosa subcollina* (Christ) Vuk.	Europeo *	PK, QK
636	*Rubus caesius* L.	Eurasiatico	BX, KY, VY
637	*Rubus canescens* DC.	Eurimediterraneo	KY, VY
638	*Rubus hirtus* Waldst. & Kit.	Centro-Europeo	BX, KY
639	*Rubus idaeus* L. ssp. *idaeus*	Circumboreale	FH, KY, VY
640	*Rubus saxatilis* L.	CIrcumboreale	KY
641	*Rubus ulmifolius* Schott	Mediterraneo-Atlantico	BX, KY, VY
642	*Sanguisorba officinalis* L.	Circumboreale	BX, EY, KY, LX, MH, MK, MY, NH, QH, QY, VY
643	*Sorbus aria* (L.) Crantz ssp. *aria*	Paleotemperato	FH, KX, KY, NH, PK, QK, SH, UK, VY
644	*Sorbus aucuparia* L. ssp. *aucuparia*	Europeo	FH, KY, PK, QK, VY
645	*Sorbus domestica* L.	Eurimediterraneo	KY, VY
646	*Sorbus torminalis* (L.) Crantz	Eurasiatico	BX, IY, KY, LX, MK, NH, PK, QK, QW, RX. SH
	RHAMNACEAE		
647	*Atadinus alpinus* (L.) Raf.	Mediterraneo-Occidentale	BX, FW, KY, TH, VY
648	*Atadinus pumilus* (Turra) Hauenschild ssp. *pumilus*	Orof. Sud-Europeo	HH, KY
649	*Paliurus spina-christi* Mill.	Pontico	BX, KY
650	*Rhamnus cathartica* L.	Pontico	KY, LX, MK, NX, RX, SH, UK, VY
651	*Rhamnus saxatilis* Jacq. – ssp. *saxatilis*	Pontico	KX, KY, LX, VY
	ULMACEAE		
652	*Ulmus glabra* Huds.	Europeo-Caucasico	BX, FH, KY, VY
653	*Ulmus minor* Mill. ssp. *minor*	Europeo-Caucasico	BX, KY, VY, ZH
	MORACEAE		
654	*Ficus carica* L.	Eurimediterraneo	KY, VY. Alloctona naturalizzata.
655	*Morus alba* L.	Asiatico	KY. Alloctona naturalizzata.
656	*Morus nigra* L.	Sud-Ovest-Asiatico *	VK. Alloctona naturalizzata.
	URTICACEAE		
657	*Parietaria judaica* L.	Eurimediterraneo	KY, VY
658	*Parietaria officinalis* L.	Europeo	KY, VY
659	*Urtica dioica* L.	Cosmopolita	EX, KY, VY
660	*Urtica urens* L	Subcosmopolita	KY
	FAGACEAE		
661	*Fagus sylvatica* L.	Centro-Europeo	EW, FH, FW, KX, KY, LX, MK, NH, VY, ZH
662	*Quercus cerris* L.	Eurimediterraneo	AH, BX, FH, KY, NK, UX, VY, ZH
663	*Quercus ilex* L. ssp. *ilex*	Stenomediterraneo	KY, VY, ZH
664	*Quercus pubescens* Willd. ssp. *pubescens*	Pontico	KY, VY

	JUGLANDACEAE		
665	*Juglans regia* L.	Asiatico	BX, KY, VY. Alloctona naturalizzata.
	BETULACEAE		
666	*Alnus cordata* (Loisel.) Duby	Sud-Est Europeo	EY, KY, VY
667	*Alnus glutinosa* L.Gaertn.	Paleotemperato	KY, RH, RW, VY
668	*Carpinus betulus* L.	Europeo	GK, KX, KY, LX, MK, NH, SK, VY
669	*Carpinus orientalis* Mill. ssp. *orientalis*	Pontico	KY VY
670	*Corylus avellana* L.	Europeo	KY, VY, ZH
671	*Ostrya carpinifolia* Scop.	Pontico	KY, OK, PW, QW, RK, VY, ZH
	CUCURBITACEAE		
672	*Bryonia dioica* Jacq.	Eurimediterraneo	KY, OK, PW, QW, RK, VY
673	*Ecballium elaterium* (L.) A. Rich.	Eurimediterraneo	BX, KY, VY
	CELASTRACEAE		
674	*Euonymus europaeus* L.	Eurasiatico *	VX, VY
675	*Euonymus latifolius* (L.) Mill. ssp. *latifolius*	Mediterraneo-Montano	FH, KX, KY, MK, NH, SK, TH, VY
676	*Parnassia palustris* L. ssp. *palustris*	Eurosiberiano	AH, BX, KY, LX
	OXALIDACEAE		
677	*Oxalis articulata* Savigny	Sud-Americano *	VY. Alloctona naturalizzata
678	*Oxalis corniculata* L.	Cosmopolita *	VY. Alloctona naturalizzata
	VIOLACEAE		
679	*Viola alba* Besser ssp. *dehnhardtii* (Ten.) W. Becker	Eurimediterraneo	KY, VY
680	*Viola arvensis* Murray ssp. *arvensis*	Eurasiatico *	KY, VY
681	*Viola eugeniae* Parl. ssp. *eugeniae*	Endemico	BX, DW, FH, HY, HH, IY, KY, PW, ZH
682	*Viola eugeniae* Parl. ssp. *levieri* (Parl.) Arcang.	Endemico *	PX
683	*Viola majellensis* Porta & Rigo ex Strobl	Appennino-Balcanico *	BX, DW, IW, OH
684	*Viola odorata* L.	Eurimediterraneo	KY, VY
685	*Viola riechenbachiana* Jord. ex Boreau	Eurosiberiano	IY, KY, MH, VY
686	*Viola riviniana* Rchb.	Europeo *	SH
687	*Viola suavis* Bieb.	Sud-Europeo-Sud-Siberiano *	QH, QY
688	*Viola tricolor* L.	Eurasiatico	BX, EY, KY, LW, VY
	SALICACEAE		
689	*Populus alba* L.	Paleotemperato	BX, KY, VY
690	*Populus nigra* L.	Paleotemperato	BX, KY, VY
691	*Populus tremula* L.	Eurosiberiano	BX, GK, KY, VY
692	*Salix alba* L.	Paleotemperato	KY, VY
693	*Salix amplexicaulis* Bory	Nord-Est-Mediterraneo	KY
694	*Salix apennina* A. K. Skvortsov	Endemico	KY, VY
695	*Salix caprea* L.	Eurasiatico	KY, VY
696	*Salix eleagnos* Scop. ssp. *eleagnos*	Orof. Sud-Europeo	KY, VY
697	*Salix purpurea* L. ssp. *purpurea*	Eurasiatico	DY, KY, VY
698	*Salix retusa* L.	Orof. Europeo	KY
699	*Salix triandra* L. ssp. *triandra*	Eurosiberiano	KY
	LINACEAE		
700	*Linum alpinum* Jacq.	Mediterraneo-Montano	DW, KY
701	*Linum bienne* Mill.	Subatlantico	KY, VY
702	*Linum capitatum* Kit. ex Schult. ssp. *serrulatum* (Bertol.) Hartvig	Appennino-Balcanico	IY, KY, OK, PW, RW, SK, VY
703	*Linum catharticum* L.	Eurimediterraneo	KY, MH, MY, OH, PK, VY
704	*Linum corymbulosum* Rchb.	Stenomediterraneo *	VY
705	*Linum tenuifolium* L.	Pontico	DW, IY, KY, VY, ZH
706	*Linum tommasinii* (Rchb.) Nyman	Appennino-Balcanico	KY, VY
707	*Linum tryginum* L.	Eurimediterraneo	EY
708	*Linum viscosum* L.	Orof. Sud-Europeo	DW, IY, KY, VY
	HYPERICACEAE		
709	*Hypericum hirsutum* L.	Paleotemperato	KY, TH, UX, VY
710	*Hypericum hyssopifolium* Chaix	Orof. Sud-Europeo *	RW, SK

711	*Hypericum montanum* L.	Europeo-Caucasico	KY
712	*Hypericum perfoliatum* L.	Stenomediterraneo	KY, MK, VY
713	*Hypericum perforatum* L. ssp. *perforatum*	Eurimediterraneo	KY, NH
714	*Hypericum richeri* Vill. ssp. *richeri*	Orof. Sud-Europeo	KY
715	*Hypericum tetrapterum* Fr.	Paleotemperato	KY, VY
	EUPHORBIACEAE		
716	*Euphorbia amygdaloides* L.	Europeo	BX, IY, KY, VY
717	*Euphorbia characias* L.	Stenomediterraneo	KY, VY, ZH
718	*Euphorbia cyparissias* L.	Europeo	BX, IY, KY, VY
719	*Euphorbia dulcis* L.	Centro-Europeo * ##	VY
720	*Euphorbia falcata* L.	Mediterraneo-Turaniano *	VY
721	*Euphorbia gasparrinii* Boiss. ssp. *samnitica* (Fiori) Pignatti	Endemico	FH
722	*Euphorbia helioscopia* L. ssp. *helioscopia*	Cosmopolita	BX, KY, VY, ZH
723	*Euphorbia maculata* L.	Nord-Americano *	VY. Alloctona naturalizzata.
724	*Euphorbia myrsinites* L. ssp. *myrsinites*	Pontico	AH, FW, IY, KY
725	*Euphorbia nicaensis* All. ssp. *nicaensis*	Eurimediterraneo	KY
726	*Euphorbia peplus* L.	Cosmopolita *	VY
727	*Euphorbia spinosa* L. ssp. *spinosa*	Nord-Mediterraneo *	VK
728	*Euphorbia platyphyllos* L.	Eurimediterraneo	IY, KY, VY
729	*Euphorbia prostrata Aiton*	Nord-Americano *	VY
730	*Euphorbia spinosa* L. ssp. *spinosa*	Nord-Mediterraneo *	VY
731	*Mercurialis annua* L.	Paleotemperato	KY, VY
732	*Mercurialis ovata* Sternb. & Hoppe	Pontico	IY, KY
733	*Mercurialis perennis* L.	Europeo	FW, IY, KY, VY
	GERANIACEAE		
734	*Erodium alpinum* L’Hér.	Endemico	KY, VY
735	*Erodium ciconium* (L.) L'Hér.	Eurimediterraneo	KY, VY
736	*Erodium cicutarium* (L.) L’Hér.	Cosmopolita	KY, VY
737	*Erodium malacoides* (L.) L’Her.	Eurimediterraneo	KY, VY
738	*Geranium austroapenninum* Aedo	Endemico	IY, KY, QH, QY
739	*Geranium columbinum* L.	Subcosmopolita	IY, KY, VY
740	*Geranium dissectum* L.	Eurasiatico	KY, VY
741	*Geranium lucidum* L.	Eurimediterraneo	FW, IY, KY, VY
742	*Geranium molle* L.	Eurasiatico	BX, KY, VY
743	*Geranium nodosum* L.	Mediterraneo-Montano	AY, BX, IY, KY, VY
744	*Geranium pratense* L. ssp. *pratense*	Eurosiberiano *	UX
745	*Geranium pyrenaicum* Burm. f. ssp. *pyrenaicum*	Eurimediterraneo *	VX, VY
746	*Geranium purpureum* Vill.	Eurimediterraneo *	VY
747	*Geranium pusillum* L.	Eurasiatico *	VY
748	*Geranium reflexum* L.	Appennino-Balcanico	KY, VY
749	*Geranium robertianum* L.	Cosmopolita	FW, KY, VY
750	*Geranium rotundifolium* L.	Paleotemperato	KY, VY
751	*Geranium sanguineum* L.	Europeo-Caucasico	IY, KY, VY, ZH
752	*Geranium sylvaticum* L.	Eurasiatico	IK, KY, VY
753	*Geranium tuberosum* L. ssp. *tuberosum*	Sud-Europeo-Sud-Siberiano *	VY
754	*Geranium versicolor* L.	Appennino-Balcanico	AY, BX, IK, KY, VH, VY
	ONAGRACEAE		
755	*Chamaenerion angustifolium* (L.) Scop.	Circumboreale	DW, KX, KY, LX, MK, NH, VY
756	*Chamaenerion dodonaei* (Vill.) Schur ex Fuss	Europeo-Caucasico *	SW
757	*Circaea lutetiana* L. ssp. *lutetiana*	Circumboreale	BX, KY, UX, VY
758	*Epilobium alsinifolium* Vill.	Artico-Alpino °°	KY
759	*Epilobium hirsutum* L.	Paleotemperato *	IY, LX, VX, VY
760	*Epilobium montanum* L.	Eurasiatico	KY, VY
761	*Epilobium palustre* L.	Circumboreale	KY
762	*Epilobium parviflorum* Schreb.	Paleotemperato	BY, KY, VY
763	*Epilobium tetragonum* L. ssp. *tetragonum*	Eurimediterraneo	BX, VY

	LYTHRACEAE		
764	*Lythrum salicaria* L.	Subcosmopolita	BX, KY
	ANACARDIACEAE		
765	*Pistacia terebinthus* L. ssp. *terebinthus*	Eurimediterraneo	KY, VY
	SAPINDACEAE		
766	*Acer campestre* L.	Europeo-Caucasico	BX, FX, HY, KY, VY
767	*Acer cappadocicum* Gled. ssp. *lobelii* (Ten.) A.E.Murray	Endemico	BQ, BX, EX, FH, IY. KY, NK, QH, QY
768	*Acer monspessulanus* L. ssp. *monspessulanus*	Eurimediterraneo	BX, IY, KY, VY
769	*Acer opalus* Mill. ssp. *obtusatum* (Waldst. & Kit. ex Willd.) Gams	Appennino-Balcanico	FW, IY, KY, PK, QK, VY
770	*Acer opalus* Mill. ssp. *opalus*	Sud-Est-Europeo	FH, KY
771	*Acer platanoides* L.	Europeo-Caucasico *	VK, VY
772	*Acer pseudoplatanus* L.	Europeo-Caucasico	BX, FH, FW, IY, KY, LX, MK, NH, VY
773	*Aesculus hippocastanum* L.	Sud-Est-Europeo	BX, VY. Utilizzato per le alberature stradali
	RUTACEAE		
774	*Ruta graveolens* L.	Sud-Europeo-Sud-Siberiano	KY
	THYMELACEAE		
775	*Daphne laureola* L.	Subatlantico	IY, KY, VY
776	*Daphne mezereum* L.	Eurosiberiano	BX, DW, KY, NH, PK, QK, RK, SH, TK
777	*Daphne oleoides* Schreb.	Eurasiatico	FH, IY, KY, VY
	CISTACEAE		
778	*Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter & Burdet	Stenomediterraneo	KY, VY, ZH
779	*Fumana procumbens* (Dunal) Gren. & Godr.	Pontico	EY, FW, KY, VY
780	*Fumana thymifolia* (L.) Spach ex Webb	Stenomediterraneo	KY, VY
781	*Helianthemum appeninum* (L.) Mill. ssp. *apenninum*	Sud-Ovest-Europeo	DW, FK, FW, IY, KY, RH, RW, VY, ZH
782	*Helianthemum nummularium* (L.) Mill. ssp. *glabrum* (W.D.J.Koch) *Wilczek*	Sud-Est-Europeo	DW, KY
783	*Helianthemum nummularium* (L.) Mill. ssp. *grandiflorum* (Scop.) Schinz & Thell.	Europeo-Caucasico	DW, IY, KY, VY, ZH
784	*Helianthemum nummularium* (L.) Mill. ssp. *obscurum* (Celak) Holub	Europeo-Caucasico	EY, KY, VY
785	*Helianthemum oleandicum* (L.) Dum. Cours. ssp. *alpestre* (Jacq.) Ces.	Orof. Sud-Europeo	HH, IY, KY, VY
786	*Helianthemum oleandicum* (L.) Dum. Cours. ssp. *incanum* (Willk.) G. Lopez	Europeo-Caucasico	CY, FW, KY, VY
787	*Helianthemum oelandicum* (L.) Dum. Cours. ssp. *italicum* (L.) Ces.	Orof. Sud-Ovest-Europeo *	BX, VX, VY
788	*Helianthemum salicifolium* (L.) Mill.	Eurimediterraneo *	VY
	SIMAROUBACEAE		
789	*Ailanthus altissima* (Mill.) Swingle	Avventizio	EX, FH, IY, KY, VY, ZH. Alloctona naturalizzata.
	MALVACEAE		
790	*Alcea rosea* L.	Avventizio	KY. Alloctona naturalizzata.
791	*Malope malacoides* L.	Eurimediterraneo	LX, MK
792	*Malva alcea* L.	Centro-Europeo	KY, OK, PW, QW, RK
793	*Malva cretica* Cav.	Stenomediterraneo	KY
794	*Malva moschata* L.	Eurimediterraneo	KX, KY, LX, MK, NH, VY
795	*Malva multiflora* (Cav.) Soldano, Banfi & Galasso	Stenomediterraneo *	VY
796	*Malva neglecta* Wallr.	Paleotemperato	KY,VY
797	*Malva pusilla* Sm.	Eurosiberiano	KY
798	*Malva setigera* K.F.Schimp. & Spenn.	Eurimediterraneo *	VY
799	*Malva sylvestris* L. ssp. *sylvestris*	Eurosiberiano	BX, FH, KY, VY
800	*Malca thuringiaca* (L.) Vis.	Sud-Europeo-Sud-Siberiano	FW, KX, KY, LX, MK, NH, VH, VY
801	*Tilia cordata* Mill.	Europeo-Caucasico	BX, GK, KY, VY
802	*Tilia platyphyllos* Scop. ssp. *platyphyllos*	Europeo	KX, KY
	RESEDACEAE		
803	*Reseda lutea* L. ssp. *lutea*	Europeo	KY, VY
804	*Reseda luteola* L.	Circumboreale	IY, KY, PK, QK, VY
	BRASSICACEAE		
805	*Aethionema saxatile* (L.) R. Br. ssp. *saxatile*	Mediterraneo-Montano	FW, IY, KX, KY, VY
806	*Alliaria petiolata* (M. Bieb.) Cavara & Grande	Eurasiatico	KY, VY
807	*Alyssum alyssoides* (L.) L.	Eurimediterraneo	IY, KY
808	*Alyssum cuneifolium* Ten.	Endemico	FY, KY,SW
809	*Alyssum diffusum* Ten. ssp. *diffusum*	Mediterraneo-Montano	VX, VY
810	*Alyssum montanun* L. ssp. *montanum*	Pontico	KY

811	*Alyssum simplex* Rudolphi	Mediterraneo-Turaniano	KY, VY
812	*Arabidopsis thaliana* (L.) Heynh.	Paleotemperato	KY
813	*Arabis alpina* L. ssp. *alpina*	Artico-Alpino	IY, KY
814	*Arabis alpina* L. ssp. *caucasica* (Willd.) Briq.	Mediterraneo-Montano	KY, LX, MK, NH, VY
815	*Arabis auriculata* Lam.	Orof. Sud-Europeo *	FW, VY
816	*Arabis bellidifolia* Crantz ssp. *stellulata* (Bertol.) Greuter & Burdet	Mediterraneo-Montano	AY, KY
817	*Arabis collina* Ten. ssp. *collina*	Mediterraneo-Montano	FW, IY, KY, VY
818	*Arabis collina* Ten. ssp. *rosea* (DC.) Minuto	Endemico *	VY
819	*Arabis hirsuta* (L.) Scop.	Orof. Sud-Europeo	KY, VY
820	*Arabis sagittata* (Bertol.) DC.	Sud-Est-Europeo	KY
821	*Arabis surculosa* N. Terracc.	Appennino-Balcanico	BX, HH, KY
822	*Aubrieta columnae* Guss. ssp. *columnae*	Endemico	KY
823	*Aurinia sinuata* (L.) Griseb.	Appennino-Balcanico	BX, EY, KY, QH, QY
824	*Ballota nigra* L. ssp. *meridionalis* (Bég.) Bég.	Eurimediterraneo	KY, VY
825	*Barbarea bracteosa* Guss.	Sud-Mediterraneo *	VY
826	*Barbarea stricta* Andrz.	Eurosiberiano	KY
827	*Barbarea vulgaris* W.T.Aiton	Eurosiberiano *	VX, VY
828	*Biscutella laevigata* L. ssp. *australis* Raffaelli & Baldoin	Endemico	FW, IY, VY
829	*Brassica gravinae* Ten.	Subendemico	EY, KY, PK, QK, VY
830	*Brassica nigra* (L.) W. D. J. Koch	Eurimediterraneo	KY
831	*Brassica oleracea* (L.)	Eurimediterraneo	KY
832	*Brassica rapa* L.	Eurimediterraneo *	VY
833	*Bunias erucago* L.	Eurimediterraneo	KY, VY
834	*Calepina irregularis* (Asso) Thell.	Mediterraneo-Turaniano *	VY
835	*Capsella bursa-pastoris* (L.) Medik. ssp. *bursa-pastoris*	Cosmopolita	BX, KY
836	*Capsella rubella* Reut.	Cosmopolita	BX, KY, VY
837	*Cardamine bulbifera* (L.) Crantz	Centro-Europeo	BX, KY, VY
838	*Cardamine chelidonia* L.	Subendemico *	VK
839	*Cardamine enneaphyllos* (L.) Crantz	Appennino-Balcanico	KY, VY
840	*Cardamine graeca* L.	Nord-Mediterraneo	KY, VY
841	*Cardamine hirsuta* L.	Cosmopolita	KY, VY
842	*Cardamine kitaibelii* Bech.	Orof. Sud-Est-Europeo	KY, VY
843	*Cardamine monteluccii* Brilli-Catt. & Gubellini	Endemico	FW, KY, VY
844	*Clypeola jonthlaspi* L. ssp. *jonthlaspi*	Stenomediterraneo	KY, VY
845	*Diplotaxis erucoides* (L.) DC. ssp. *erucoides*	Stenomediterraneo	KY, VY
846	*Diplotaxis muralis* (L.) DC.	Atlantico *	VY
847	*Diplotaxis tenuifolia* (L.) DC.	Subatlantico	KY
848	*Draba aizoides* L. ssp. *aizoides*	Mediterraneo-Montano	HY, FY, HH, IY, KY, VY
849	*Drava verna* L. subsp *verna*	Circumboreale	BX, FW, KY, VY
850	*Drabella muralis* (L.) Fourr.	Circumboreale *	VY
851	*Erysimum apenninum* Peccenini & Polatschek	Endemico *	NW
852	*Erysimum cheiri* (L.) Crantz.	Eurimedterraneo	KY, VY
853	*Erysimum majellense* Polatscheck	Endemico	FH, IY, JX, KK, KX, KY, LX
854	*Erysimum pseudorhaeticum* Polatscheck	Endemico	AY, BX, IY, JX, KK, KY, VY
855	*Fibigia clypeata* (L.) Medik	Orof. Sud-Est Europeo	KY
856	*Hesperis laciniata* All. ssp. *laciniata*	Nord-Mediterraneo	FW, IY, KY, RW, SK, VY
857	*Hornungia petraea (L.) Rchb. ssp. petraea*	Eurimediterraneo	FW, KY, VY
858	*Iberis saxatilis* L. ssp. *saxatilis*	Mediterraneo-Montano °°	BX, DW, FY, HH, KY, OH, VY
859	*Iberis violacea* W.T.Aiton	Mediterraneo-Montano *	VY
860	*Isatis apennina* Ten. ex Grande	Subendemico °°	KY
861	*Isatis tinctoria* L. ssp. *tinctoria*	Eurasiatico	KY, VY, ZH
862	*Lepidium campestre* (L.) W.T. Aiton	Europeo-Caucasico	KY, VY
863	*Lepidium draba* L. ssp. *draba*	Mediterraneo-Turaniano	KY, VY
864	*Lunaria annua* L.	Sud-Est Europeo	IY, KY, VY
865	*Lunaria rediviva* L.	Europeo	KY
866	*Malcolmia orsiniana* (Ten.) Ten. ssp. *orsiniana*	Appennino-Balcanico °°	BX, IY, KY
867	*Matthiola fruticulosa* (L.) Maire	Subendemico	KY

868	*Microthlaspi perfoliatum* (L.) F. K. Mey	Paleotemperato	BX, KY, VY
869	*Mummenhoffia alliacea* (L.) Esmailbegi & Al-Shehbaz	Subatlantico	LX, VY
870	*Noccaea stylosa* (Ten.) Rchb.	Endemico	FH. HH, KY
871	*Pseudoturritis turrita* (L.) Al-Shehbaz.	Stenomediterraneo	KY, VY
872	*Raphanus raphanistrum* L. ssp. *landra* (Moretti ex DC.) Bonnier & Layens	Stenomediterraneo *	VY
873	*Rapistrum rugosum* (L.) Arcang.	Eurimediterraneo	KY, VY
874	*Rorippa sylvestris* (L.) Besser ssp. *sylvestris*	Eurasiatico	KY, VY
875	*Sinapis alba* L. ssp. *alba*	Mediterraneo-Orientale *	VY
876	*Sinapis arvensis* L. ssp. *arvensis*	Stenomediterraneo *	VY
877	*Sisymbrium officinale* (L.) Scop.	Eurasiatico	KY, VY
878	*Sisymbrium orientale* L.	Eurimediterraneo *	FW, VX, VY
879	*Thlaspi arvense* L.	Subcosmopolita	KY
880	*Turritis glabra* L.	Artico-Alpino *	VY
	LORANTHACEAE		
881	*Loranthus europaeus* Jacq.	Europeo	KY, VY
	SANTALACEAE		
882	*Osyris alba* L.	Eurimediterraneo	KY, VY
883	*Thesium humifusum* DC.	Eurimediterraneo	IY, KY, VY
884	*Thesium linophyllon* L.	Sud-Est Europeo	IY, KY, VY
885	*Thesium parnassii* A. DC.	Appennino-Balcanico *	BX, HH, KY
886	*Viscum album* L. ssp. *album*	Eurasiatico	KY, VY
	PLUMBAGINACEAE		
887	*Armeria gracilis* Ten. ssp. *gracilis*	Endemico	HH, KY, LX, MK, SK, TH, UX, VY
888	*Armeria gracilis* Ten. ssp. *majellensis* (Boiss.) *Arrigoni*	Endemico	FH, HY, KY
889	*Plumbago europaea* L.	Stenomediterraneo	KY
	POLYGONACEAE		
890	*Bistorta officinalis* Delarbre	Circumboreale	BX, KY, OH, PK, SK, VY
891	*Bistorta vivipara* (L.) Delarbre	Artico-Alpino	BX, KY
892	*Fallopia convolvulus* (L.) Á.Löve	Cosmopolita *	VY
893	*Persicaria amphibia* (L.) Delarbre	Subcosmopolita	IK, VY
894	*Persicaria lapathifolia* (L.) Delarbre	Cosmopolita	BX, KY, VY
895	*Polygonum aviculare* L. ssp. *aviculare*	Cosmopolita	EY, FH, KY, VY
896	*Rumex acetosa* L. ssp. *acetosa*	Circumboreale	BX, KY,SK. UX. VY
897	*Rumex acetosella* L. ssp. *acetosella*	Subcosmopolita *	VX
898	*Rumex arifolius* All.	Eurasiatico	KY, SW, VY
899	*Rumex conglomeratus* Murray	Eurasiatico	IY, KY
900	*Rumex crispus* L.	Cosmopolita	KY, MH, MY, SK, VY
901	*Rumex nebroides* Campd.	Nord-Mediterraneo	KY
902	*Rumex obtusifolius* L. ssp. *obtusifolius*	Europeo-Caucasico	KY, QK, RH
903	*Rumex patientia* L. ssp. *patientia*	Europeo *	QH, QY, VY
904	*Rumex pulcher* L. ssp. *pulcher*	Subcosmopolita *	VY
905	*Rumex sanguineus* L.	Europeo-Caucasico *	VY
906	*Rumex scutatus* L. ssp. *scutatus*	Mediterraneo-Montano	BX, FX, KY, VY
	CARYOPHYLLACEAE		
907	*Agrostemma githago* L.	Eurasiatico	KY, SW
908	*Arenaria bertolonii* Fiori	Endemico *	BX
909	*Arenaria grandifora* L. ssp. *grandifora*	Mediterraneo-Montano	BX, HY, KY, OH
910	*Arenaria serpyllifolia* L. ssp. *serpyllifolia*	Subcosmopolita	FW, KY, VY
911	*Cerastium arvense* L. ssp. *arvense*	Paleotemperato	KY, SW, VY
912	*Cerastium arvense* L. ssp. *suffruticosum* (L.) Ces.	Orof. Sud-Europeo	HH, KY, VY
913	*Cerastium brachypetalum* Desp. ex Pers. ssp. *roeseri* (Boiss. & Heldr.) Nyman	Mediterraneo-Turaniano *	FW, VY
914	*Cerastium cerastoides* (L.) Britton	Artico-Alpino	HH
915	*Cerastium glomeratum* Thuill.	Eurimediterraneo	IY, KY, VY
916	*Cerastium glutinosum* Fr.	Eurimediterraneo	IY, KY
917	*Cerastium holosteoides* Fr.	Eurasiatico	VK, VY

918	*Cerastium pumilum* Curtis	Eurimediterraneo	IY
919	*Cerastium scaranoi* Ten.	Endemico *	QH, QY, ZH
920	*Cerastium thomasii* Ten.	Endemico	HH, KY
921	*Cerastium tomentosum* L.	Ovest-Europeo	BX, CY, DW, FH, KY, NH, SK, TH, VY
922	*Cherleria capillacea* (All.) A.J. Moore & Dillenb.	Orof. Sud-Europeo °°	AY, BX, EY, IK, IY, KY
923	*Dianthus barbatus* L. ssp. *compactus* (Kit.) Heuff	Orof. Sud-Europeo *	VY
924	*Dianthus brachycalyx* A.Huet & É.Huet ex Bacch., Brullo, Casti & Giusso	Endemico *	SK, TH
925	*Dianthus carthusianorum* L. ssp. *tenorei* (Lacaita) Pignatti	Endemico	KY, OH, , SH
926	*Dianthus ciliatus* Guss. ssp. *ciliatus*	Appennino-Balcanico	KY, VY
927	*Dianthus deltoides* L.	Eurasiatico	BX, KY, SK, SW, VY, TH
928	*Dianthus hyssopifolius* L.	Mediterraneo-Montano	IY, KY, PK, VY
929	*Dianthus virgineus* L.	Stenomediterraneo	KY, SW, VY
930	*Drypis spinosa* L. ssp. *spinosa*	Appennino-Balcanico	BX, FH, KY, MY, OH, PK, VY
931	*Gypsophila repens* L.	Orof. Sud-Europeo	KY
932	*Heliosperma pusillum* (Waldst. & Kit.) Rchb.	Mediterraneo-Montano.	IY, KY
933	*Herniaria bornmuelleri* Chaudhri	Endemico	HY, KY
934	*Herniaria glabra* L. ssp. *nebrodensis* Nyman	Orof. Sud-Est-Europeo	HH
935	*Herniaria incana* Lam.	Eurimediterraneo *	SW, VY
936	*Lychnis flos-cuculi* L. ssp. *flos-cuculi*	Europeo	KY, OH, VY
937	*Mcneillia graminifolia* (Ard.) Dillenb. & Kadereit ssp. *rosanoi* (Ten.) F. Conti, Bartolucci, Iamonico & Del Guacchio	Endemico	KY, VY
938	*Moehringia trinervia* (L.) Clairv.	Eurasiatico *	VX, VY
939	*Paronykia kapela* (Hacq.) A. Kern. ssp. *kapela*	Appennino-Balcanico	BX, DW, KY, VY
940	*Pethroragia prolifera* (L.) P. W. Ball & Heywood	Eurimediterraneo	KY, VY
941	*Pethroragia saxifraga* (L.) Link ssp. *saxifraga*	Eurimediterraneo	IY, KY, VY, ZH
942	*Polycarpon tetraphyllum* (L.) L. ssp. *tetraphyllum*	Eurimediterraneo *	VY
943	*Rabelera holostea* (L.) M.T.Sharples & E.A.Tripp	Eurasiatico	KY, SW, VY
944	*Sabulina glaucina* (Dvořáková) Dillenb. & Kadereit	Eurasiatico	FW, KY
945	*Sabulina tenuifolia* (L.) Rchb.ssp. *tenuifolia*	Paleotemperato	FW, KY, VY
946	*Sabulina verna* (L.) Rchb. ssp. *verna*	Eurasiatico	HY, FY, HH, IY, LX, VY
947	*Sagina glabra* (Willd.) Fenzl	Orof. Sud-Ovest-Europeo	HH, IY, KY
948	*Sagina procumbens* L. ssp. *procumbens*	Subcosmopolita *	VY
949	*Sagina saginoides* (L.) H. Karst. ssp. *saginoides*	Artico-Alpino *	HY
950	*Saponaria bellidifolia* Sm.	Appennino-Balcanico °°	IY, KY, VY
951	*Saponaria ocymoides* L. ssp. *ocymoides*	Mediterraneo-Montano °°	BX, DW, KY
952	*Saponaria officinalis* L.	Eurosiberiano	KY, MK, NH. UX
953	*Scleranthus annuus* L.	Paleotemperato *	VY
954	*Silene acaulis* (L.) Jacq. ssp. *bryoides* (Jord.) Nyman	Artico-Alpino	HY, FY, HH, KY
955	*Silene catholica* (L.) W. T. Aiton	Appennino-Balcanico	AH, IY, KY
956	*Silene conica* L.	Paleotemperato	KY, VY
957	*Silene dioica* (L.) Clairv.	Paleotemperato	KY, SK
958	*Silene italica* (L.) Pers. ssp. *italica*	Eurimediterraneo	BX, FW, KY, OK, VY
959	*Silene latifolia* Poir.	Paleotemperato	BX, DW, KY, RK, RX, SH, TK, VY, ZH
960	*Silene multicaulis Guss. ssp. multicaulis*	Appennino-Balcanico	AY, KY
961	*Silene nemoralis Waldst. & Kit.*	Eurimediterraneo.	KY
962	*Silene notarisii Ces.*	Endemico	BX come Silene parnassica Boiss. & Spruner, FW, KY, MY, OH, PK, SW
963	*Silene nutans* L.	Paleotemperato	KY, VY
964	*Silene otites* (L.) Wibel ssp. *otites*	Eurasiatico	KY, VY
965	*Silene saxifraga* L.	Orof. Sud-Europeo	IY, VY
966	*Silene tenuiflora* Guss.	Stenomediterraneo *	ZH
967	*Silene viridiflora* L.	Sud-Europeo *	VY
968	*Silene vulgaris* (Moench) Garcke ssp. *prostrata* (Gaudin) Schinz & Thell.	Orof. Sud-Ovest-Europeo	AY, BX, KY
969	*Silene vulgaris* (Moench) Garcke ssp. *vulgaris*	Paleotemperato	BX, DW, KY, VY
970	*Stellaria graminea* L.	Eurasiatico	EY, IK, IY, KY,SW, VY
971	*Stellaria media* (L.) Vill. ssp. *media*	Cosmopolita	KY, VY
972	*Stellaria nemorum* L. ssp. *montana* (Pierrat) Berher	Europeo-Caucasico	KY, SW, VY

	AMARANTHACEAE		
973	*Amaranthus retroflexus* L.	Cosmopolita	KY, VY
974	*Atriplex patula* L. ssp. *patula*	Subcosmopolita *	VY
975	*Atriplex prostrata* Boucher ex DC.	Paleotemperato *	VY
976	*Beta vulgaris* L. ssp. *vulgaris*	Eurimediterraneo *	VY
977	*Blitum bonus-henricus* (L.) Rchb.	Circumboreale	BX, FH, FX, HY, KY, VY
978	*Chenopodiastrum hybridum* (L.) S.Fuentes, Uotila & Borsch	Circumboreale	KY, VY
979	*Chenopodiastrum murale* (L.) S. Fuentes, Uotila & Borsch	Subcosmopolita *	VX
980	*Chenopodium album* L. ssp. *album*	Cosmopolita	BX, KY, VY
981	*Chenopodium opulifolium* Schrad. ex W.D.J.Koch & Ziz	Europeo *	VY
982	*Chenopodium vulvaria* L.	Europeo *	VY
983	*Oxybasis urbica* (L.) S.Fuentes, Uotila & Borsch	Subcosmopolita *	VY
	PORTULACACEAE		
984	*Portulaca trituberculata* Danin, Domina & Raimondo	Subcosmopolita	KY, VY
	CORNACEAE		
985	*Cornus mas* L.	Pontico	FH, IY, KY, MK, NH, NK, OK, VY
986	*Cornus sanguinea* ssp. *hungarica* (Kàrpàti) Soò	Eurasiatico	KY, NH, VY
	PRIMULACEAE		
987	*Androsace villosa* L. ssp. *villosa*	Orof. Eurasiatico	BX, DW, HH, KY
988	*Androsace vitaliana* (L.) Lapeyr. ssp. *praetutiana* (Sund.) Kress	Endemico	BX, KY
989	*Cyclamen hederifolium* Aiton ssp. *hederifolium*	Stenomediterraneo	IY, KY, VH, VY
990	*Cyclamen repandum* Sm. ssp. *repandum*	Nord-Mediterraneo	IY, KY, VY, ZH
991	*Lysimachia arvensis* (L.) U. Manns & Anderb. ssp. *arvensis*	Eurimediterraneo	BX, KY, VY, ZH
992	*Lysimachia linum-stellatum* L.	Stenomediterraneo *	VY
993	*Lysimachia vulgaris* L.	Eurasiatico *	VY
994	*Primula auricula* L. ssp. *ciliata* (Moretti) Ludi	Mediterraneo-Montano	BX,DW, KY
995	*Primula intricata* Gren. & Godr.	Orof. Sud-Europeo °°	IK, KY
996	*Primula veris* L. ssp. *columnae* (Ten.) Maire & Petitm.	Eurimediterraneo	BX, FW, KY, UX
997	*Primula vulgaris* Huds. ssp. *vulgaris*	Europeo	BX, FH, IY, KY
	ERICACEAE		
998	*Arctostaphylos uva-ursi* (L.) Spreng.	Artico-Alpino	CY, FH, FW, IIY, KY, RW, SK, VY
999	*Orthilia secunda* (L.) House	Circumboreale	KY, VY
	RUBIACEAE		
1000	*Asperugo procumbens* L.	Paleotemperato *	VY
1001	*Asperula arvensis* L.	Eurimediterraneo	IY, KY
1002	*Asperula laevigata* L.	Mediterraneo-Occidentale *	VY
1003	*Asperula taurina* L. ssp. *taurina*	Orof. Sud-Europeo	IY, KY, VY
1004	*Cruciata glabra* (L.) C.Bauhin ex Opiz	Eurasiatico	IY, KY
1005	*Cruciata laevipes* Opiz	Eurasiatico	KY, VY
1006	*Cruciata pedemontana* (Bellardi) Ehrend.	Eurimediterraneo *	VY
1007	*Cynanchica aristata* (L.f.) P.Caputo & Del Guacchio	Mediterraneo-Montano	DW, KY, VY
1008	*Cynanchica pyrenaica* (L.) P.Caputo & Del Guacchio	Eurimediterraneo	KY, VY
1009	*Galium album* Mill. ssp. *album*	Eurasiatico *	BX
1010	*Galium anisophyllon* Vill.	Orof. Centro-Europeo	CY, KY
1011	*Galium aparine* L.	Eurasiatico	KY, VY
1012	*Galium corrudifolium* Vill.	Stenomediterraneo	FW, KY, VY
1013	*Galium lucidum* All. ssp. *lucidum*	Eurimediterraneo	AY, IY, KY
1014	*Galium lucidum* All. ssp. *venustum* (Jord.)	Endemico	AY, KY
1015	*Galium magellense* Ten.	Endemico	BX, DW, HY, HH, IY, KY
1016	*Galium mollugo* L.	Eurasiatico	BX, KY, VY
1017	*Galium murale* (L.) All.	Stenomediterraneo *	VY
1018	*Galium odoratum* (L.) Scop.	Eurasiatico	KY, VY
1019	*Galium palustre* L.	Eurasiatico	BX, KY, SK, TH, VY
1020	*Galium parisiense* L.	Eurimediterraneo *	VY
1021	*Galium rotundifolium* L. ssp. *rotundifolium*	Eurasiatico	KY
1022	*Galium verum* L. ssp. *verum*	Eurasiatico	BX, FH, IY, KY, QK, RH, RW, SK, VY

1023	*Rubia peregrina* L. ssp. *peregrina*	Stenomediterraneo	KY, VY
1024	*Sherardia arvensis* L.	Eurimediterraneo	FW, KY, VY
1025	*Thliphthisa purpurea* (L.) P.Caputo & Del Guacchio ssp. *purpurea*	Orof. Sud-Est-Europeo	KY, VY
	GENTIANACEAE		
1026	*Blackstonia perfoliata* (L.) Huds. ssp. *perfoliata*	Eurimediterraneo	KY, VY
1027	*Centaurium erythraea* Rafn ssp. *erythraea*	Paleotemperato	KY, VY
1028	*Centaurium tenuiflorum* (Hoffmanns. & Link) Fritsch ssp. *acutiflorum* (Schott) Zeltner	Paleotemperato *	VY
1029	*Gentiana cruciata* L. ssp. *cruciata*	Eurasiatico	DW, KH, KX, KY, LX, MK, NH, VH
1030	*Gentiana dinarica* Beck	Appennino-Balcanico	BX, CY, IY, KY, OH, VY
1031	*Gentiana lutea* L. ssp. *lutea*	Orof. Sud-Europeo	DW, KH, KY, MY, OH, PK, PW, RH, VY, ecc.
1032	*Gentiana nivalis* L.	Artico-Alpino	SW
1033	*Gentiana orbicularis* Schur	Orof. Sud-Europeo °°	DW, KY
1034	*Gentiana verna* L. ssp. *tergestina* (Beck) Hayek	Appennino-Balcanico °°	BH, BX, KY
1035	*Gentiana verna* L. ssp. *verna*	Orof. Eurasiatico	DW, HY, KY, LW, VY
1036	*Gentianella columnae* (Ten.) Holub	Endemico	BX, HY, HH, KY, VY
1037	*Gentianopsis ciliata* (L.) Ma ssp. *ciliata*	Mediterraneo-Montano	KH, KY
	APOCYNACEAE		
1038	*Vinca major* L. ssp. *major*	Eurimediterraneo	BX, KY, VY
1039	*Vinca minor* L.	Europeo *	KY, VY
1040	*Vincetoxicum hirundinaria* Medik. ssp. *hirundinaria*	Eurasiatico	BX, IY, KY, VY
	CONVOLVULACEAE		
1041	*Convolvulus arvensis* L.	Paleotemperato	BX, KY, VY
1042	*Convolvulus cantabrica* L.	Eurimediterraneo	KY, VY
1043	*Convolvulus sepium* L.	Eurasiatico	KY
1044	*Convolvulus silvaticus* Kit.	Sud-Europeo *	VY
1045	*Cuscuta europaea* L.	Paleotemperato	KY, VY
1046	*Cuscuta planiflora* Ten.	Eurimediterraneo	AH, KY, VY
	SOLANACEAE		
1047	*Atropa bella-donna* L.	Mediterraneo-Montano	BX, FH, HY, RX, SH, TK, VH, VY
1048	*Datura stramonium* L. ssp. *stramonium*	Cosmopolita	KY, PK, QH, QK
1049	*Hyoscyamus niger* L.	Eurasiatico	KY, VY
1050	*Solanum dulcamara* L.	Paleotemperato	KY, VY
1051	*Solanum tuberosum* L.	Sud-Americano *	VX, VY. Alloctona naturalizzata
1052	*Solanum villosum* Mill.	Eurimediterraneo *	VY
	BORAGINACEAE		
1053	*Aegonychon purpurocaeruleum* (L.) Holub.	Pontico	IY, KY, VY, ZH
1054	*Anchusa azurea* Mill.	Eurimediterraneo	IY, KY
1055	*Borago officinalis* L.	Eurimediterraneo	KY
1056	*Buglossoides arvensis* (L.) I. M. Johnst.	Eurimediterraneo	KY, VY
1057	*Cynoglossum apenninum* L.	Endemico	BX, IY, KY, VY
1058	*Cynoglossum columnae* Ten.	Appennino-Balcanico *	VX
1059	*Cynoglossum montanum* L.	Mediterraneo-Turaniano	KY, VY
1060	*Cynoglossum magellense* Ten.	Endemico	FK, FY, IY, KY, VY
1061	*Cynoglottiss barrellieri* (All.) Vural & Kit Tan. ssp. *barrellieri*	Appennino-Balcanico	KY, SW, VY, ZH
1062	*Echium italicum* L. ssp. *italicum*	Eurimediterraneo	BX, KY, VY
1063	*Echium plantagineum* L.	Eurimediterraneo *	FW, VY, ZH
1064	*Echium vulgare* L. ssp. *vulgare*	Europeo	KY, VY, ZH
1065	*Lithospermum offcinale* L.	Eurosiberiano	KY
1066	*Myosotis arvensis* (L.) Hill ssp. *arvensis*	Eurasiatico	FW, KY, QH, VY
1067	*Myosotis graui* Selvi.	Endemico	DW, HY, FY, HH, IY, KY. Sono state ricondotte al taxon le segnalazioni di Myosotis alpestris F. W. Schmidt e M. ambigens (Bég.) Grau.
1068	*Myosotis laxa* Lehm. ssp. *cespitosa* (Schultz) Hyl. ex Nordh.	Europeo *	EX
1069	*Myosotis nemorosa* Besser	Eurasiatico	KY
1070	*Myosotis ramosissima* Rochel ssp. *ramosissima*	Eurasiatico *	VY
1071	*Myosotis scorpioides* L. ssp. *scorpioides*	Europeo	EX. KY
1072	*Myosotis incrassata* Guss.	Appennino-Balcanico	KY

1073	*Myosotis sylvatica* Hoffm. ssp. *sylvatica*	Paleotemperato	IY, KY, VY
1074	*Onosma echioides* (L.) L.	Appennino-Balcanico	KY, VY
1075	*Pulmonaria hirta* L.	Subendemico	BX, IY, KY, PK, QK, VY
	HELIOTROPIACEAE		
1076	*Heliotropium europaeum* L.	Eurimediterraneo	BX, KY, VY
	OLEACEAE		
1077	*Fraxinus angustifolia* Vahl ssp. *oxycarpa* (M.Bieb. ex Willd.) Franco & Rocha Afonso	Pontico *	
1078	*Fraxinus excelsior* L. ssp. *excelsior*	Europeo-Caucasico	GK, KH, KX, KY, LW, LX, OK, VY
1079	*Fraxinus ornus* L. ssp. *ornus*	Pontico	IY, KY, VY
1080	*Ligustrum lucidum* W.T.Aiton	Asiatico-Orientale *	VY
1081	*Ligustrum vulgare* L.	Europeo *	FH, FW, LX, MK, NH, PW, OK, QW, RK, VY
1082	*Olea europaea* L.	Stenomediterraneo	KY
1083	*Phillyrea latifolia* L.	Stenomediterraneo *	VY
1084	*Syringa vulgaris* L.	Orof, Sud-Est-Europeo *	VY
	PLANTAGINACEAE		
1085	*Antirrhinum majus* L.	Mediterraneo-Occidentale	KY
1086	*Antirrhinum siculum* Mill.	Endemico *	VY
1087	*Chaenorhinum minus* (L.) Lange ssp. *minus*	Eurimediterraneo	KY, VY
1088	*Cymbalaria muralis* Gaertn., B. Mey & Scherb. subsp *muralis*	Subcosmopolita	IY, KY, VY
1089	*Cymbalaria pallida* (Ten.) Wettst.	Endemico	BX, DW, KY
1090	*Digitalis ferruginea* L.	Nord-Est-Mediterraneo	DW, KX, KY, OK, PK, PW, QK, RK, VH, VY
1091	*Digitalis micrantha* Roth ex Schweigg.	Endemico	BX, DW, IK, KY, MK, OK, RX, SH, VY
1092	*Erinus alpinus* L.	Mediterraneo-Montano *	VK
1093	*Globularia cordifolia* L. ssp. *bellidifolia* (Nyman) Wettst.	Appennino-Balcanico	CY, KY, VY
1094	*Globularia bisnagarica* L.	Mediterraneo-Montano	KY
1095	*Kickxia elatine* (L.) Dumort. ssp. *crinita* (Mabille) Greuter	Eurimediterraneo *	VY
1096	*Kickxia spuria* (L.) Dumort. ssp. *integrifolia* (Brot.) R.Fern.	Eurasiatico *	VY
1097	*Linaria alpina* (L.) Mill.	Mediterraneo-Montano °°	BX, DW, KY
1098	*Linaria purpurea* (L.) Mill.	Endemico	BX, FH, FW, IY, KY
1099	*Linaria simplex* (Willd.) DC.	Eurimediterraneo *	VY
1100	*Linaria vulgaris* Mill. ssp. *vulgaris*	Eurasiatico	KY, VY
1101	*Misopates orontium* Raf. ssp. *orontium*	Eurimediterraneo	KY
1102	*Plantago afra* L. ssp. *afra*	Stenonediterraneo *	VY
1103	*Plantago argentea* Chaix ssp. *argentea*	Sud-Europeo-Sud-Siberiano	AY, BX, KY, VY
1104	*Plantago atrata* Hoppe ssp. *atrata*	Mediterraneo-Montano	HY, HH, IY, KY
1105	*Plantago atrata* Hoppe ssp. *fuscescens* (Jord.) Pilg	Subendemico	BX, KX, KY, MK
1106	*Plantago lanceolata* L.	Cosmopolita	BX, FW, KY, VY
1107	*Plantago major* L.	Eurasiatico	BX, IY, KY, VY
1108	*Plantago media* L. ssp. *media*	Eurasiatico	IY, KY, NX, OK, RX, SH, UX, VY
1109	*Plantago sempervirens* Crantz	Eurimediterraneo	KY
1110	*Plantago subulata* L.	Mediterraneo-Occidentale	IY, KY, SW, VY
1111	*Veronica alpina* L.	Artico-Alpino *	BX, IY
1112	*Veronica anagallis-acquatica* L. ssp. *anagallis acquatica*	Cosmopolita	EX, IK, KY, VY
1113	*Veronica aphylla* L. ssp. *aphylla*	Orof. Centro-Europeo	KY
1114	*Veronica agrestis* L.	Europeo *	VY
1115	*Veronica arvensis* L.	Cosmopolita.	BX, FW, KY, VY
1116	*Veronica beccabunga* L.	Eurasiatico	DW, EX, KY, VY
1117	*Veronica catenata* Pennell ssp. *catenata*	Circumboreale *	SW, VY
1118	*Veronica chamaedrys* L.	Eurosiberiano	IY, KY, SW, VY
1119	*Veronica cymbalaria* Bodard ssp. *cymbalaria*	Eurimediterraneo	BX, FW, KY
1120	*Veronica hederifolia* L. ssp. *hederifolia*	Eurasiatico	FW, KY
1121	*Veronica kindlii* Adamović	Appennino-Balcanico *	QH, QY
1122	*Veronica montana* L.	Centro-Europeo	KY, VY
1123	*Veronica officinalis* L.	Orof. Eurasiatico *	VY
1124	*Veronica orsiniana* Ten. ssp. *orsiniana*	Orof. Sud-Europeo	IY, KY, SW, VY
1125	*Veronica persica* Poir.	Eurasiatico	KY, VY

1126	*Veronica polita* Fr.	Subcosmopolita	KY, VY
1127	*Veronica prostrata* L.	Eurasiatico	IK, KY
1128	*Veronica serpyllifolia* L.	Circumboreale	KY, VY
	SCROPHULARIACEAE.		
1129	*Scrophularia canina* L.	Eurimediterraneo	FK, KY, MK, VY
1130	*Scrophularia juratensis* Schleicher	Orofita-Sud-Europeo	KY
1131	*Scrophularia nodosa* L.	Circumboreale	KY, RH, RW, VY
1132	*Scrophularia scopolii* Hoppe ex Pers.	Eurasiatico	EX, KY, VY
1133	*Scrophularia umbrosa* Dumort. ssp. *umbrosa*	Subatlantico	KY, VY
1134	*Scrophularia vernalis* L.	Europeo-Caucasico *	VX, VY
1135	*Verbascum densiflorum* Bertol.	Sud-Europeo	DW, KY
1136	*Verbascum longifolium* Ten.	Appennino-Balcanico	AH, IY, KY, NH, VY
1137	*Verbascum lychnitis* L.	Europeo-Caucasico *	KY
1138	*Verbascum macrurum* Ten.	Appennino-Balcanico *	BX
1139	*Verbascum mallophorum* Boiss. & Heldr.	Appennino-Balcanico	BX, DW, KY, VY
1140	*Verbascum nigrum* L.	Eurosiberiano	BX, KY
1141	*Verbascum phlomoides* L.	Eurimediterraneo	AH, KY
1142	*Verbascum pulverulentum* Vill.	Centro-Europeo	KY
1143	*Verbascum thapsus* L. ssp. *thapsus*	Europeo-Caucasico	BX, DW, FH, KY, VY
	LAMIACEAE		
1144	*Ajuga chamaepitys* (L.) Schreb. ssp. *chia* (Schreb.) Arcang.	Eurimediterraneo	AH, QH, QY
1145	*Ajuga chamaepitys* (L.) Schreb. ssp. *chamaepitys*	Stenomediterraneo	KY, VY
1146	*Ajuga pyramidalis* L. ssp. *pyramidalis*	Europeo-Caucasico *	ZH
1147	*Ajuga reptans* L.	Europeo-Caucasico	DW, IY, KY, NX, OK, VY
1148	*Ajuga tenorei* C.Presl	Endemico	KY
1149	*Ballota nigra* L. ssp. *meridionalis* (Bég.) Bég.	Eurimediterraneo	KY, VY
1150	*Betonica alopecuros* L.	Orof. Sud-Europeo	KY, VY
1151	*Betonica officinalis* L.	Europeo-Caucasico	FW, KY, VY
1152	*Clinopodium nepeta* (L.) Kuntze ssp. *nepeta*	Mediterraneo-Montano	BX, KY, VY
1153	*Clinopodium vulgare* L. ssp. *vulgare*	Circumboreale	KY
1154	*Galeopsis angustifolia* Hoffm. ssp. *angustifolia*	Eurimediterraneo	KY, VY
1155	*Galeopsis ladanum* L.	Eurasiatico	KY, SW
1156	*Galeopsis tetrahit* L.	Eurasiatico	KY
1157	*Glechoma hirsuta* Waldst. & Kit.	Sud-Est-Europeo *	QH, QY, VY
1158	*Hyssopus officinalis* L. ssp. *aristatus* (Godr.) Nyman	Eurimediterraneo	KY,VY, ZH
1159	*Lamium album* L. ssp. *album*	Eurasiatico	BX, KY
1160	*Lamium amplexicaule* L.	Eurasiatico	KY, VY
1161	*Lamium bifidum* Cirillo ssp. *bifidum*	Stenomediterraneo *	VY
1162	*Lamium flexuosum* Ten.	Nord-Ovest-Mediterraneo	KY
1163	*Lamium galeobdolon* (L.) L. ssp. *montanum* (Pers.) Hayek	Europeo-Caucasico	KY
1164	*Lamium garganicum* L. s.l.	Mediterraneo-Montano	IY, KY, VY
1165	*Lamium maculatum* L.	Eurasiatico	FW, IY, KY, KY
1166	*Lamium purpureum* L.	Eurasiatico	KY, VY
1167	*Lycopus europaeus* L.	Circumboreale	KY
1168	*Marrubium incanum Desr.*	Sud-Est-Europeo	BX, KY, SW, VY
1169	*Melissa officinalis* L. ssp. *officinalis*	Eurimediterraneo *	VY
1170	*Melittis melissophyllum* L. ssp. *melissophyllum*	Europeo	FW, IY, KY, VY, ZH
1171	*Mentha arvensis* L.	Circumboreale	DX, DZ, EX, KY, QY, VY
1172	*Mentha longifolia* (L.) Huds.	Paleotemperato	EX, IY, KY, SW, VY
1173	*Mentha pulegium* L. ssp. *pulegium*	Subcosmopolita *	VY
1174	*Mentha spicata* L.	Eurimediterraneo	IK, KY, VY
1175	*Micromeria graeca* (L.) Benth. ex Rchb. ssp. *graeca*	Stenomediterraneo	KY, VY
1176	*Nepeta nuda* L. ssp. *nuda*	Sud-Europeo-Sud-Siberiano	BX, IK, KY, NH, NX, QK, RH, RW, SK, TH, UX, VY
1177	*Origanum vulgare* L. ssp. *vulgare*	Eurasiatico	AK, KY, VY
1178	*Prunella laciniata* (L.) L.	Eurimediterraneo	KY, VY
1179	*Prunella vulgaris* L.	Circumboreale	KY, OK, PW, QW, RK, VY

1180	*Salvia glutinosa* L.	Eurasiatico	KY
1181	*Salvia nemorosa* L. ssp. *nemorosa*	Sud-Europeo-Sud-Siberiano	KY
1182	*Salvia pratensis* L. ssp. *pratensis*	Eurimediterraneo	FH, KY
1183	*Salvia verbenaca* L.	Eurimediterraneo	KY, VY
1184	*Satureja montana* L. ssp. *montana*	Orof. Sud-Europeo	IY, KY, VY
1185	*Scutellaria alpina* L. ssp. *alpina*	Orof. Sud-Europeo	IY, KY
1186	*Scutellaria altissima* L.	Pontico *	ZH
1187	*Scutellaria columnae* All. ssp. *columnae*	Nord-Est-Mediterraneo	KY, VY
1188	*Scutellaria galericulata* L.	Circumboreale	CX, EX, IK, KY, QH, QY, VY
1189	*Stachys annua* (L.) L. ssp. *annua*	Eurimediterraneo	IY, KY, VY
1190	*Stachys italica* Mill.	Endemico	AH, KY, VY
1191	*Stachys germanica* L. ssp. *germanica*	Eurimediterraneo	BX, IY, KY, LX, ZH
1192	*Stachys germanica* L. ssp. *salviifolia* (Ten.) Gams.	Appennino-Balcanico	BX, KY, VY
1193	*Stachys recta* L. ssp. *recta*	Mediterraneo-Montano	KY, SK, VY
1194	*Stachys romana* (L.) E. H. L. Krause	Stenomediterraneo	KY, VY
1195	*Stachys sylvatica* L.	Eurosiberiano	BX, KX, KY, NH, OK, PW, QW, RK, UX, VY
1196	*Stachys tymphaea* Hausskn.	Appennino-Balcanico	BX, KY, VY
1197	*Stachys thirkei* C. Koch	Appennino-Balcanico *	IK, QH, QY, VY
1198	*Teucrium botrys* L.	Eurimediterraneo °°	KY, VY
1199	*Teucrium capitatum* L. ssp. *capitatum*	Stenomediterraneo	BX, KY
1200	*Teucrium chamaedrys* L. ssp. *chamaedrys*	Eurimediterraneo	BX, KY,VY
1201	*Teucirum flavum* L. ssp. *flavum*	Stenomediterraneo	KY, VY
1202	*Teucrium montanum* L.	Mediterraneo-Montano	IY, KY, VY
1203	*Teucrium scordium* L. ssp. *scordioides* (Schreb.) Arcang.	Europeo *	VX
1204	*Thymus longicaulis* C. Presl. ssp. *longicaulis*	Eurimediterraneo	KY, ZH
1205	*Thymus praecox* Opiz ssp. *polytrichus* (Borbàs) Jalas	Appennino-Balcanico	BX, HY, HH, KY
1206	*Thymus vulgaris* L. ssp. *vulgaris*	Stenomediterraneo	KY
1207	*Ziziphora acinos* (L.) Melnikov	Eurimediterraneo	KY, VY
1208	*Ziziphora granatensis* (Boiss. & Reut.) Melnikov ssp. *alpina* (L.) Bräuchler & Gutermann	Orof. Sud-Europeo	BX, FH, FW, FY, HH, IY, KY, VY
	OROBANCHACEAE		
1209	*Euphrasia italica* Wettst.	Subendemico	KY
1210	*Euphrasia salisburgensis* Funck ex Hoppe	Europeo	BX, KY
1211	*Euphrasia stricta* D.Wolff ex J.F.Lehm.	Centro-Europeo *	FW, VY
1212	*Lathraea squamaria* L.	Eurasiatico	KY
1213	*Melampyrum arvense* L. ssp. *arvense*	Eurasiatico *	FW, VX, VY
1214	*Melampyrum barbatum* Waldst. & Kit. ssp. *carstiense* Ronniger	Appennino-Balcanico *	VY
1215	*Melampyrum italicum* Soò	Endemico	KY
1216	*Melampyrum nemorosum* L.	Eurasiatico	IY, KY
1217	*Odontites luteus* (L.) Clairv.	Eurimediterraneo	KY
1218	*Odontites vernus* (Bellardi) Dumort. ssp. *serotinus* Corb.	Eurasiatico	KY, VY
1219	*Orobanche caryophyllacea*	Eurimediterraneo	FW, IY, KY, VY
1220	*Orobanche crenata* Forssk.	Mediterraneo-Turaniano	KY, VY
1221	*Orobanche gracilis* Sm.	Europeo-Caucasico *	FW, VY
1222	*Orobanche hederae* Vaucher ex Duby	Eurimediterraneo *	VY
1223	*Orobanche minor* Sm.	Subcosmopolita *	VY
1224	*Orobanche reticulata* Wallr. ssp. *reticulata*	Centro-Europeo *	QH, QY, VY
1225	*Orobanche teucrii* Holandre	Orof. Sud-Europeo *	VY
1226	*Parentucellia latifolia* (L.) Caruel	Eurimediterraneo	KY, VY
1227	*Pedicularis comosa* L. ssp. *comosa*	Mediterraneo-Montano	KY
1228	*Pedicularis elegans* Ten.	Endemico	BX, HY, KY, OH, SW, VY
1229	*Pedicularis hoermanniana* K. Malý	Appennino-Balcanico	HH, KY, LX, MK, MY, OH, OK, PK, QK, SW, VY, ecc.
1230	*Pedicularis petoliaris* Ten.	Appennino-Balcanico	IY, KX, KY
1231	*Pedicularis verticillata* L. ssp. *verticillata*	Artico-Alpino	VX
1232	*Phelipanche purpurea* (Jacq.) Soják	Eurosiberiano *	QH, QY, VY
1233	*Rhinanthus alectorolophus* (Scop.) Pollich ssp. *alectorolophus*	Centro-Europeo	KY, VY, ZH
1234	*Rhinanthus minor* L.	Circumboreale	IY, KY, LX, OH, PK, VY

1235	*Rhinanthus wettsteinii* (Sterneck) Soò	Endemico *	AY, BX
	VERBENACEAE		
1236	*Verbena officinalis* L.	Paleotemperato	KY, VY
	AQUIFOLIACEAE		
1237	*Ilex aquifolium* L.	Subatlantico	BX, EW, FH, FK, IY, KX, KY, LX, MK, NH, VY
	CAMPANULACEAE		
1238	*Campanula cochleariifolia* Lam.	Orof. Sud-Europeo *	VX
1239	*Campanula foliosa* Ten.	Orof. Sud-Est-Europeo *	IK, KY, VY
1240	*Campanula fragilis* Cirillo ssp. *cavolinii* Ten.	Endemico	KX, KY, VH, VY
1241	*Campanula glomerata* L.	Eurasiatico	DW, FW, KX, KY, MK, NH, VY
1242	*Campanula latifolia* L.	Europeo-Caucasico *	ZH
1243	*Campanula micrantha* Bertol.	Endemico *	VY
1244	*Campanula persicifolia* L. ssp. *persicifolia*	Eurasiatico	KY, VY
1245	*Campanula rapunculus* L.	Paleotemperato	BX, DW, IY, KY, UX, VY, ZH
1246	*Campanula scheuchzeri* Vill. ssp. *scheuchzeri*	Mediterraneo-Montano	CY, DW, IY, KY, SW, VY
1247	*Campanula tanfanii* Podlech	Endemico	GH, KY
1248	*Campanula trachelium* L. ssp. *trachelium*	Eurasiatico	FW, IY, KY, LX, MK, OK, NH, RX, SH, TK, VY
1249	*Edraianthus graminifolius* (L.) A. DC. ssp. *graminifolius*	Appennino-Balcanico	HY, FY, HH, KX, KY, LX, RW, SK, VY
1250	*Jasione montana* L.	Europeo-Caucasico *	FK
1251	*Legousia falcata* (Ten.) Fritsch	Stenomediterraneo *	VY
1252	*Legousia hybrida* (L.) Delarbre	Mediterraneo-Atlantico *	VY
1253	*Legousia speculum-veneris* (L.) Chaix	Eurimediterraneo	KY, VY
1254	*Phyteuma orbiculare* L.	Mediterraneo-Montano	HY, HH, IY, KY, VY
	ASTERACEAE		
1255	*Achillea barrellieri* Ten. ssp. *barellieri*	Endemico	DW, HY, HH, KY
1256	*Achillea collina* Becker ex Rchb.	Sud-Est Europeo	EY, KY
1257	*Achillea millefolium* L. ssp. *millefolium*	Eurosiberiano	BX, KY, VY
1258	*Achillea setacea* Waldst. & Kit. ssp. *setacea*	Sud-Est-Europeo	BX, IY, KY
1259	*Achillea tenorei* Grande	Endemico	IY, KH, KX, KY, LW, LX, MK, NH, RH, TH, VY, ecc.
1260	*Adenostyles australis* (Ten.) Iamonico & Pignatti	Endemico	IY, KX, KY, VY. E' stata ricondotta al taxon la segnalazione di Adenostyles alpina
1261	*Antennaria dioica* (L.) Gaertn.	Circumboreale	KY
1262	*Anthemis arvensis* L. ssp. *arvensis*	Subcosmopolita	KY, VY
1263	*Anthemis cotula* L.	Eurasiatico *	VX
1264	*Anthemis cretica* L. ssp. *alpina* (L.) R.Fern.	Endemico	KY
1265	*Anthemis cretica* L. ssp. *petraea* (Ten.) Greuter	Endemico	KY
1266	*Arctium lappa* L.	Eurasiatico	KY, NH, OK,VY
1267	*Arctium minus* (Hill) Bernh.	Eurimediterraneo *	VX
1268	*Arctium nemorosum* Lej.	Subatlantico	KY
1269	*Artemisia absitnthium* L.	Subcosmopolita	KY, VY
1270	*Artemisia alba* Turra	Sud-Europeo	AH, IY, KY, VY
1271	*Artemisia eriantha* Ten.	Orof. Sud-Europeo	DW, KY
1272	*Artemisia vulgaris* L.	Circumboreale	KY, VY
1273	*Aster alpinus* L. ssp. *alpinus*	Circumboreale °°	FY, HH, KY, OK, PW, QW, RK
1274	*Bellidiastrum michelii Cass.*	Orof. Sud-Europeo *	BX, VY
1275	*Bellis perennis* L.	Circumboreale	BX, KY,VY
1276	*Bellis sylvestris Cirillo*	Stenomediterraneo	FW, KY, VY
1277	*Bombycilaeana erecta (L.) Smoljan*	Eurosiberiano *	VX, VY
1278	*Calendula arvensis* L.	Eurimediterraneo	KY
1279	*Calendula officinalis* L.	Mediterraneo-Occidentale *	VY
1280	*Carduus affinis* Guss. ssp. *affinis*	Endemico *	VX
1281	*Carduus chrysacanthus* Ten. ssp. *chrysacanthus*	Appennino-Balcanico	FH, HH, KY
1282	*Carduus corymbosus* Ten.	Endemico	KY
1283	*Carduus defloratus* L. ssp. *carlinifolius* (Lam.) Ces.	Orof. Sud-Europeo	BH, BX, KY, VY
1284	*Carduus nutans* L. ssp. *nutans*	Europeo	KY, VY
1285	*Carduus pycnocephalus* L. ssp. *pycnocephalus*	Eurimediterraneo	IY, LX, VY
1286	*Carlina acanthifolia*	Orof. Sud-Europeo	FX, KY, VY

1287	*Carlina acaulis* L. ssp. *caulescens* (Lam.) Schubl. & G. Martens	Europeo	KY, VH, VY
1288	*Carlina corymbosa* L.	Stenomediterraneo	KY, SH, VY
1289	*Carlina vulgaris* L. ssp. *spinosa* (Velen.) Vandas	Nord-Mediterraneo	BX, KY, SH
1290	*Carthamus lanatus* L. ssp. *lanatus*	Eurimediterraneo	KY, VY
1291	*Centaurea ambigua* Guss. ssp. *ambigua*	Endemico	KY, VY
1292	*Centaurea ambigua* Guss. ssp. *nigra* (Fiori) Pignatti	Endemico	BX, KX, LX
1293	*Centaurea calcitrapa* L.	Eurimediterraneo	BX, KY. VY
1294	*Centaurea ceratophylla* Ten. ssp. *ceratophylla*	Endemico	KY, OH, PK, VY
1295	*Centaurea cyanus* L.	Stenomediterraneo	KY
1296	*Centaurea deusta* Ten.	Eurimediterraneo	KY
1297	*Centaurea jacea* L. ssp. *gaudinii* (Boiss. & Reut.) Gremli	Orof. Sud-Europeo *	QK, RH, RW, SK, UX, VY
1298	*Centaurea jacea* L. ssp. *jacea*	Eurasiatico	KY, MY, VH, VY
1299	*Centaurea scabiosa* L. ssp. *scabiosa*	Eurasiatico	HY, KY, VY
1300	*Centaurea solstitialis* L. ssp. *solstitialis*	Stenomediterraneo	BX, KY, VY
1301	*Centaurea tenoreana* Willk.	Endemico	BX, KY, VY
1302	*Centaurea triumfetti* All.	Europeo-Caucasico	BX, IY, KY, VY, ZH
1303	*Chondrilla juncea* L.	Eurosiberiano	BX, VY
1304	*Cichorium intybus* L.	Paleotemperato	KY, VY
1305	*Cirsium acaulon* (L.) Scop. ssp. *acaulon*	Eurasiatico	AH, EX, KY, VY
1306	*Cirsium arvense* (L.) Scop.	Eurasiatico	HY, KY, SH, SK, VY
1307	*Cirsium creticum* (Lam.) d'Urv. ssp. *triumfettii* (Lacaita) K.Werner	Appennino-Balcanico *	TK, UK
1308	*Cirsium oleraceum* (L.) Scop.	Eurosiberiano	KY
1309	*Cirsium palustre* (L.) Scop.	Eurasiatico *	QH, QY
1310	*Cirsium vulgare* (Savi) Ten.	Paleotemperato	KY, SH, TK, UK, VY
1311	*Cota tinctoria* (L.) J. Gaj ssp. *tinctoria*	Pontico	IY, KY, OH, PK,VY
1312	*Crepis aurea* (L.) Cass. ssp. *glabrescens* (Caruel) Arcang.	Appennino-Balcanico	HY, KY, SW, VY
1313	*Crepis biennis* L.	Centro-Europeo	KY, VY
1314	*Crepis lacera* Ten.	Appennino-Balcanico	AH, FH, FW, HY, KY, PK, QK, VY
1315	*Crepis magellensis* F. Conti & Uzunov	Endemico *	QH, QY, SW
1316	*Crepis neglecta* L. ssp. *neglecta*	Eurimediterraneo	HY, KY, VY
1317	*Crepis pygmaea* L.	Orof. Sud-Ovest-Europeo °°	KY
1318	*Crepis sancta* (L.) Babc. ssp. *nemausensis* (P. Fourn.) Babc.	Mediterraneo-Turaniano	KY,VY
1319	*Crepis setosa* Haller f.	Mediterraneo-Orientale	IY, KY
1320	*Crepis vesicaria* (L.)	Subatlantico	KY, VY
1321	*Crupina crupinastrum* (Moris) Vis.	Stenomediterraneo *	ZH
1322	*Crupina vulgaris* Cass.	Eurosiberiano	FK, IY, KY, VY, ZH
1323	*Dittrichia viscosa* (L.) Greuter ssp. *viscosa*	Eurimediterraneo *	VY
1324	*Doronicum columnae* Ten.	Orof. Sud-Europeo	FX, FY, Y, KX, KY, VY
1325	*Echinops ritro* L. ssp. *ritro*	Stenomediterraneo	KY
1326	*Echinops siculus* Strobl	Endemico	BX, KY, QH
1327	*Echinops sphaerocephalus* L. ssp. *sphaerocephalus*	Eurasiatico	BX, IK, KY, VH, VY
1328	*Erigeron acris* L. ssp. *acris*	Circumboreale	BX, VY
1329	*Erigeron alpinus* L.	Orof. Eurasiatico *	DW
1330	*Erigeron bonariensis* L.	Americano	BH, KY. Alloctona naturalizzata.
1331	*Erigeron epiroticus* (Vier.) Halàcsy	Appennino-Balcanico	HY, FY, HH, KY
1332	*Erigeron sumatrensis* Retz.	Sud-Americano *	VY. Alloctona naturalizzata.
1333	*Erigeron uniflorus* L.	Artico-Alpino	KY. VY
1334	*Eupatorium cannabinum* L. ssp. *cannabinum*	Paleotemperato	BX, KY, VY
1335	*Helichrysum italicum* (Roth) G. Don ssp. *italicum*	Eurimediterraneo	KX, KY, LX, VY, ZH
1336	*Helminthotheca echioides* (L.) Holub	Eurimediterraneo	KY, VY
1337	*Hieracium acanthodontoides* Arv.-Touv. & Belli	Endemico *	IX
1338	*Hieracium bifidum* Kit. ex Hornem. ssp. *nummulariifolium* Gottschl.	Endemico	IX, KY
1339	*Hieracium huetianum* Arv.-Touv.	Appennino-Balcanico	IX, KY
1340	*Hieracium humile* Jacq. ssp. *brachycaule* Vuk. ex Zahn	Appennino-Balcanico	IX, KY
1341	*Hieracium hypochoeroides* S.Gibson ssp. *potamogetifolium* Gottschl.	Endemico	IX, KY
1342	*Hieracium montis-porrarae* Gottschl.	Endemico *	IX, KY. QH

1343	*Hieracium murorum* L. ssp. *amaurocymum* (Touton & Zahn ex Dalla Torre & Sarnth.) Greuter	Orof. Sud-Est-Europeo °°	BH, KY
1344	*Hieracium murorum* L. ssp. *pleiotrichum* (Zahn) Zahn	Endemico * °°	EY
1345	*Hieracium murorum* L. ssp. *subintegerrimum* Gottschl.	Endemico	IX, KY
1346	*Hieracium orodoxum* Gottschl.	Endemico	IX, KY, QH
1347	*Hieracium pilosum* Schleich. ex Froel. ssp. *villosiceps* Nägeli & Peter ex Gottschl.	Orof. Sud-Est-Europeo	BH, BX. KY
1348	*Hieracium pseudogrovesianum* Gottschl. ssp. *circinans* Gottschl.	Endemico *	IX
1349	*Hieracium pseudopallidum* Gottschl.	Endemico	IX, KY
1350	*Hieracium racemosum* Waldst. & Kit. ex Willd. ssp. *crinitum* (Sm.) Rouy	Orof. Sud-Est-Europeo	IX, KY
1351	*Hieracium racemosum* Waldst. & Kit. ex Willd. ssp. *pulmonarifolium*	Endemico	IX, KY
1352	*Hieracium scorzonerifolium* Vill. ssp. *flexuosum* Waldst. & Kit. ex Nägeli & Peter	Orof. Sud-Est-Europeo	IX, KY
1353	*Inula helenium* L. ssp. *helenium*	Orof. Sud-Est-Europeo	KY, QY, SH, TK, UK, VY
1354	*Jacobaea alpina* (L.) Moench ssp. *samnitum* (Nyman) Peruzzi	Endemico	EX, FH, LW, TH, UX, VY
1355	*Jacobaea erucifolia* (L.) G.Gaertn., B.Mey. & Scherb. ssp. *erucifolia*	Eurasiatico *	VY
1356	*Jurinea mollis* (L.) Rchb. ssp. *mollis*	Sud-Est Europeo	KY, VY
1357	*Lactuca perennis* L.	Eurimediterraneo	KY, VY
1358	*Lactuca saligna* L.	Europeo *	VX, VY
1359	*Lactuca sativa* ssp. *serriola* (L.) Galasso, Banfi, Bartolucci & Ardenghi	Eurimediterraneo	KY, VY
1360	*Lactuca viminea* (L.) J.& C. Presl. ssp. *viminea*	Eurimediterraneo	KY, MK, NH, VY
1361	*Lactuca virosa* L.	Mediterraneo-Atlantico *	VY
1362	*Lapsana communis* L. ssp. *communis*	Paleotemperato	KY, VY
1363	*Leontodon crispus* Vill.	Sud-Europeo-Sud-Siberiano	FW, HH, KY, VY
1364	*Leontodon hispidus* L. ssp. *dubius* (Hoppe) Pawłowska	Orofita Sud-Europeo °°	IY, KY, QY
1365	*Leontodon hispidus* L. ssp. *hispidus*	Europeo-Caucasico	VX, VY
1366	*Leontodon rosanoi* (Ten.) *DC.*	Nord-Ovest-Mediterranaeo *	VY
1367	*Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz.	Appennino-Balcanico	FH, BX, DW, FY, KY
1368	*Leucanthemum coronopifolium* Vill. ssp. *tenuifolium* (Guss.) Vogt & Greuter	Endemico	BX, HY, KX, KY, LX, UX, VY
1369	*Leucanthemum pallens* (J.Gay ex Perreym.) DC.	Eurimediterraneo *	VX, VY
1370	*Leucanthemum tridactylites* (Kern. & Huter) Huter, Porta & Rigo	Endemico	HH, KY, SW
1371	*Leucanthemum vulgare* Lam. ssp. *vulgare*	Eurimediterraneo	FH. KY, ZH
1372	*Lophiolepis eriophora* (L.) Del Guacchio, Bureš, Iamonico & P.Caputo	Centro-Europeo	IW, KY
1373	*Lophiolepis lobelii* (Ten.) Del Guacchio, Bureš, Iamonico & P.Caputo	Endemico	FH, KY
1374	*Lophiolepis tenoreana* (Petr.) Del Guacchio, Bureš, Iamonico & P.Caputo	Endemico	KY, VH, VY
1375	*Matricaria chamomilla* L.	Subcosmopolita	KY. Alloctona naturalizzata.
1376	*Mycelis muralis* (L.) Dumort.	Eurasiatico	KY, RH, RW, SK, VY
1377	*Omalotheca diminuta* (Braun-Blanq.) Bartolucci & Galasso	Appennino-Balcanico	HY, HH, KY, SW
1378	*Omalotheca sylvatica* (L.) Sch.Bip. & F.W.Schultz	Circumboreale *	VY
1379	*Onopordum acanthium* L.	Eurasiatico	KY, RW, SK, SW, VH, VY, ZH
1380	*Onopordum illyricum* ssp. *illyricum*	Stenomediterraneo	KY
1381	*Pallenis spinosa* (L.) Cass. ssp. *spinosa*	Eurimediterraneo	BX, KY, VY
1382	*Pentanema hirtum* (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M.Mart.Ort.	Sud-Europeo-Sud-Siberiano	IY, KY
1383	*Pentanema montanum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort	Mediterraneo-Occidentale	KY, OH, PK, VY, ZH
1384	*Pentanema salicinum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort.	Eurasiatico	IY, KY, SH, VY
1385	*Pentanema squarrosum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort	Centro-Europeo	AH, EY, KY , VY
1386	*Petasites albus* (L.) Gaertn.	Europeo	KY
1387	*Petasites hybridus* (L.) P. Gaertn. B. Mey. & Scherb.	Eurasiatico	KY, VY
1388	*Picnomon acarna* (L.) Cass.	Stenomediterraneo *	VY
1389	*Picris hieracioides* L. ssp. *hieracioides*	Eurosiberiano	KY, VY
1390	*Pilosella anchusoides* Arv.-Touv.	Europeo * °°	IX
1391	*Pilosella cymosa* (L.) F.W. Schultz & Sch.Bip.	Europeo *	IX
1392	*Pilosella hoppeana* (Schult.) F.W.Schultz & Sch.Bip. ssp. *macrantha* (Ten.) S.Bräut. & Greuter	Nord-Est-Mediterraneo	BH, KY
1393	*Pilosella officinarum* Vaill.	Europeo-Caucasico	BH, HY, HH, IX, IY, KY
1394	*Pilosella piloselloides* (Vill.) Soják ssp. *praealta* (Vill. ex Gochnat) S. Bräut. & Greuter	Europeo	BH. IX, IY, KY

1395	*Pilosella ziziana* (Tausch) F.W. Schultz & Sch.Bip.	Orof. Sud-Europeo	IX. KY
1396	*Prenanthes purpurea* L.	Europeo	IX, KY, RH, RW, VY
1397	*Ptilostemon strictus* (Ten.) Greuter	Appennino-Balcanico	FW, KY, VY
1398	*Pulycaria dysenterica* (L.) Bernh.	Eurimediterraneo	KY, SH, TK, VY
1399	*Reichardia picroides* (L.) Roth	Stenomediterraneo	KY, VY
1400	*Rhagadiolus stellatus* (L.) Gaertn.	Eurimediterraneo	KY, VY
1401	*Robertia taraxacoides* (Loisel.) DC.	Endemico	FW, KY, VY
1402	*Scolymus hispanicus* L.	Eurimediterraneo	KY, VY
1403	*Scorzonera cana* (C.A. Mey.) Griseb.	Pontico	KY, VY
1404	*Scorzonera laciniata* L. ssp. *laciniata*	Paleotemperato	KY
1405	*Scorzoneroides autumnalis* (L.) Moench	Paleotemperato	BX, KY, MH, MY, OH, PK, SK, TH, VY
1406	*Scorzoneroides montana* (Lam.) Holub ssp. *breviscapa* (DC.) Greuter	Endemico	KY
1407	*Scorzoneroides montana* (Lam.) Holub ssp. *melanotricha*	Orof. Sud-Est-Europeo	HY, HH, IY, KY. Sono state ricondotte al taxon le segnalazioni di Leontodon montanus Lam. ssp. montanus.
1408	*Senecio apenninus* Tausch	Endemico *	VY
1409	*Senecio doronicum* (L.) L.	Orof. Sud-Europeo	KY, VY
1410	*Senecio ovatus* (G.Gaertn., B.Mey. & Scherb.) Willd.	Centro-Europeo	KY
1411	*Senecio rupestris* Waldst. & Kit.	Orof. Sud-Est-Europeo *	VX, VY
1412	*Senecio scopolii*	Appennino-Balcanico	KY, QY, VY
1413	*Senecio vulgaris* L.	Eurimediterraneo	FW, KY, VY
1414	*Serratula tinctoria* L.	Eurosiberiano	IK, KX, KY, LX, VY
1415	*Silybum marianum* (L.) Gaertn.	Eurimediterraneo	KY, VY
1416	*Solidago virgaurea* L. ssp. *virgaurea*	Circumboreale	KX, KY, VY
1417	*Sonchus asper* (L.) Hill. ssp. *asper*	Eurasiatico	BX, KY, VY, ZH
1418	*Sonchus bulbosus* (L.) N.Kilian & Greuter ssp. *bulbosus*	Stenomediterraneo *	VY
1419	*Sonchus oleraceus* L.	Subcosmopolita	KY
1420	*Tanacetum corymbosum* (L.) Sch.Bip. ssp. *achilleae* (L.) Greuter	Sud-Est-Europeo	IY, KY,VY, ZH
1421	*Tanacetum parthenium* (L.) Sch.Bip.	Eurasiatico	BX, KY, VY
1422	*Taraxacum apenninum* (Ten.) Ten.	Endemico	BX, HY, HH, KY, SW
1423	*Taraxacum glaciale* E. & A. Huet. ex Hand.-Mazz.	Endemico	HY, HH, KY
1424	*Taraxacum officinale* Weber	Circumboreale	FX, KY, VY
1425	*Tephroseris integrifolia* (L.) Holub ssp. *integrifolia*	Artico-Alpino	KY, VY
1426	*Tragopogon crocifolius* L. ssp. *crocifolius*	Stenomediterraneo *	VX
1427	*Tragopogon eriospermus* Ten.	Eurimediterraneo *	AY, BX, VH, VY
1428	*Tragopogon porrifolius* L. ssp. *porrifolius*	Eurimediterraneo	FK, IY, KY, SK, TH, VY, ZH
1429	*Tragopogon pratensis* L.	Eurosiberiano	FH, KY
1430	*Tragopogon samaritanii* Heldr. & Sartori ex Boiss.	Appennino-Balcanico *	VY
1431	*Tripleurospermum inodorum* (L.) Sch.Bip.	Europeo	KY, MW, QH, QK, QY, RH, VY
1432	*Tussilago farfara* L.	Paleotemperato	KY,VY
1433	*Urospermum dalechampii* (L.) F. W. Schmidt	Eurimediterraneo	KY, VY, ZH
1434	*Urospermum picroides* (L.) Scop. ex F.W.Schmidt	Eurimediterraneo *	VY
1435	*Xanthium spinosum* L.	Sud-Americano *	VY
1436	*Xeranthemum cylindraceum* Sm.	Sud-Europeo-Sud-Siberiano	KY, VY
1437	*Xeranthemum inapertum* (L.) Mill.	Pontico	KY, VY
	VIBURNACEAE		
1438	*Adoxa moschatellina* L. subsp. *moschatellina*	Eurasiatico *	VX, VY
1439	*Sambucus ebulus* L.	Eurimediterraneo	KX, KY, LX, VY
1440	*Sambucus nigra* L.	Europeo	KY, VY
1441	*Viburnum lantana* L.	Eurasiatico	IY, KY, VY
1442	*Viburnum tinus* L. ssp. *tinus*	Stenomediterraneo *	PK, QK, VY, ZH
	CAPRIFOLIACEAE.		
1443	*Lonicera alpigena* L. ssp. *alpigena*	Orof. Sud-Europeo	KY, MY, UX, VY
1444	*Lonicera caprifolium* L.	Pontico	BX, KY, NX, OK, SK, UX, VY
1445	*Lonicera etrusca* Santi	Eurimediterraneo.	KY, VY
1446	*Lonicera implexa* Aiton ssp. *implexa*	Stenomediterraneo *	VY
1447	*Lonicera xylosteum* L.	Eurasiatico *	VX

	DIPSACACEAE		
1448	*Cephalaria leucantha* (L.) Roem. & Schult.	Sud-Europeo *	BX, LX, VY
1449	*Cephalaria transsylvanica* (L.) Roem. & Schult.	Pontico *	VX, VY
1450	*Dipsacus fullonum* L.	Eurimediterraneo	BX, FX, OK, RX, SH, VH, VY
1451	*Knautia calycina* (C.Presl) Guss.	Endemico *	FW, VY
1452	*Knautia dinarica* (Murb.) Borbás ssp. *silana* (Grande) Ehrend.	Endemico	LY, QH, QY, VX, VY
1453	*Lomelosia crenata* (Cirillo) Greuter & Burdet ssp. *crenata*	Sud-Mediterraneo	BX, JW, QY, VY
1454	*Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *pseudisetensis* (Lacaita) Greuter & Burdet	Endemico *	QK, VY
1455	*Lomelosia graminifolia* (L.) Greuter & Burdet ssp. *graminifolia*	Mediterraneo-Montano *	PK, QK, VY
1456	*Scabiosa columbaria* L. ssp. *columbaria*	Eurasiatico *	VX
1457	*Scabiosa holosericea* Bertol.	Orof. Sud-Est-Europeo *	VX
1458	*Scabiosa silenifolia* Waldst. & Kit.	Appennino-Balcanico *	VY
1459	*Scabiosa triandra* L.	Sud-Europeo	KY
1460	*Scabiosa uniseta* Savi	Endemico	KY
1461	*Sixalix atropurpurea* (L.) Greuter & Burdet	Stenomediterraneo *	VX, VY
	VALERIANACEAE		
1462	*Centranthus angustifolius* (Mill.) DC. ssp. *angustifolius*	Mediterraneo-Occidentale °°	KY, QH, QY
1463	*Centranthus ruber* (L.) DC. ssp. *ruber*	Stenomediterraneo	KY, VH, VY, ZH
1464	*Valeriana montana* L.	Mediterraneo-Montano	IY, KH, KX, KY, LW, VY
1465	*Valeriana officinalis* L.	Europeo	KY, MK, NH
1466	*Valeriana saliunca* All.	Subendemico °°	FY, HH, KY
1467	*Valeriana stolonifera* Czern. ssp. *angustifolia* Soó	Centro-Europeo	IY, KY
1468	*Valeriana tripteris* L. ssp. *tripteris*	Mediterraneo-Montano	KY
1469	*Valeriana tuberosa* L.	Mediterraneo-Montano	FW, KY, MK, VY
1470	*Valerianella carinata* Loisel.	Mediterraneo-Orientale *	FW
1471	*Valerianella coronata* (L.) DC.	Eurimediterraneo	KY
1472	*Valerianella locusta* (L.) Laterr.	Subcosmopolita *	VX
	ARALIACEAE		
1473	*Hedera helix* L. ssp. *helix*	Mediterraneo-Atlantico	IY, KY, VY
	APIACEAE		
1474	*Aegopodium podagraria* L.	Eurosiberiano *	RW, SK, SW, VY
1475	*Aethusa cynapium* L.	Eurosiberiano *	VY
1476	*Anethum piperitum* Ucria	Mediterraneo-Macaronesico *	VY
1477	*Angelica sylvestris* L.	Eurosiberiano	DY, KH, KY, VY
1478	*Anethum foeniculum* L.	Eurimediterraneo	KY
1479	*Anethum piperitum* Ucria	Mediterraneo-Macaronesico *	VK
1480	*Anthriscus caucalis* M.Bieb.	Paleotemperato *	FW
1481	*Anthriscus nitida* (Wahlenb.) Hazsl.	Pontico	IY, KY, QH, VY
1482	*Anthriscus sylvestris* (L.) Hoffm.	Paleotemperato	BX
1483	*Apium graveolens* L.	Paleotemperato *	VY
1484	*Astrantia major* L. ssp. *involucrata* (W.D.J.Koch) Ces.	Europeo	AY, BX. IY, KY, MK, NH, VY
1485	*Bunium bulbocastanum* L.	Ovest-Europeo	BX, KY, VY, ZH
1486	*Bunium petraeum* Ten.	Endemico	BX, KY
1487	*Bupleurum baldense Turra*	Eurimediterraneo	EY, IK, IY , KY, VY
1488	*Bupleurum falcatum* L. ssp. *cernuum* (Ten.) *Arcang.*	Orof. Sud-Europeo	AH, EY, IK, KY, VY
1489	*Buplerurum praealtum* L.	Pontico	KY, VY
1490	*Carum carvifolium (DC.) Arcang.*	Appennino-Balcanico	BX, KY, VY
1491	*Carum heldreichii Boiss.*	Appennino-Balcanico *	VX
1492	*Caucalis platycarpos* L.	Mediterraneo-Turaniano	KY
1493	*Cervaria rivini* Gaertn.	Eurosiberiano *	VY
1494	*Chaerophyllum aureum*	Nord-Mediterraneo	FH, IY, KY, OH, OK, PK, QK, VY
1495	*Chaerophyllum hirsutum* L.	Orof. Centro-Europeo	EX, KY, MK, VY
1496	*Chaerophyllum magellense* Ten.	Endemico *	EY
1497	*Chaerophyllum nodosum* (L.) Crantz	Stenomediterraneo * ##	VY
1498	*Chaerophyllum temulum* L.	Eurasiatico	BX, IY, KY, OH, VY

1499	*Conium maculatum* L. ssp. *maculatum*	Eurimediterraneo	KY, PK, QK, TH
1500	*Coristospermum cuneifolium* (Guss.) Bertol.	Endemico	IY, KY, VY
1501	*Daucus carota* L. ssp. *carota*	Paleotemperato	BX, FH, FX, HY, KY, OK, PW, QW, RK. SH. VY
1502	*Eryngium amethystinum* L.	Sud-Est-Europeo	BX, EY, IK , KY, PK, QK, SH, TK, UK, VH
1503	*Eryngium campestre* L.	Eurimediterraneo	BX, KY, TK, UK, VY
1504	*Foeniculum vulgare* Mill. ssp. *vulgare*	Eurimediterraneo	KY, VY
1505	*Heracleum sibiricum* L. ssp. *ternatum* (Velen.) Briq.	Orof. Sud-Est-Europeo *	PK, QK, RH, RW, SK, VY
1506	*Heracleum sphondylium* L.	Paleotemperato	KY, NH, OK, PW, QW, RK, VY
1507	*Katapsuxis silaifolia* (Jacq.) Reduron, Charpin & Pimenov	Sud-Est-Europeo *	VY
1508	*Laserpitium latifolium* L.	Europeo	IY, KY, VY
1509	*Oenanthe fistulosa* L.	Eurasiatico	KY
1510	*Oenanthe pimpinelloides* L.	Mediterraneo-Atlantico *	VY
1511	*Opopanax chironium* (L.) W.D.J.Koch	Stenomediterraneo	BX, IY, KY, OH, PK, RH, RW, SK, SW, VY
1512	*Oreoselinum nigrum* Delarbre	Europeo-Caucasico *	VX
1513	*Orlaya grandiflora* (L.) Hoffm.	Centro-Europeo	BX, KY, VY, ZH
1514	*Orlaya platycarpos* W.D.J. Koch.	Stenomediterraneo	BX, IY, VY
1515	*Pastinaca sativa* L. ssp. *urens* (Req. ex Godr.) Celak.	Eurosiberiano	BX, FX, KY, SH, VY
1516	*Pimpinella major* (L.) Huds.	Europeo-Caucasico	BX, KY
1517	*Pimpinella saxifraga* L. ssp. *saxifraga*	Europeo	KY, VY
1518	*Pimpinella tragium* Vill.	Eurimediterraneo	BX, KY, VY
1519	*Sanicula europea* L.	Mediterraneo-Montano	IY, KY, MK, NH, VY
1520	*Scandix pecten-veneris* L.	Subcosmopolita *	VK, VY
1521	*Seseli libanotis* (L.) W.D.J. Koch	Centro-Europeo	BX, IY, KY
1522	*Seseli montanum* L. ssp. *montanum*	Mediterraneo-Montano	IY, VY
1523	*Seseli tommasinii* Rchb.	Appennino-Balcanico	KY
1524	*Siler montanum* Crantz ssp. *garganicum* (Ten.) Iamonico, Bartolucci & F. Conti	Mediterraneo-Turaniano	AY, KY
1525	*Siler montanum* Crantz ssp. *stabianum* (Lacaita) F.Conti & Bartolucci	Endemico	IY, KY, VY
1526	*Sison amomum* L.	Submediterraneo *	VY
1527	*Thapsia asclepium* L.	Stenomediterraneo *	FW, VY
1528	*Tordylium apulum* L.	Stenomediterraneo	FK, KY, VY
1529	*Tordylium maximum* L.	Eurimediterraneo *	VY
1530	*Torilis africana* Spreng.	Subcosmopolita *	VY
1531	*Torilis arvensis* (Huds.) Link	Subcosmopolita	BX, KY, PK, QK, VY
1532	*Torilis japonica* (Houtt.) DC.	Subcosmopolita *	VY
1533	*Trinia dalechampii* (Ten.) Janch.	Appennino-Balcanico	HY, HH, IY, KY, OH, PK, SW, VY
1534	*Trinia glauca* (L.) Dumort. ssp. *glauca*	Sud-Est-Europeo *	KY
1535	*Xanthoselinum venetum* (Spreng.) Soldano & Banfi	Sud-Ovest-Europeo *	VY

FLORA PALENE (NACIONALNI PARK MAJELLA): FLORISTIČNA POSODOBITEV

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POVZETEK

To delo predstavlja nadaljevanje prispevku iz leta 2012 in prispeva posodobljen floristični seznam taksonov, ugotovljenih na preučevanem območju. Sestava novega kontrolnega seznama je bistvenega pomena, ker so nedavne študije privedle do taksonomskih revizij, novih zapisov in izključitve drugih taksonov, ki so bili prej obravnavani kot prisotni. Trenutni floristični seznam vključuje 1535 taksonov, vključno s 162 endemičnimi vrstami, kar povečuje fitogeografski pomen preučevanega območja. Horološki spekter kaže, da pripadajo zabeleženi taksoni 47 različnim horotipom, razdeljenim v 9 geografskih kontingentov.

Ključne besede: Palena, Abruci, flora, reka Aventino

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DELO NAŠIH ZAVODOV IN DRUŠTEV

ATTIVITÀ DEI NOSTRI ISTITUTI E SOCIETÀ

ACTIVITIES BY OUR INSTITUTIONS AND ASSOCIATIONS

REVIVING LANDSCAPES, CONNECTING SPECIES: LESSONS FROM THE RECO PROJECT

Interreg
CENTRAL EUROPE
Co-funded by
the European Union
ReCo

The ReCo project (Interreg Central Europe 2021–2027) demonstrates how coordinated ecosystem restoration and enhanced ecological cooperation can foster recovery of biodiversity along the European Green Belt. This unique corridor, spanning over 12,500 km and connecting 24 countries along the former Iron Curtain, represents a remarkable natural and cultural heritage. Serving as the backbone of the Pan-European Ecological Network, the Green Belt significantly contributes to Europe's green infrastructure. The area encompasses 40 national parks, and within a 50-km buffer on either side, over 3,200 protected areas which collectively cover almost all European biogeographical regions.

Building on six transboundary pilot actions, the ReCo project applied geo-information tools, data-driven management, and community-based approaches to counteract the degradation of key habitats and species. Its pilots demonstrate how restoration actions can be successfully transferred to other regions facing similar ecological challenges. The project also developed practical guidance for practitioners, prepared regional restoration plans, and supported policy integration, thereby contributing to the EU Biodiversity Strategy for 2030 and reinforcing the European Green Belt as a backbone for ecological coherence across the continent.

The project's significance and broader policy relevance were highlighted at the final ReCo conference, held on 5th of November 2025 at the European Parliament in Brussels. The event brought together Members of the European Parliament, representatives of the European Commission, national ministries, project partners, and NGOs from across Europe. Hosted by MEP Prof. dr. Danuše Nerudová, the conference emphasized the Green Belt as both a biodiversity corridor and a symbol of European cooperation. In her opening remarks, she described it as a connecting element of natural and cultural heritage, and a testament to the EU's commitment to nature conservation and restoration. The presentation of the ReCo results showcased the importance of cross-border collaboration, habitat restoration, and species conservation across the six pilot regions in Poland, the Czech Republic, Germany, Austria, Italy, and Slovenia. A high-level panel discussion explored the Green Belt's role in shaping EU biodiversity policy, the practical challenges of restoration, and opportunities for future cooperation and sustainable development. The conference provided a comprehensive overview of project achievements, facilitated knowledge exchange and offered strategic insights on strengthening the Green Belt as a model for transnational ecosystem restoration.

The ReCo pilot actions provide practical examples of ecosystem restoration and connectivity enhancement. In Poland, Federacja Zielonych GAJA together with the West Pomeranian Nature Society strengthened the free-ranging European bison (*Bos bonasus*) population in the Ińsko Lakeland through long-term management, including breeding, reintroductions, GPS monitoring, winter feeding, veterinary care, and conflict mitigation. In Germany, BUND (Friends of the Earth Germany, Bavarian branch) and in the Czech Republic, Ametyst NGO, restored habitats for the freshwater pearl mussel (*Margaritifera margaritifera*) and the marsh fritillary butterfly (*Euphydryas aurinia*) by dismantling drainage infrastructure, removing non-native afforestation, rewetting wetlands and improving

First professional excursion of the ReCo project in the Czech Republic (photo: Sonia Pytkowska).

water quality and gravel-bed conditions, while also re-establishing the host plant *Succisa pratensis*. Along the Austrian–Czech border, Nationalpark Thayatal and Národní park Podyjí carried out a controlled reintroduction of the European wildcat (*Felis silvestris*), supported by camera trapping, genetic sampling, and GPS telemetry of two released individuals, complemented by the creation of native shrub corridors and stepping-stone habitats to facilitate safe movements. In Slovenia, BSC Kranj cooperated with local farmers to revitalise species-rich alpine meadows around Mount Golica by adapting mowing regimes, removing invasive shrub encroachment and reseeding with native species, while also engaging the public through innovative AR/VR tools and volunteer-based traditional land-management activities. On the Pian del Grisa Plateau in Italy, WWF Italy restored degraded karst heathland and dry grassland by manually removing invasive shrubs, propagating native species in local nurseries and replanting them to enhance habitat continuity. Across all pilots, the combination of scientific monitoring, local knowledge and cross-border cooperation has proven essential for building resilient ecosystems and strengthening ecological connectivity throughout the Green Belt.

Based on this transnational framework, the pilot action implemented at the Škocjanski zatok Nature Reserve further demonstrates how climate-adaptive restoration can strengthen ecological resilience in coastal wetlands. Škocjanski zatok is a brackish nature reserve shaped by the dynamic interaction of marine and terrestrial habitats, making it highly sensitive to climate-induced sea-level rise and altered hydrological conditions. These pressures threaten halophytic vegetation, bird-nesting sites and the long-term stability of wetland communities, highlighting the need for adaptive management. The restoration pilot interventions focused on creating new habitats and enhancing ecosystem functionality. Two shallow mudflats in the central part of the lagoon were established in 2023, using redistributed sediment, which supported the expansion of halophytic vegetation and provided secure nesting sites for waterbirds, especially colonial-nesting terns.

Initial monitoring has produced promising results: within one year, new breeding colonies of the common tern (*Sterna hirundo*) and the little tern (*Sternula albifrons*) formed on the newly created islands, while vegetation surveys confirmed the expected development of halophytic communities. These outcomes demonstrate that targeted micro-topographic interventions can effectively strengthen the ecological functionality and climate resilience of brackish lagoons. The pilot demonstrates the transferability of methods such as artificial mudflat creation using locally sourced sediment, microhabitat shaping and adaptive water level management to other Mediterranean brackish wetlands. Technical approaches, such as sediment relocation with floating excavators, and integration of community science and public awareness activities are especially applicable to protected coastal zones. The project also provides a legal and procedural blueprint for restoration within protected areas, including

As part of the ReCo project, two new mudflats were created in the brackish lagoon of Škocjanski zatok (photo: Archive ŠZNR).

obtaining conservation consents and collaborating with municipal and port authorities.

Most importantly, the ReCo project fostered opportunities for expertise to be intertwined with relationships across multiple European borders, demonstrating that restoring ecosystems and reconnecting habitats is most successful when built on shared knowledge, cross-border cooperation and evidence-based practice. The pilot actions, from large herbivore conservation, wetland restoration, species reintroduction, alpine meadow revitalisation to karst landscape management, show how locally implemented interventions can contribute to a coherent ecological network stretching across Europe. By integrating scientific monitoring, traditional land-management knowledge, community engagement and innovative tools, the project created a set of practical models that can be replicated well beyond the Green Belt.

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Bojana Lipej
DOPPS-BirdLife Slovenia

IN MEMORIAM

IN MEMORIAM

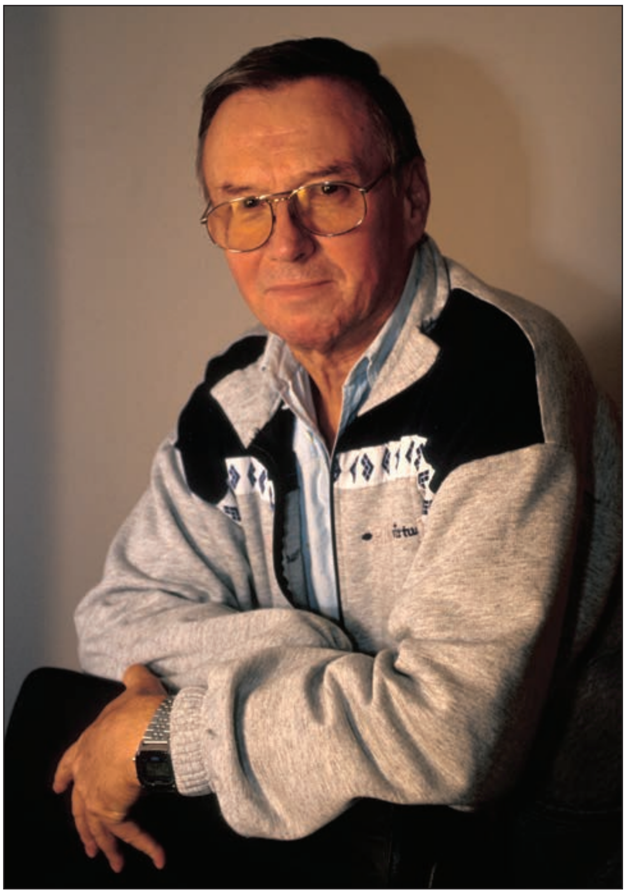
V SPOMIN MARJANU RICHTERJU

(1935 - 2025)

Vem za vrt pod morjem
Lep in molčeč
Tvoja zibelka in grob
(Pesem iz Markeških otokov)

Na začetku poletja nas je zapustil starosta slovenskega podvodnega filma in podvodne fotografije Marjan Richter. Marjan je bil eden zadnjih pionirjev slovenske potapljaške zgodovine, če odmislimo že zdavnaj preminule Račane, pravzaprav zadnji. Kot mlademu fantu so mu bili Račani vzor in navdih, zato se jim je v rani mladosti tudi sam pridružil in se od njih marsikaj naučil. Njegovi sopotniki, kot so bili tisti, ki so se udeležili prve slovenske odprave na arhipelag Dahlak v Rdečem morju so tudi že prah, ki je potonil in se zlil v neskončno modrino. In zdaj se jim je pridružil tudi Marjan, kot zadnji med njimi. Spet so združeni in spet se bodo lahko skupaj odpravili raziskovat neznane globine in vse kar je tam živega.

Marjana sem spoznal kmalu po tistem, ko sem se kot biolog in potapljač začel zanimati za podvodno fotografijo. Marjan je o njej vedel vse, a še več, čeprav brez formalne izobrazbe in akademskih naslovov, je vedel o morski biologiji. Med biologi je imel veliko znancev in prijateljev, tako da to njegovo znanje pravzaprav ni bilo tako presenetljivo in rad ga je delil tudi z nami mlajšimi. Spomnim se dolgih pogovorov, ko sva se nekaj poletij zapored z mojim avtom skupaj vozila na krajše potapljaške tabore v Žrnovnico pri Sv. Juraju pod Velebitom. Tam so znamenite vrulje, kjer je tudi sam z Račani začenjal svoje podmorske izlete. Podvodni izviri sladke vode, ki ustvarjajo posebno okolje z bogatim življenjem, so ga privlačili tudi kasneje in o njih in tamkajšnjem življenju sva veliko razpravljala. Marjan mi je tudi odprl nova obzorja, zanimanje za zelo majhne organizme, plankton in tudi alge, ki jih je še posebno radovedno preučeval. Pa tudi o bogatem življenju pod in med obrežnimi kamni, kar večina potapljačev v iskanju »večjih zverin« skoraj vedno spregleda. Marjan je najraje raziskoval in fotografiral kar na domačem dvorišču ob njemu ljubi Piranski punti. Leta so minevala in Marjan je prispeval tudi pomembno poglavje in fotografije o algah in morskih cvetnicah v moji knjigi Pod gladino Mediterana (2007). Ne dolgo tega sem ga prav v zvezi s tem hotel poklicati, ker pripravljam novo izdajo in sem ga hotel povabiti k sodelovanju, čeprav sem se zavedal, da mu leta ne prizanašajo. Te knjige žal ne bova napisala skupaj, bosta pa njegova dediščina in izročilo vidna tudi tokrat. Še prej sva se kar nekajkrat pogovarjala o njegovih načrtih, kajti želel je napisati knjigo o koraligenski biocenozi, tej najbolj pestri in vrstno bogati biocenozi Sredozemskega morja. Te načrte mu je prekrižala starost in je idejo kasneje opustil. Tudi kasneje pa se je še kako dobro zavedal nevarnosti, ki preti tej krhki združbi, zlasti zaradi segrevanja morja, kajti dviga temperature v njej živeči organizmi dolgoročno ne prenesejo. Prav naravovarstvena problematika je bila tudi velikokrat tema najinih pogovorov. V teh pogovorih je pogosto izrazil skrb kaj se dogaja z morjem, saj se je še dobro spominjal časov, ko je bilo morje in življenje v njem precej drugačno kakor je danes. Marjan je imel obsežen arhiv svojih podvodnih posnetkov, večinoma v obliki diapozitivov, v zadnjem obdobju, ko je še zahajal v podmorje, pa je svoje doživljaje in morske organizme beležil tudi z digitalnim fotoaparatom. Tako se je v desetletjih nabralo ogromno gradiva, ki ga bo v dogovoru z njegovo hčerko prevzelo Prirodoslovno društvo. Tako bosta njegova fotografska dediščina in arhiv podvodne fotografije ohranjena in na razpolago vsem, ki bi jih to zanimalo ali bi želeli določene posnetke uporabiti.



Marjan Richter (foto: Borut Furlan)

Marjan je bil dolgo časa zaposlen na RTV in verjetno prvi, ki je snemal pod vodo. Njegovo znanje o filmu in podvodni fotografiji je bilo za tiste čase pionirsko in hkrati edinstveno. V knjigi *Podmorski svet in mi* je zapisal tudi tole: «*Ob tihih in mirnih večerih ali pa ko je burja zavijala mimo skal, smo vedno obujali podmorska doživetja preteklega dne. Ugotovil sem, da nisem edini, ki sem se spraševal …in želel, da bi iz morja ponesli s seboj za spomin še kaj več kot samo izsušene ali v formalinu konzervirane živali. Menili smo, da bi nejevernim Tomažem najlaže dopovedali, kakšna je podmorska pokrajina, če bi naša doživetja posneli na film*« Kasneje je veliko teh doživetij prelil na film in še več na fotografski film, na koncu pa celo na digitalne kartice. Marjan je bil tudi eden od pobudnikov in protagonistov fotolova, tekmovanj v podvodni fotografiji, katerega namen je bil na film ujeti čim več vrst rib. Skupaj s »Pirančani«, kot sta Tine Valentinčič in tudi že pokojni Milan Orožen Adamič, so bili prvi pobudniki teh tekmovanj, ki so se kasneje razvila in uveljavila tudi drugod po Sredozemlju. Marjanovo vodilo je bilo, da ribo na posnetku lahko prodaš večkrat, na krožniku le enkrat. To je bil tudi razlog, da si s podvodnimi ribiči, ki jih je imenoval »ribopičniki«, nikoli ni bil prav blizu. Svoja doživetja je širil tudi skozi različne zapise in predavanja, bil je dejaven v Prirodoslovnem društvu, dolga leta je bil član uredniškega odbora Proteusa, za katerega je napisal številne članke s podmorsko tematiko. Bil je tudi avtor oziroma soavtor nekaj knjig o življenju v morju, najbolj znano njegovo delo je Naše Morje, kjer opisuje živi svet Tržaškega zaliva (2005), v katerega se je vedno rad vračal. Marjan je bil tudi eden glavnih protagonistov dokumentarnega filma »Lovci teme« (2008), v katerem smo predstavili vso zgodovino potapljanja v Sloveniji.

Marjana sem poznal kot tihega in mirnega človeka, ki pa se je razvnel ob vsakem pogovoru o morju. Morje je imel v sebi in morje ima zdaj Marjana. Naj njegova duša mirno plava v tihi modrini in občuduje tisto, kar živi ne moremo videti.

Tom Turk
Univerza v Ljubljani

KAZALO K SLIKAM NA OVITKU

SLIKA NA NASLOVNICI: Sprehajalčki (družina Tripterygiidae) so bližnji sorodniki babic (Blenniidae), od katerih se ločijo predvsem po tem, da imajo hrbtno plavut razdeljeno na tri dele. Sredozemske vrste so tudi bolj pisane od večine babic. To velja tudi za pritlikavega sprehajalčka (*Tripterygium melanurus*). (Foto: Tihomir Makovec)

Sl. 1: Ker je za mnoge babice značilen kriptobentoški način življenja, jih najpogosteje odkrivamo in beležimo z vizualnimi metodami popisa, bodisi s potapljanjem na vdih bodisi z avtonomnim potapljanjem. Starševsko skrb navadno prevzamejo samci, ki pripravijo gnezda in privabljajo samice, da jih obiščejo in vanje odložijo jajca. Takšen vzorec je značilen tudi za rdečepikasto babico (*Microlipophrys canevae)*. (Foto: Tihomir Makovec)

Sl. 2: Večina populacij navadnega morskega biča (*Dasyatis pastinaca*) v Sredozemskem morju močno upada in jim grozi veliko tveganje izumrtja. Čeprav morski bič navadno ni tarča komercialnega ribolova, se pogosto ulovi kot prilov v vlečne in zabodne mreže ter v parangale. (Foto: Borut Mavrič)

Sl. 3: Kot uspešen primer podnebju prilagojene obnove obalnega mokrišča, izvedene v okviru projekta ReCo, Škocjanski zatok dokazuje, da lahko s ciljnim ustvarjanjem habitatov in prilagodljivim upravljanjem okrepimo odpornost brakičnih lagun. (Foto: Bojana Lipej)

Sl. 4: Velika babica (*Parablennius gattorugine*) je precej pogosta riba plitvih obalnih skalnatih habitatov. Je zelo teritorialna in vztrajno brani svoje gnezdo in zavetje, ki se nahaja v razpoki v skalnatem grebenu. (Foto: Tihomir Makovec)

Sl. 5: Morski kelih, *Calyx nicaeensis* (Risso, 1826), je endemična sredozemska vrsta čašaste kremenaste spužve, ki velja za redko vrsto s potrebo po ohranjanju. Med letoma 2023 in 2025 je bilo na skalnatih osamelcih v Tržaškem zalivu prvič opaženih več primerkov te vrste. (Foto: Borut Mavrič)

Sl. 6: Čreda prostoživečih zobrov (*Bison bonasus*) v Zahodnem Pomorjanskem. Čreda predstavlja eno ključnih populacij, ki prispevajo k obnavljanju evropskega bizona v severozahodni Poljski. (Foto: Aneta Kozłowska)

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FRONT COVER: Triplefin blennies (family Tripterygiidae) are close relatives of combtooth blennies (Blenniidae), differing mainly in having a tripartite dorsal fin. The Mediterranean species are also more colorful than most blennies. This is also true of the small triplefin blenny (*Tripterygion melanurus*). (Photo: Tihomir Makovec)

Fig. 1: Since many blennies have a cryptobenthic lifestyle, they are detected and recorded mainly through visual census methods, either by snorkeling or by diving. They generally exhibit male parental care, with males preparing nests and attracting females to visit and lay their eggs. This pattern is also characteristic of Caneva's Blenny (*Microlipophrys canevae*). (Photo: Tihomir Makovec)

Fig. 2: Most populations of the common stingray (*Dasyatis pastinaca*) in the Mediterranean Sea are in serious decline and face a high risk of extinction. Although stingrays are generally not targeted by commercial fisheries, they are frequently caught as bycatch in bottom trawls, gillnets, and longlines. (Photo: Borut Mavrič)

Fig. 3: As a successful example of climate-adaptive coastal wetland restoration carried out within the ReCo project, Škocjanski zatok demonstrates that targeted habitat creation and adaptive management can strengthen the resilience of brackish lagoons. (Photo: Bojana Lipej)

Fig. 4: The tompot blenny (*Parablennius gattorugine*) is a fairly common fish in shallow littoral rocky habitats. It is highly territorial and tenaciously defends its nest and shelter, which is typically located in a crevice in the rocky reef. (Photo: Tihomir Makovec)

Fig. 5: The cup-shaped demosponge, *Calyx nicaeensis* (Risso, 1826), is an endemic Mediterranean species, classified as rare. Between 2023 and 2025, many specimens were recorded for the first time on the rocky outcrops in the Gulf of Trieste. (Photo: Borut Mavrič)

Fig. 6: A herd of free-living European bison (*Bison europaeus*) in Western Pomerania. The herd represents one of the key populations contributing to the ongoing restoration of the European bison in northwestern Poland. (Photo: Aneta Kozłowska)

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