

REVIEW

The elusive Mediterranean gobies (Actinopteri: Gobiidae and Oxudercidae), their geographic pattern and the discussion on the rareness of Mediterranean fishes

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Abstract: Among the 64 native Mediterranean gobies (Gobiidae and Oxudercidae), a rather high number of species was historically considered rare, and until today, some of these species have only a limited number of published records with a positive identification. Reviewing published data and applying quantitative thresholds shows that out of the 64 native species, 25 remain rarely recorded and can be considered elusive. Additional 13 species had been considered rare historically or just a decade ago. However, the increasingly high number of publications on gobies since the turn of the century revealed that the latter ones now have to be considered rather common. Almost all elusive gobies appear to be restricted to northern and eastern Mediterranean areas. The four areas with the highest elusive species richness showed no clear biogeographic pattern. Rather, an increased diversity counts of elusive gobies are likely sampling artifact of a high level of research activity in these areas. Almost all elusive Mediterranean gobies are very small littoral fish with no recognizable general preference for a specific bottom habitat or depth range. The best available published source was used to review and discuss the rarity of Mediterranean fishes in general. However, most of the elusive and potentially rare Mediterranean fish species lack a review of all their positive published records that would allow quantified discussion and conclusion on their elusiveness.

Keywords: Gobiidae; Oxudercidae; Mediterranean Sea; elusive species; rare species; fishes

Sažetak: NEPRIMJETNI SREDOZEMNI GLAVOČI (ACTINOPTERI: GOBIIDAE I OXUDERCIDAE), NJIHOV GEOGRAFSKI RASPORED I RASPRAVA O RIJETKOSTI MEDITERANSKIH RIBA. Među mediteranskim glavočima (Gobiidae i Oxudercidae), brojne su se vrste povijesno smatrale rijetkima. I danas neke od tih vrsta imaju ograničen broj objavljenih nalaza s pouzdanom identifikacijom. Pregledom objavljenih podataka i primjenom kvantitativnih pragova pokazuje se da se 25 vrsta glavoča još uvijek rijetko pronalazi i može se smatrati neprimjetnim. Među 64 autohtone mediteranske vrste glavoča, dodatnih 13 vrsta smatralo se rijetkima prije samo nekoliko desetljeća ili samo jedno desetljeće unazad. Međutim, veliki broj publikacija o glavočima od početka ovog stoljeća ukazuje na to da su ove vrste mnogo češće nego što se ranije mislilo. Neprimjetni glavoči gotovo su isključivo ograničeni na sjeverna i istočna mediteranska područja. Četiri područja s najvećim bogatstvom neprimjetnih vrsta nisu pokazala jasan geografski obrazac. Visoka zabilježena raznolikost neprimjetnih glavoča vjerojatno je povezana s visokom razinom istraživačke aktivnosti u tim područjima. Gotovo svi neprimjetni mediteranski glavoči vrlo su male litoralne ribe bez prepoznatljive zajedničke sklonosti za određeno pridreno stanište ili za određeni raspon dubine dna. Najbolji dostupni objavljeni izvor upotrijebljen je za pregled i raspravu o rijetkosti mediteranskih riba općenito. Međutim, većini neprimjetnih i potencijalno rijetkih mediteranskih vrsta riba nedostaje pregled svih njihovih pouzdanih objavljenih nalaza za bilo kakvu kvantificiranu raspravu i zaključak o njihovoj neprimjetnosti.

Ključne riječi: Gobiidae; Oxudercidae; Sredozemno more; neprimjetne vrste; rijetke vrste; ribe

INTRODUCTION

There are multiple definitions of species rarity, which can be broadly organized in two groups: those that treat rarity as of low population size and those that treat it as of small geographic range, or area of occupancy (Cerquiera *et al.*, 2013). However, Brown (1984) found that there is a positive correlation between local population density and the extent of spatial distribution among similar species, so widespread species are usually also locally abundant, and *vice versa*, and the rare species usually feature both kinds of rareness. The widely used definition of rarity developed by Rabinow-

itz (1981) includes habitat specificity as a third criterion, classifying species based on their geographic range (large or small), habitat specificity (wide or narrow), and local abundance (somewhere large or everywhere small). The eight possible combinations included one for common species (all three criteria met: large geographic range, wide habitat specificity and high number of specimens) and seven types of some kind of rarity (Rabinowitz, 1981).

The main risk in classifying species as rare or as common is to confound rarity with elusiveness. In the absence of misidentification, detection is a sure sign of presence, but non-detection can result from real absence

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Received: 24 October 2025, accepted: 27 November 2025

ISSN: 0001-5113, eISSN: 1846-0453

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or from missing a species that is actually present (Cerquiera *et al.*, 2013). The apparent rarity of species based on the published data could be an artifact of sampling methodologies that are just ineffective for species that are not truly rare (Pritt, 2010). These species are often cryptic or shy or have special life history strategies that can reduce detectability, leading ultimately to substantial underestimates of their distribution or abundance (Flather and Hull Sieg, 2007), if sampling is not done at the appropriate time, at the appropriate locality and habitat, or by an appropriate method. The underestimates of abundance or range can expand the number of species considered to be rare. The literature has many examples of a species historically considered rare, but later turning out to be much more abundant or widespread than originally thought (Flather and Hull Sieg, 2007).

The Mediterranean gobies are currently divided into two families, Gobiidae and Oxudercidae (both *sensu* Fricke *et al.*, 2025), representing 2181 species worldwide and 78 species in the Mediterranean, 64 native and 14 alien species (Kovačić *et al.*, 2022a; Mavruk *et al.*, 2022). The Gobiidae family alone, has the largest number of new species descriptions in the past decade among all fish families both worldwide and in the Mediterranean (Kovačić *et al.*, 2022a; Fricke *et al.*, 2025). Families Gobiidae and Oxudercidae are also unique since they are the only species-rich fish families with numerous species both in marine and freshwater environments. In warm temperate and tropical seas, gobies are often the most species-rich fishes, but gobiid diversity decreases with higher latitudes and markedly declines in cold temperate seas (Kovačić *et al.*, 2025). Due to the small size and cryptic behavior, most gobiid species cannot be collected by fishing gears, contrary to the majority of other fishes. The introduction of alternative methods for collecting cryptobenthic fishes in the Mediterranean enabled discoveries of real gobiid abundance and species richness (Kovačić *et al.*, 2012a). In the Mediterranean, many of the species of the family Gobiidae continued to be considered rare even decades after their original descriptions, due to the limited or very limited number of published records (Ahnelt and Dorda, 2004).

The aim of this paper is to review the elusive Mediterranean gobiid species based on the published data, to search for putative geographic patterns of their presence or for putative shared traits, and to discuss the rarity of Mediterranean fishes in general.

MATERIAL AND METHODS

Rare fish species are considered here as those having a small number of individuals in their populations, due to their narrow ecological niches or due to their limited geographic distribution, as discussed in the Introduction. These species may be permanently rare or they can switch between rare and abundant states depending on periodic changes in environmental conditions (Jia *et al.*, 2018). An elusive fish species is here defined as fish species with a

limited number of published records with positive identification, or with a limited number of known localities with species records, or, finally, with a limited number of recorded specimens from throughout its geographic range or from a subrange since the original description.

Criteria for elusive Mediterranean gobiid species used here were based on their published rareness, for which the quantitative thresholds were set arbitrarily. The gobiid species is considered elusive or apparently rare in the Mediterranean based on published data, if any of the following criteria based on published records with positive identification was fulfilled as the total number for Mediterranean: the number of publications with positive findings 10 or less, the number of localities with positive findings 20 or less or the number of positively recorded individuals 50 or less. Only one paper with the best material citation was cited here when two or more papers were based on the same records (e.g., Scsepká and Ahnelt, 1999 was selected for Patzner, 1999; Scsepká and Ahnelt, 1999; Scsepká *et al.*, 1999). Locations were considered the same if the distance between them is less than 200 m, even if geomorphology, habitat characteristics or toponyms are distinct. The distance criterion was used to prevent excessive splitting of areas and increased records by inflated localities. If the number of individuals recorded at a locality was not specified or only vague expressions were used (like “a few”, “several”) in publications, a positive minimum of one individual was counted. If the research included more than one locality, and the number of localities with particular species recorded was not reported, a positive minimum of one locality was counted (e.g., Kovačić *et al.*, 2024a). All data in this work are supported by a reference to the published original data. Criteria of positive species identification in publications followed Kovačić *et al.* (2020), including also fish individuals properly identified from the photos (Kovačić *et al.*, 2022a). Publications without at least one of the following evidences were excluded from counts: individuals stored, individuals or photographs studied with the data provided, or the identification protocol explained. For example, checklists, reviews and books listing species without having neither original data nor cited references of the record were excluded. Further, species distribution localities just marked in mini maps or listed without explanation were not taken into consideration. Analogously, ecological and other papers, as well as fishery technical reports, claiming species observations with no evidences or identification protocol were not considered, e.g., Francour *et al.* (2007). Sometimes the authors themselves presented the record as unconfirmed, since the individual was just observed and not collected or photographed, e.g., *Thorogobius macrolepis* (Kolombatović, 1891) in Kovačić *et al.* (2011). Online records with photographs and without positive identification were only considered if they were checked and verified based on publications, and the publication reviewing them was cited here, like in Kovačić *et al.* (2022a).

The geographic division of the Mediterranean was based on the continental shelf distribution, considering that gobies are prevailingly littoral species, with just a few upper bathyal representatives in the Mediterranean (Fig. 1). Each of the six Mediterranean parts from Kovačić and Patzner (2011) is further divided into a total of 25 continental shelf zones. The approach to geographic division was eclectic, aimed to produce the most convenient areas according to size and shelf isolation, while avoiding overlapping or gaps. The continental shelf areas are listed clockwise from northwest and illustrated in Fig. 1: large islands with a distinctive continental shelf: Balearic Islands, Corsica, Sardinia, Sicily, Malta Islands and Lampedusa, Crete and Cyprus; distinctive continental shelves of local Mediterranean seas: North Alboran Sea, Ligurian Sea, Tyrrhenian Sea, West Ionian Sea, Adriatic Sea, East Ionian Sea, Western Aegean Sea, Marmara Sea, Eastern Aegean Sea, North Levantine Sea, Eastern Levantine Sea; South Levantine Sea, South Alboran Sea; remaining areas are long stretches of Mediterranean continental shelf which are divided, without landmarks, by national borders: the Spanish Mediterranean coast east of Alboran Sea, the French Mediterranean coast, the Libyan coast, the Tunisian coast, the Algerian coast. Species data on maximum size, bottom depth range and bottom composition for Mediterranean gobies are from Kovačić *et al.*, 2018, 2019, 2022a, 2022b, 2023a, 2024b and for individual species also from Miller, 1966, 1982; Van Tassel *et al.*, 1988; Mejri *et al.*, 2009a; Kovačić and Schembri, 2019; Iglésias *et al.*, 2021a and Kovačić and Froglija, 2023. The size of elusive species of gobies vs. non-elusive

native Mediterranean species of gobies was statistically tested. The dataset of species maximum total lengths did not meet ANOVA assumptions, both for normality (Shapiro-Wilk normality test) and homogeneity of the variances (Bartlett test of homogeneity of variances), so the Wilcoxon rank sum test was applied (R Core Team, 2025). The coastal length estimation in each area was based on coastal length data from various online sources (Supplementary Table S1). As the correlation coefficient between species richness and coastal length of areas, Spearman's Rank correlation coefficient was calculated, since the assumptions for the Pearson correlation coefficient were not met on the original or on the transformed data (R Core Team, 2025).

RESULTS

Among 64 native Mediterranean species of gobies, at least one criterion of elusiveness was fulfilled for 25 species (Table 1, Fig. 2), while the remaining species surpass thresholds in all criteria: records, localities with records, and collected or recorded individuals. Among other species, an additional 13 species had been considered rare only a few decades or just a decade ago, but the number of publications reporting them has increased recently (Table 2). Among the 25 elusive species, 15 belonged to the family Oxudercidae, which is half of all Mediterranean Oxudercidae species, including aliens (Table 1). The other ten belonged to Gobiidae, which is only 21% of all Mediterranean representatives of this family. On the contrary, only one species of Oxudercidae, or 3.3% of all Mediterranean Oxudercidae species,

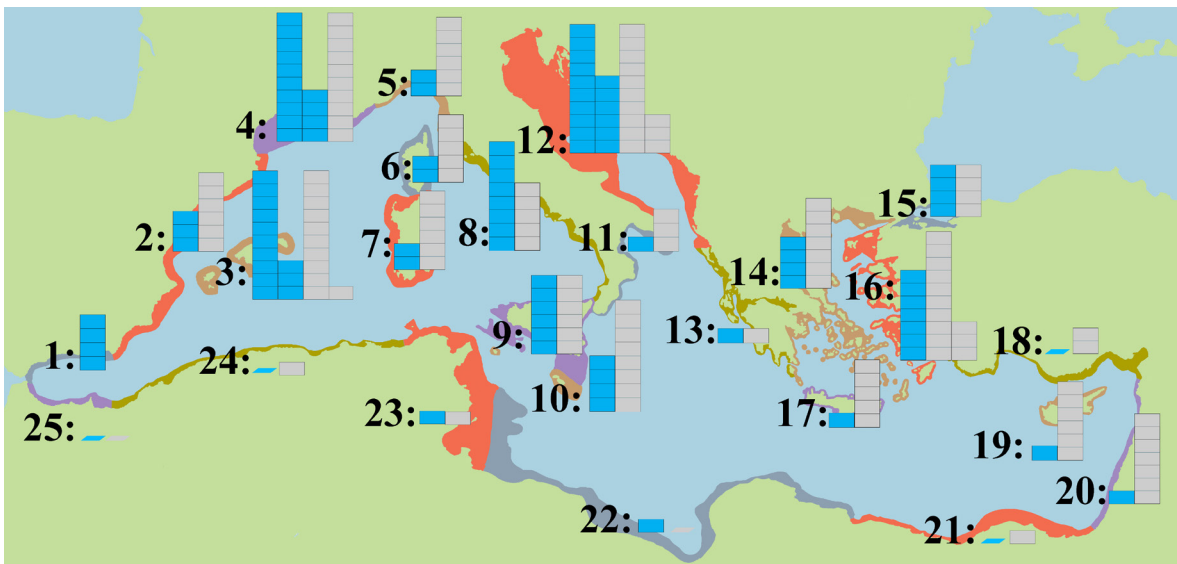


Fig. 1. The continental shelf zone of the Mediterranean Sea is divided into areas. The differently colored continental shelf areas on the map are listed clockwise from northwest: 1. North Alboran Sea, 2. Spanish Mediterranean coast east of the Alboran Sea, 3. Balearic Islands, 4. French Mediterranean coast, 5. Ligurian Sea, 6. Corsica, 7. Sardinia, 8. Tyrrhenian Sea, 9. Sicily, 10. Malta Islands and Lampedusa, 11. West Ionian Sea, 12. Adriatic Sea, 13. East Ionian Sea, 14. Western Aegean Sea, 15. Marmara Sea, 16. Eastern Aegean Sea, 17. Crete, 18. North Levantine Sea, 19. Cyprus, 20. Eastern Levantine Sea, 21. South Levantine Sea, 22. Libyan coast, 23. Tunisian coast, 24. Algerian coast, 25. South Alboran Sea. The number of species of gobies in each area is presented as vertical columns: blue cells, elusive species (Table 1), grey cells, species formerly considered rare (Table 2).

Table 1. The list of the elusive species of Mediterranean gobies based on the published data.

Species; family	Publications with positive findings	Number of localities from publications	Number of individuals from publications	Geographic distribution in the Mediterranean
<i>Buenia affinis</i> Iljin, 1930; Oxudercidae	Zander, 1982a; Sanzo, 1911; Kovačić, 2002; Kovačić and La Mesa, 2008; Kovačić and Patzner, 2009; Kovačić <i>et al.</i> , 2012b, 2018, 2022a; Engin <i>et al.</i> , 2014, 2016a; Iglésias <i>et al.</i> , 2020	15	279	Balearic Islands, French Mediterranean coast, Tyrrhenian Sea, Adriatic Sea, Marmara Sea, Eastern Aegean Sea
<i>Buenia lombartei</i> Kovačić, Ordines & Schliewen, 2018; Oxudercidae	Kovačić <i>et al.</i> , 2018	2	2	Balearic Islands
<i>Buenia massutii</i> Kovačić, Ordines & Schliewen, 2017; Oxudercidae	Kovačić <i>et al.</i> , 2017; Ordines <i>et al.</i> , 2019a, b; Dulčić <i>et al.</i> , 2022; Seyhan Öztürk and Oruç, 2023	12	55	North Alboran Sea, Balearic Islands, Adriatic Sea, Eastern Aegean Sea
<i>Didogobius bentuvii</i> Miller, 1966; Gobiidae	Miller, 1966	1	1	Eastern Levantine Sea
<i>Didogobius schlieweni</i> Miller, 1993; Gobiidae	Miller, 1993; Ballesta <i>et al.</i> , 1998; Kovačić, 2005; Patzner, 2007; Francour, 2008; Kampouri <i>et al.</i> , 2019; Iglésias <i>et al.</i> , 2021b	15	18	French Mediterranean coast, Ligurian Sea, Adriatic Sea, Western Aegean Sea
<i>Gammogobius steinitzi</i> Bath, 1971; Gobiidae	Bath, 1971; Ahnelt and Patzner, 1996; Scsepka and Ahnelt, 1999; Kovačić, 1999; Arko-Pijevac <i>et al.</i> , 2001; Fischer <i>et al.</i> , 2007; Kovačić <i>et al.</i> , 2011, 2021b; Colombo and Langeneck, 2013; Gerovasileiou <i>et al.</i> , 2015; Engin <i>et al.</i> , 2016a; Glavičić <i>et al.</i> , 2016; Iglésias <i>et al.</i> , 2020; Ragkousis <i>et al.</i> , 2021	26	47	Balearic Islands, French Mediterranean coast, Tyrrhenian Sea, Sardinia, Sicily, Adriatic Sea, Western Aegean Sea, Eastern Aegean Sea, Crete
<i>Gobius ater</i> Bellotti, 1888; Gobiidae	Bellotti, 1888 (the number of types based on Fricke <i>et al.</i> , 2025); Lozano y Rey, 1919; Gramitto, 1993; Ahnelt, 2001; Kovačić and Schembri, 2019; Kovačić <i>et al.</i> , 2022b	21	70	Balearic Islands, French Mediterranean coast, Sicily, Malta Islands and Lampedusa, Adriatic Sea

Table 1. Continuation

Species; family	Publications with positive findings	Number of localities from publications	Number of individuals from publications	Geographic distribution in the Mediterranean
<i>Gobius gasteveni</i> Miller, 1974; Gobiidae	Ahnelt and Dorda, 2004; Ahnelt <i>et al.</i> , 2011; Kovačić and Schembri, 2019; Iglésias <i>et al.</i> , 2021b; Kovačić <i>et al.</i> , 2022a	10	27	North Alboran Sea, Balearic Islands, French Mediterranean coast, Ligurian Sea
<i>Gobius kolombatovici</i> Kovačić & Miller, 2000; Gobiidae	Kovačić and Miller, 2000; Kovačić, 2005; Francour and Mangialajo, 2007; Bilecenoglu <i>et al.</i> , 2013; Crocetta <i>et al.</i> , 2015; Iglésias <i>et al.</i> , 2015; Engin <i>et al.</i> , 2016a; Tiralongo <i>et al.</i> , 2020; Renoult <i>et al.</i> , 2022	22	33	Spanish Mediterranean coast east of the Alboran Sea, Balearic Islands, French Mediterranean coast, Corsica, Tyrrhenian Sea, Sicily, Adriatic Sea, Eastern Aegean Sea
<i>Gobius xoriguer</i> Iglésias, Vukić & Šanda, 2021; Gobiidae	Iglésias <i>et al.</i> , 2021a; Kovačić <i>et al.</i> , 2023a; Kovačić and Frogia, 2023	18	45	Spanish Mediterranean coast east of the Alboran Sea, Balearic Islands, Corsica, Tyrrhenian Sea, Adriatic Sea
<i>Gymnesigobius medits</i> Kovačić, Ordines, Ramirez-Amaro & Schliewen, 2019; Gobiidae	Kovačić <i>et al.</i> , 2019, 2023a	3	5	Spanish Mediterranean coast east of the Alboran Sea, Balearic Islands
<i>Lebetus guilleti</i> (Le Danois, 1913); Oxudercidae	Zander, 1982a; Herler and Kovačić, 2002; Engin <i>et al.</i> , 2015; Riolo and Betti, 2015; Kovačić and Schembri, 2019; Schliewen <i>et al.</i> , 2019	15	37	Balearic Islands, French Mediterranean coast, Malta Islands and Lampedusa, Adriatic Sea, Marmara Sea
<i>Lebetus patzneri</i> Schliewen, Kovačić & Ordines, 2019; Oxudercidae	Schliewen <i>et al.</i> , 2019	2	2	Balearic Islands
<i>Pomatoschistus adriaticus</i> Miller, 1973; Oxudercidae	Kolombatović, 1891; Miller, 1973a; Bouchereau <i>et al.</i> , 2003	7	35	French Mediterranean coast, Adriatic Sea, Marmara Sea
<i>Pomatoschistus anatoliae</i> Engin & Innal, 2017; Oxudercidae	Engin and Innal, 2017	1	3	Northern Levantine Sea
<i>Pomatoschistus bathi</i> Miller, 1982; Oxudercidae	Miller, 1982; Zander, 1982a, b; Kovačić, 2005; Engin <i>et al.</i> , 2016a; Giacobbe <i>et al.</i> , 2017; Engin and Seyhan, 2017	54	240	French Mediterranean coast, Tyrrhenian Sea, Sicily, Adriatic Sea, Marmara Sea, Eastern Aegean Sea

Table 1. Continuation

Species; family	Publications with positive findings	Number of localities from publications	Number of individuals from publications	Geographic distribution in the Mediterranean
<i>Pomatoschistus knerii</i> (Steindachner, 1861); Oxudercidae	Steindachner, 1861 (the number of types based on Fricke <i>et al.</i> , 2025); Kolombatović, 1900; Bini, 1969; Kovačić, 2003, 2005	11	25	Tyrrhenian Sea, Adriatic Sea
<i>Pomatoschistus nanus</i> Engin & Seyhan, 2017; Oxudercidae	Engin and Seyhan, 2017; Seyhan Öztürk and Oruç, 2023; Kovačić <i>et al.</i> , 2024b	5	12	Malta Islands and Lampedusa, Cyprus, Northern Levantine Sea
<i>Pomatoschistus norvegicus</i> (Collett, 1902); Oxudercidae	Fage, 1918; de Buen, 1923; Stefanni, 2000; Ahnelt and Dorda, 2004; Kovačić <i>et al.</i> , 2012b	6	14	North Alboran Sea, French Mediterranean coast, Tyrrhenian Sea, Adriatic Sea, Western Aegean Sea
<i>Pomatoschistus quagga</i> (Heckel, 1837); Oxudercidae	Heckel, 1837 (the number of types based on Fricke <i>et al.</i> , 2025); Steindachner, 1868; Kolombatović, 1891; Zander, 1982a, b; Kovačić, 2003, 2005; Fricke <i>et al.</i> , 2007; Engin <i>et al.</i> , 2016a	21	53	North Alboran Sea, French Mediterranean coast, Sicily, Adriatic Sea
<i>Pomatoschistus tortonesei</i> Miller, 1969; Oxudercidae	Miller, 1969a, 1982; Mejri <i>et al.</i> , 2009a, b	8	177	Sicily, Tunisian coast, Libyan coast
<i>Speleogobius llorisi</i> Kovačić, Ordines & Schliewen, 2016; Oxudercidae	Kovačić <i>et al.</i> , 2016, 2022a; Engin <i>et al.</i> , 2017; Kovačić and Schembri 2019; Kovačić and Glavičić 2019; Iglésias <i>et al.</i> , 2025	14	16	Balearic Islands, French Mediterranean coast, Malta Islands and Lampedusa, Adriatic Sea, Eastern Aegean Sea
<i>Speleogobius trigloides</i> Zander & Jelinek, 1976; Oxudercidae	Zander and Jelinek, 1976; Fesser, 1980; Kovačić, 1997; Engin <i>et al.</i> , 2017; Iglésias <i>et al.</i> , 2020; Kovačić <i>et al.</i> , 2022a	12	26	French Mediterranean coast, Tyrrhenian Sea, Adriatic Sea, Eastern Aegean Sea
<i>Vanneaugobius pruvoti</i> (Fage, 1907); Gobiidae	Fage, 1907	1	1	Balearic Islands
<i>Zebrus pallaoroi</i> Kovačić, Šanda & Vukić, 2021; Gobiidae	Kovačić <i>et al.</i> , 2021c, 2022a, 2024c; Digenis <i>et al.</i> , 2024; Ahnelt, 2025	25	86	French Mediterranean coast, Sardinia, Adriatic Sea, Western Ionian Sea, Eastern Ionian Sea, Western Aegean Sea

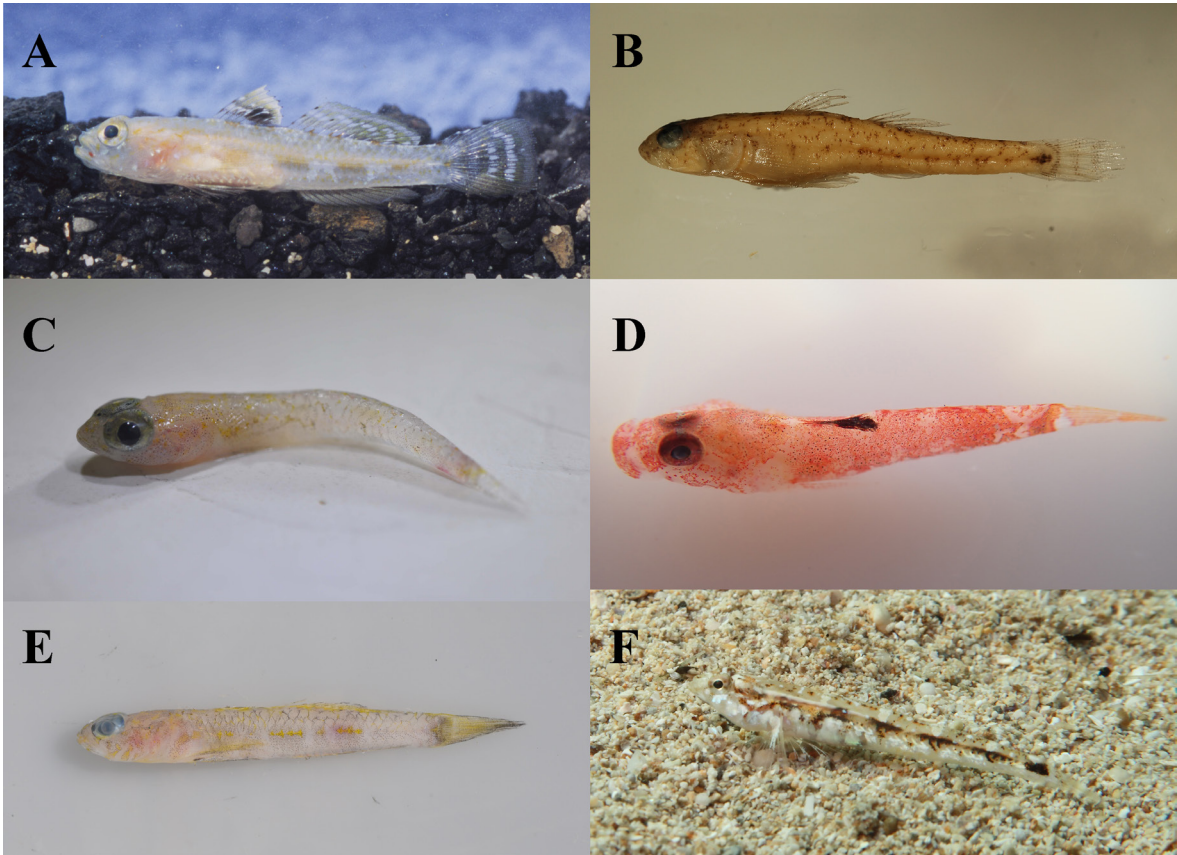


Fig. 2. The species of gobies having five or fewer Mediterranean localities with the known records (Table 1). The species not restricted to the Mediterranean marked with *. One locality: *Didogobius bentuvii* Miller, 1966, unfortunately, the only existing illustration of *Didogobius bentuvii* Miller, 1966 is the drawing in the original description; *Vanneaugobius pruvoti* (Fage, 1907)* (A); *Pomatoschistus anatholiae* Engin & Innal, 2017 (B). Two localities: *Buena lombartei* Kovačić, Ordines & Schlieven, 2018 (C); *Lebetus patzneri* Schlieven, Kovačić & Ordines, 2019 (D). Three localities: *Gymnesigobius medits* Kovačić, Ordines, Ramirez-Amaro & Schlieven, 2019 (E). Five localities: *Pomatoschistus nanus* Engin & Seyhan, 2017 (F). Photos by: Jim Van Tassel (A), Marcelo Kovačić (B) and (C), Francesc Ordines (D) and (E), Mark-Anthony Falzon (F).

including aliens, was among 13 species formerly considered rare. All others were Gobiidae, 25% of all Mediterranean Gobiidae species, including aliens.

All 25 elusive gobies are restricted to the northern and eastern Mediterranean (Fig. 1). The absence or nearly complete absence of their records along the entire southern Mediterranean coast is astonishing. The highest species richness was recorded for the Adriatic Sea, the Balearic Islands, the French Mediterranean coast and the Eastern Aegean Sea. Along the northern and eastern Mediterranean there is no apparent geographic gradient or geographic concentration of species among areas (Fig. 1). Species rich and species poor areas alternate without a recognizable pattern along the entire north and east Mediterranean coast (Fig. 1). Also, there is no significant correlation of species richness with the area size, based on coastal length of each area (Spearman's Rank correlation coefficient $r=0.200$, $p=0.339$) (Fig. 3, Supplementary Table S1).

Elusive Mediterranean gobies are very small littoral fish. All species, except two, are smaller than 7 cm in total length (Fig. 4). The maximum total lengths of elusive

species of gobies were significantly smaller than in non-elusive native Mediterranean species of gobies (the Wilcoxon rank sum test, $W = 214$, $p\text{-value} = 0.0001704$). Contrary to the unambiguous trait of very small size of elusive fish, there is no characteristic ecological trait discernable for elusive goby species, such as a preference for the specific bottom habitat (Fig. 5). The number of Mediterranean elusive species of gobies decreases at deep littoral and bathyal depths (Fig. 6).

DISCUSSION

The traits of the elusive Mediterranean gobies

The two present families of gobies, Gobiidae and Oxudercidae (Fricke *et al.*, 2025), are the two most species-rich Mediterranean fish families, 48 and 30, respectively (Kovačić, 2020; Kovačić *et al.*, 2021a). Together, they represent about one tenth of the Mediterranean fish diversity. However, the number of the described new species of Gobiidae and Oxudercidae in the Mediterranean in this century is about equal to the number of

Table 2. The list of the species of Mediterranean gobies with increased number of published records in recent years, although considered rare in the last century.

Species; family	Publications with positive findings	Number of localities from publications	Number of individuals from publications	Geographic distribution in the Mediterranean
<i>Chromogobius quadrivittatus</i> (Steindachner, 1863); Gobiidae	Steindachner, 1863 (the number of types based on Miller, 1971), 1868; Bellotti, 1879; Kolombatović, 1891; Miller, 1971, 1977; Golani and Ben-Tuvia, 1986; Ahnelt, 1990, 1991; Kovačić, 1997, 2005; Colombo and Langeneck, 2013; Engin <i>et al.</i> , 2016a; Trkov <i>et al.</i> , 2019; Glavičić <i>et al.</i> , 2020; Kara and Yüsek, 2023	43	62	Spanish Mediterranean coast east of Alboran Sea, French Mediterranean coast, Corsica, Sardinia, Adriatic Sea, Marmara Sea, Eastern Aegean Sea, Eastern Levantine Sea
<i>Chromogobius zebratus</i> (Kolombatović, 1891); Gobiidae	Kolombatović, 1891 (the number of types based on Miller, 1971); Miller, 1971, 1977; Ahnelt, 1990; Bouchereau and Tomasini, 1990; Mercader, 1994; Ahnelt and Patzner, 1996; Kovačić, 1997, 2005; Fischer <i>et al.</i> , 2007; Fricke <i>et al.</i> , 2007; Engin and Dalgıç, 2008; Kovačić <i>et al.</i> , 2011, 2012a, 2024a; Colombo and Langeneck, 2013; Engin <i>et al.</i> , 2016a, 2016b; Glavičić <i>et al.</i> , 2016, 2020; Kovačić and Schembri, 2019; Iglésias <i>et al.</i> , 2020; Tiralongo <i>et al.</i> , 2020; Kara and Yüsek, 2023; Báez <i>et al.</i> , 2025	42	171	Balearic Islands, French Mediterranean coast, Corsica, Sardinia, Tyrrhenian Sea, Ligurian Sea, Malta Islands and Lampedusa, Adriatic Sea, Eastern Aegean Sea, Marmara Sea, North Levantine Sea, Eastern Levantine Sea
<i>Corcyrogobius liechtensteini</i> (Kolombatović, 1891); Gobiidae	Kolombatović, 1891; Miller, 1972; Ahnelt <i>et al.</i> , 1994, 1998; Ahnelt and Patzner 1996; Herler <i>et al.</i> , 1999; Arko-Pijevac <i>et al.</i> , 2001; Ahnelt and Dorda, 2004; Kovačić, 2005; Fischer <i>et al.</i> , 2007; Kovačić <i>et al.</i> , 2011, 2012a, 2021b, 2024a; Bussotti <i>et al.</i> , 2015; Gerovasileiou <i>et al.</i> , 2015; Bilecenoğlu, 2016; Engin <i>et al.</i> , 2016a; Glavičić <i>et al.</i> , 2016, 2020; Ragkousis <i>et al.</i> , 2021; Tsagarakis <i>et al.</i> , 2021; Montesanto <i>et al.</i> , 2022	36	387	Balearic Islands, Sardinia, Tyrrhenian Sea, Sicily, Malta Islands and Lampedusa, Western Ionian Sea, Adriatic Sea, Crete, Western Aegean Sea, Eastern Aegean Sea, Cyprus
<i>Gobius couchi</i> Miller & El-Tawil, 1974; Gobiidae	Stefanni and Mazzoldi, 1999; Kovačić, 2001a, 2005; Kovačić and Golani, 2007a; Liu <i>et al.</i> , 2009a; Özen <i>et al.</i> , 2009; Šanda and Kovačić, 2009; Kovačić <i>et al.</i> , 2011, 2012b, 2013; Engin <i>et al.</i> , 2016a; Iglésias, 2021b; Santin <i>et al.</i> , 2021; Renoult <i>et al.</i> , 2022	24	60	Spanish Mediterranean coast east of Alboran Sea, Balearic Islands, French Mediterranean coast, Ligurian Sea, Adriatic Sea, Eastern Ionian Sea, Eastern Aegean Sea, Crete, Cyprus

Table 2. Continuation

Species; family	Publications with positive findings	Number of localities from publications	Number of individuals from publications	Geographic distribution in the Mediterranean
<i>Gobius roulei</i> de Buen, 1928; Gobiidae	de Buen, 1928; Kovačić, 1995, 2001b; Ahnelt and Dorda, 2004; Lipej <i>et al.</i> , 2005; Kovačić and Golani, 2006; Fischer <i>et al.</i> , 2007; Liu <i>et al.</i> , 2009b; Kovačić <i>et al.</i> , 2012b, 2022a; Engin <i>et al.</i> , 2016a; Kovačić and Schembri, 2019	25	669	Balearic Islands, French Mediterranean coast, Ligurian Sea, Malta Islands and Lampedusa, Adriatic Sea, Eastern Aegean Sea, Cyprus
<i>Marcelogobius splechnai</i> (Ahnelt & Patzner, 1995); Gobiidae	Ahnelt and Patzner, 1995; Stefanni, 1999; Herler and Patzner, 2002; Ahnelt and Dorda, 2004; Fischer <i>et al.</i> , 2007; Francour, 2008; Kovačić <i>et al.</i> , 2011, 2012b, 2021b; Colombo and Langeneck, 2013; Engin <i>et al.</i> , 2016a; Bussotti <i>et al.</i> , 2017; Iglésias <i>et al.</i> , 2020, 2021b; Ragkousis <i>et al.</i> , 2021	34	90	Balearic Islands, French Mediterranean coast, Sardinia, Sicily, Malta Islands and Lampedusa, Tyrrhenian Sea, Adriatic Sea, Western Aegean Sea, Eastern Aegean Sea, Crete
<i>Millerigobius macrocephalus</i> (Kolombatović, 1891); Gobiidae	Kolombatović, 1891; Bath, 1973; Gandolfi <i>et al.</i> , 1977; Miller, 1977; Ramos Espla and Perez-Ruzafa, 1987; Bouchereau and Tomasini, 1990; Ahnelt and Patzner, 1996; Patzner, 1999; Bouchereau 2002; Kovačić, 2005; Lipej <i>et al.</i> , 2005; Fischer <i>et al.</i> , 2007; Bogorodsky <i>et al.</i> , 2010; Kovačić <i>et al.</i> , 2011, 2012a, 2012b, 2013, 2021b, 2024a, 2024c; Vanhove <i>et al.</i> , 2011; Engin <i>et al.</i> , 2016a; Giacobbe <i>et al.</i> , 2016; Trkov <i>et al.</i> , 2019; Glavičić <i>et al.</i> , 2020; Kara and Yuksek 2023; Langeneck <i>et al.</i> , 2023	63	454	Spanish Mediterranean coast east of Alboran Sea, French Mediterranean coast, Corsica, Ligurian Sea, Sicily, Malta Islands and Lampedusa, Adriatic Sea, Western Ionian Sea, Western Aegean Sea, Marmara Sea, Eastern Aegean Sea, Crete, Cyprus, Eastern Levantine Sea
<i>Odondebuena balearica</i> (Pellegrin & Fage, 1907); Gobiidae	Pellegrin and Fage, 1907; Miller and Tortonese, 1968; Escoubet <i>et al.</i> , 1981; Ahnelt <i>et al.</i> , 1994; Ahnelt and Dorda, 2004; Kovačić, 2005; Kovačić and Golani, 2007a; Kovačić <i>et al.</i> , 2012a, 2012b, 2021b, 2024a; Glavičić <i>et al.</i> , 2016, 2020; Consoli <i>et al.</i> , 2019; Kovačić and Schembri, 2019; Stern <i>et al.</i> , 2019; Ordines <i>et al.</i> , 2019a; Gerovasileiou <i>et al.</i> , 2020	61	507	Spanish Mediterranean coast east of Alboran Sea, Balearic Islands, French Mediterranean coast, Sicily, Malta Islands and Lampedusa, Tyrrhenian Sea, Western Ionian Sea, Adriatic Sea, Western Aegean Sea, Eastern Aegean Sea, Cyprus, Eastern Levantine Sea
<i>Pseudaphya ferrerii</i> (de Buen & Fage, 1908); Oxudercidae	de Buen and Fage, 1908; Fage, 1910; Mortara, 1918; de Buen 1918; Miller, 1973b; Kovačić, 2003; Kovačić and Golani, 2007b; Kovačić <i>et al.</i> , 2012b; Dimitriadis <i>et al.</i> , 2015; Engin <i>et al.</i> , 2016a; Perez-Mayol <i>et al.</i> , 2021; Riera-Batle <i>et al.</i> , 2023	34	340	Spanish Mediterranean coast east of Alboran Sea, Balearic Islands, Adriatic Sea, Eastern Aegean Sea, Eastern Levantine Sea, South Levantine Sea

Table 2. Continuation

Species; family	Publications with positive findings	Number of localities from publications	Number of individuals from publications	Geographic distribution in the Mediterranean
<i>Thorogobius ephippiatus</i> (Lowe, 1839); Gobiidae	Riedl, 1966; Miller, 1969b; Schultz, 1975; Kovačić, 1997; Patzner, 1999; Arko-Pijevac <i>et al.</i> , 2001; Lipej <i>et al.</i> , 2005; Kovačić <i>et al.</i> , 2011, 2012b, 2021b; Gerovasileiou <i>et al.</i> , 2015; Engin <i>et al.</i> , 2016a; Glavičić <i>et al.</i> , 2016; Stern <i>et al.</i> , 2018; Trkov <i>et al.</i> , 2019; Ragkousis <i>et al.</i> , 2021; Borg <i>et al.</i> , 2022; Renoult <i>et al.</i> , 2022	43	67	Balearic Islands, French Mediterranean Coast, Corsica, Sardinia, Tyrrhenian Sea, Adriatic Sea, Western Aegean Sea, Eastern Aegean Sea, Crete, Cyprus, Eastern Levantine Sea
<i>Thorogobius macrolepis</i> (Kolombatović, 1891); Gobiidae	Kolombatović, 1891 (the number of types based on Fricke <i>et al.</i> , 2025); Miller, 1969b; Ahnelt and Patzner, 1996; Ahnelt and Kovačić, 1997; Patzner, 1999; Arko-Pijevac <i>et al.</i> , 2001; Guidetti <i>et al.</i> , 2006; Fischer <i>et al.</i> , 2007; Kovačić <i>et al.</i> , 2012a, 2024a; Colombo and Langeneck, 2013; Engin <i>et al.</i> , 2016a; Glavičić and Kovačić, 2016; Glavičić <i>et al.</i> , 2016; Bilecenoglu and Yokes, 2016; Trkov <i>et al.</i> , 2019; Renoult <i>et al.</i> , 2022	48	66	Balearic Islands, French Mediterranean coast, Ligurian Sea, Corsica, Malta, Adriatic Sea, Eastern Aegean Sea, North Levantine Sea
<i>Vanneaugobius dollfusi</i> Brownell, 1978; Gobiidae	Pallaoro and Kovačić, 2000; Ahnelt and Dorda, 2004; Kovačić, 2008; Glavičić and Kovačić, 2016; Glavičić <i>et al.</i> , 2016; Consoli <i>et al.</i> , 2019; Kovačić and Schembri, 2019; Ordines <i>et al.</i> , 2019a; Iglésias <i>et al.</i> , 2020; Kovačić <i>et al.</i> , 2022a; Kovačić and Froglija, 2023	43	75	Balearic Islands, Sicily, Malta Islands and Lampedusa, Adriatic Sea, Western Aegean Sea, Eastern Aegean Sea
<i>Zebrus zebrus</i> (Risso, 1827); Gobiidae	Risso, 1827; Kolombatović, 1891; Miller, 1977; Ahnelt, 1990, 1991; Ahnelt and Patzner, 1996; Kovačić, 1997; Patzner 1999; Kovačić <i>et al.</i> , 2005, 2012a, 2012b, 2013, 2021b, 2021c, 2024a, 2024c; Fischer <i>et al.</i> , 2007; Mejri <i>et al.</i> , 2007; Bogorodsky <i>et al.</i> , 2010; Bilecenoglu <i>et al.</i> , 2014; Glavičić <i>et al.</i> , 2016, 2020; Kesici and Daylan, 2019; Trkov <i>et al.</i> , 2019	82	430	Spanish Mediterranean coast east of Alboran Sea, Balearic Islands, French Mediterranean coast, Ligurian Sea, Corsica, Sardinia, Sicily, Malta Islands and Lampedusa, Adriatic Sea, Western Aegean Sea, Marmara Sea, Eastern Aegean Sea, Northern Levantine Sea, Eastern Levantine Sea, Tunisian coast, Algerian coast

the described new species of all other Mediterranean fish families together in this century (Kovačić, 2020; Kovačić *et al.*, 2021a). This disproportion shows that the Mediterranean diversity of gobies is understudied

as compared to Mediterranean marine fishes in general. The majority of still elusive species belonged to Oxudercidae (Table 1), although they represent just less than 2/5 of the Mediterranean total diversity of gobies. On

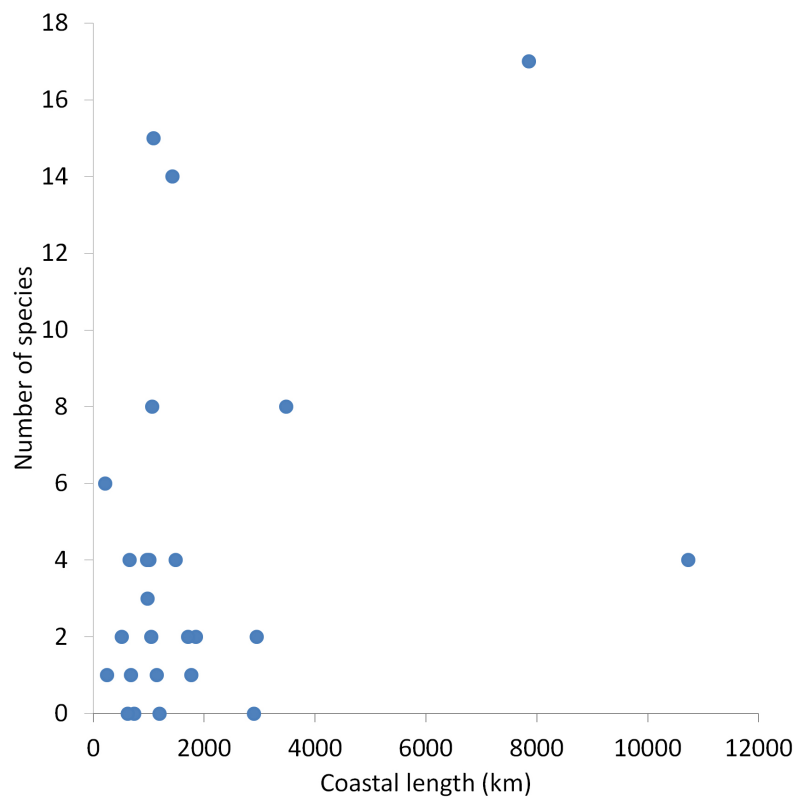


Fig. 3. The number of the Mediterranean elusive species (Table 1) in each area compared to the coastal length of each area.

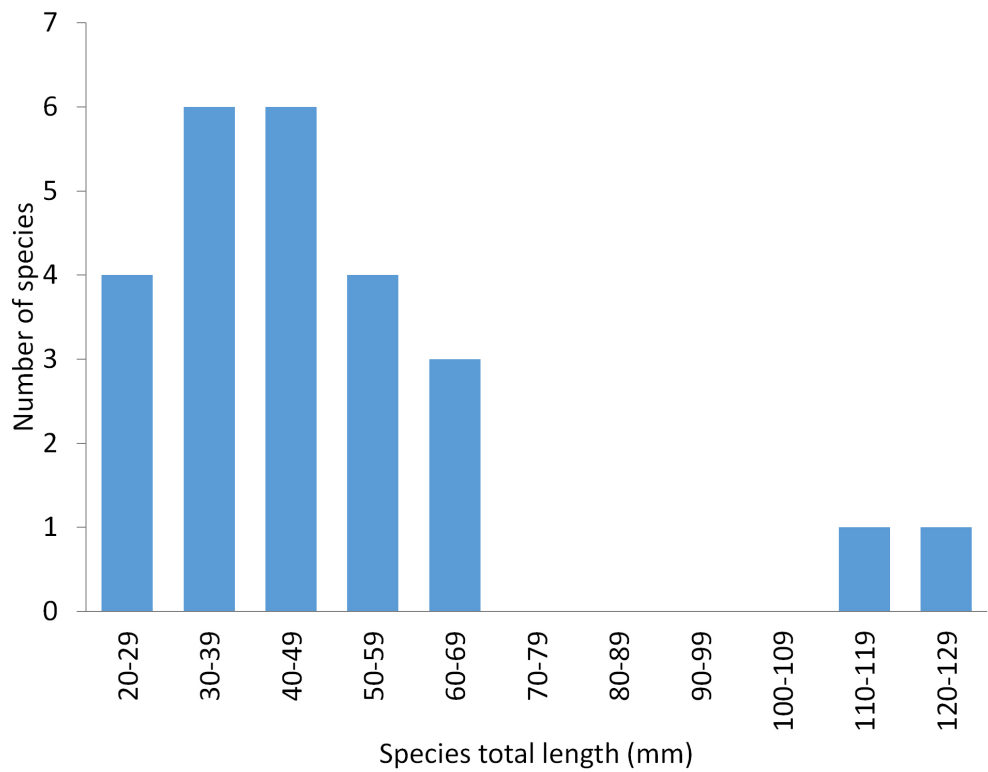


Fig. 4. Length distribution of elusive Mediterranean gobies.

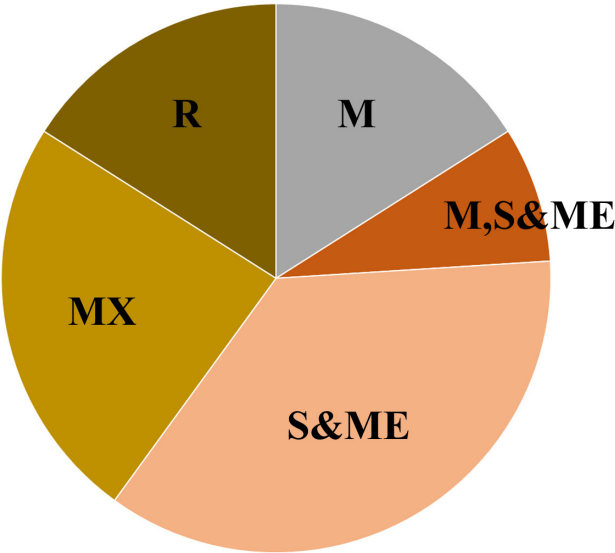


Fig. 5. Bottom habitat tolerance of elusive Mediterranean gobies as the number of species for each range of bottom. Bottom habitats: M - mud; M, S& ME - mud, sand or/and maerl; S& ME - sand or/and maerl; MX - mixed-substrate bottom; R - rocky bottom.

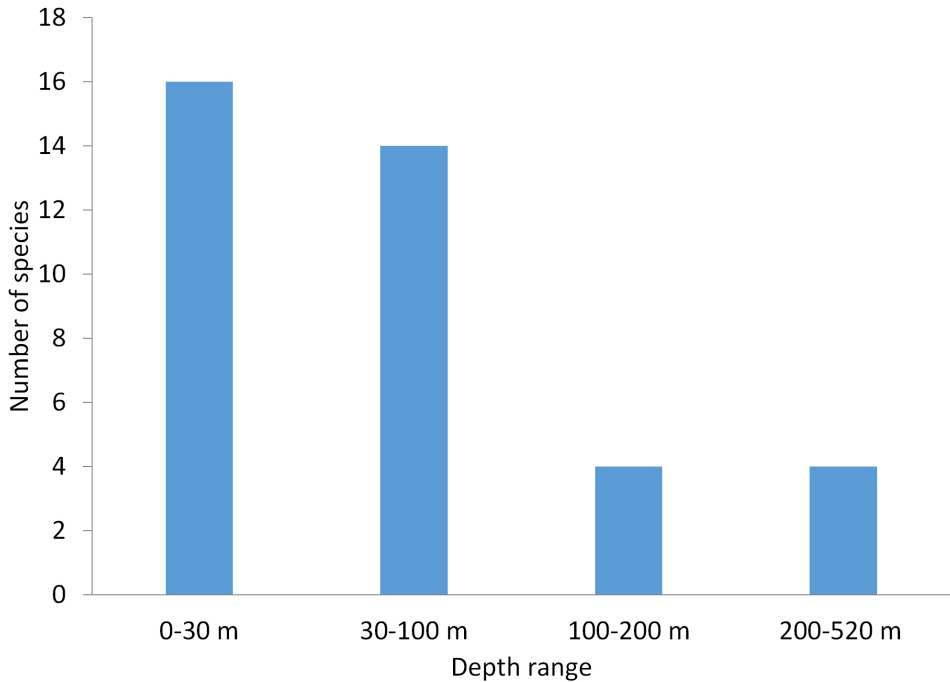


Fig. 6. Number of elusive Mediterranean species of gobies at each depth range.

the contrary, the increased reporting of species formerly considered rare mainly happened to Gobiidae (Table 2). The only shared species trait among the elusive Mediterranean gobies is their very small size (Fig. 4), while various species occur variably at different bottom types and at different depths (Figs. 5 and 6), with species richness of elusive Mediterranean gobies decreasing by depth

proportionally to species richness of all Mediterranean gobies (Kovačić and Patzner, 2011). The geographic presence of elusive Mediterranean gobies is, most probably, a sampling artefact related to research intensity for particular area. The Adriatic Sea, the Balearic Islands, French Mediterranean coast and Eastern Aegean Sea feature the highest diversity of elusive gobies and, fur-

ther, these areas have the most numerous new records of species that were previously considered rare (Tables 1 and 2, Fig. 1). Thus, these areas differ from others mainly by the comparatively large number of published studies. Although many other researchers also contributed in each area, studies done by Robert A. Patzner and his collaborators or Francesc Ordines and his collaborators at the Balearic Islands, by Samuel Iglesias, Julien P. Renoult and their collaborators along French Mediterranean coast, by Harald Ahnelt and Marcelo Kovačić and their collaborators in the Adriatic Sea or by Semih Engin and his collaborators or Murat Bilecenoglu and his collaborators in the Eastern Aegean Sea, changed the knowledge on elusive gobies within a decade or two in each of these areas (references in Tables 1 and 2). The almost complete absence of positive records of elusive species of Gobiidae and Oxudercidae from the southern Mediterranean coastline is most likely related to the lack of research with adequate methods (Fig. 1). It matches the low species richness already found for these areas for gobies in general by Kovačić and Patzner (2011). The size of areas, at least of their estimated coastal length, did not correlate with elusive goby species richness (Fig. 3). The applied geographic subdivision of Mediterranean Sea (see Material and methods), unequal in the coastline length (Supplement Table S1) and in the surface of continental shelf bottom (Fig. 1), is a compromise between the bottom surface size and isolation of continental shelves. Surface area of the continental shelf bottom should be a better geographic variable for the geographical distribution of littoral and upper bathyal benthic animal taxa than the entire sea surface area or just the coastline length of an area.

The rareness of Mediterranean fishes

Among Mediterranean fish families in general, elusive species, mostly labeled as “rarely reported” (e.g., Ragkousis *et al.*, 2021), “uncommon” (e.g., Langeneck *et al.*, 2023) or simply “rare” (e.g., Tiralongo *et al.*, 2020) in published records, are present across various fish families. However, fish species records accompanied by a review of all published records of a reported species that actually demonstrate that a particular fish species is elusive in the Mediterranean, like reviews provided by Bello (2018) or Galasso *et al.* (2024), are quite rare. Considering the lack of similar published reviews for the wide variety of Mediterranean fish taxa, these publications are insufficient as a source for the general overview of either elusiveness or real rareness among the Mediterranean fishes. To investigate the pattern of elusiveness across habitats, habitus, or taxonomy for all Mediterranean fishes, the only available data source are published summary checklists. Among the checklists or summaries on Mediterranean fishes published over the last half century (Quignard, 1978; Fredj and Maurin, 1987; Quignard and Tomasini, 2000; Psomadakis *et al.*, 2012; Kovačić *et al.*, 2021a), only the checklist for

the North-Eastern Atlantic and Mediterranean by Hureau and Monod (1973) contained comments about the rareness of each species written by the expert for each of the fish families, but these accounts were based on expert opinions rather than on quantitative data. Nevertheless, this estimated rareness is the best available proxy for elusiveness, since all fishes considered rare are not necessary really rare, but all of them are elusive, at least at the time of the publication (see Introduction). From about 550 native Mediterranean species known half a century ago, 74 were considered rare (Hureau and Monod, 1973). The rare Mediterranean fishes in Hureau and Monod (1973) mostly belonged to cryptobenthic or deep-living or rather large species (82.4% of all species labeled rare) (Fig. 7). Indeed, out of 74 rare native Mediterranean species, 24 species feature a cryptobenthic lifestyle, 19 are deep sea fishes (4 mesopelagic, 6 bathypelagic and 9 bathyal benthic species) and 18 are large Elasmobranchii (15 species) or Acipenseriformes (3 species) fishes (Fig. 7). Among cryptobenthic fishes, small species, followed by snake-like ones, dominated, with one third of rare cryptobenthic fishes being gobies. The habitats of cryptobenthic and deep sea fishes are understudied by adequate methodology, thus, species from those habitats are most likely elusive and not really rare. However, large Elasmobranchii and Acipenseriformes might be truly rare, as they occur naturally as small-sized population or their population have been decimated by human impact. Species rarity is closely related to extinction risk (Hartley and Kunin, 2003). In the European seas, large fish species, predominantly sharks, rays and sturgeons, are also the most threatened group with extinction among all marine fishes (Fernandes *et al.*, 2017). Among the remaining Mediterranean fishes considered rare in Hureau and Monod (1973), five species were littoral and eight species were epipelagic fishes. Some of the remaining species can be attributed to a group of large bony fishes, sharing the overall characteristics of large Elasmobranchii and Acipenseriformes; some are tropical to subtropical Atlantic fishes, with the Mediterranean being on the edge of their geographic distribution, whereas for the remaining ones of them, there is no apparent shared characteristic of habitat, habitus, geography or taxonomy that could explain putative rareness. An updated quantitative review of records is needed for all Mediterranean elusive fish species, as initial data for any discussions on their rareness and for the proper extinction risk assessments. This kind of data is not available in the IUCN assessments (IUCN, 2025), but should be part of future species assessments and reviews.

The changing knowledge on the elusive Mediterranean gobies

The numerous new records of “rare” species of gobies (references in Tables 1 and 2) since the turn of the century further confirm the historical research deficien-

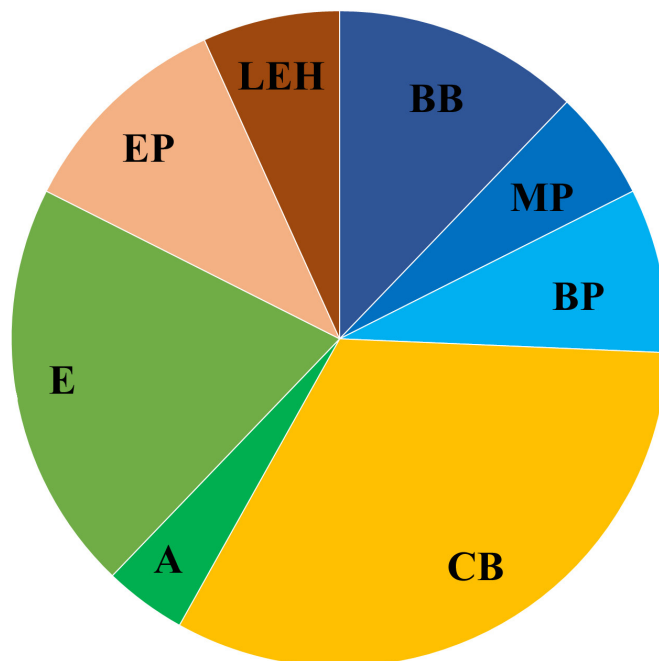


Fig. 7. Mediterranean fish species considered rare by Hureau and Monod (1973): CB - cryptobenthic fishes; deep sea fishes: MP - mesopelagic, BP - bathypelagic, and BB - bathyal benthic species; large fishes: E - large Elasmobranchii, A - Acipenseriformes; other fishes: LEH - littoral epibenthic and hyperbenthic, EP - epipelagic.

cy resulting in large knowledge gaps on Mediterranean gobies (Fig. 8). Therefore, the high number of 25 elusive species among them (Table 1) is not surprising and it is most likely not the result of true rareness. This is in line with the fact that some of the species considered to be rare a few decades ago (Ahnelt, 1990; Ahnelt *et al.*, 1994) are now excluded from the list (Table 2), based on the numerous published findings in this century, e.g., see *Chromogobius zebratus* (Kolombatović, 1891), *Coryrogobius liechtensteini* (Kolombatović, 1891), *Millerigobius macrocephalus* (Kolombatović, 1891), *Odondebuenia balearica* (Pellegrin & Fage, 1907), or *Zebrus zebrus* (Risso, 1827) in Table 2. For some species, many new records were brought about just in the last decade, like *Chromogobius quadrivittatus* (Steindachner, 1863), *Vanneaugobius dollfusi* Brownell, 1978 or *Marcelogobius splechnai* (Ahnelt & Patzner, 1995) (Table 2). Some other species, like *Gammogobius steinitzi* Bath, 1971, *Pomatoschistus bathi* Miller, 1982 or *Pomatoschistus quagga* (Heckel, 1837) are on the edge of the arbitrary set thresholds for elusiveness in this paper, i.e., with one criterion recently approaching the threshold, other two already surpassing them (Table 1 and references therein).

The total number of elusive Mediterranean species of gobies has been shown to be dynamic over time and appears to be affected by two opposite research-related processes: by the unlabelling a species as elusive based on advances in research and collecting (Table 2) and by

the description of scientifically new species yet lacking established natural history knowledge (e.g., recently described *Gobius xoriguer* Iglésias, Vukić & Šanda, 2021 or *Zebrus pallaoroi* Kovačić, Šanda & Vukić, 2021, see Table 1). *Coryrogobius liechtensteini* was known only from the species description for about a hundred years (Ahnelt *et al.*, 1994; Table 2), while all other findings of this species were reported over the last three decades. *Odondebuenia balearica*, although without a century long gap between its original description and the next record, was also rarely reported (Table 2). However, quantitative studies on cryptobenthic fishes in the Adriatic Sea showed these two species as not just common, but as the most abundant fish species in various cryptic bottom habitats (e.g., *C. liechtensteini* in Glavičić *et al.* (2016) and Kovačić *et al.* (2021b), *O. balearica* in Kovačić *et al.*, 2012a, 2024a). Nevertheless, gobies remain to represent the most significant portion of still elusive Mediterranean fish species up to today. However, the still elusive goby species are most likely not rare, as discussed previously. Both characteristics, rareness and elusiveness, are crucial for species conservation. The rarity is widely used to predict the vulnerability of species to extinction (Harnik *et al.*, 2012), since it is considered a high risk factor for extinction. Elusiveness is often an obstacle for species conservation assessment, generally resulting in labelling an elusive species account as data deficient. While rareness is a genuine species trait and mostly permanent, elusiveness rather reflects human

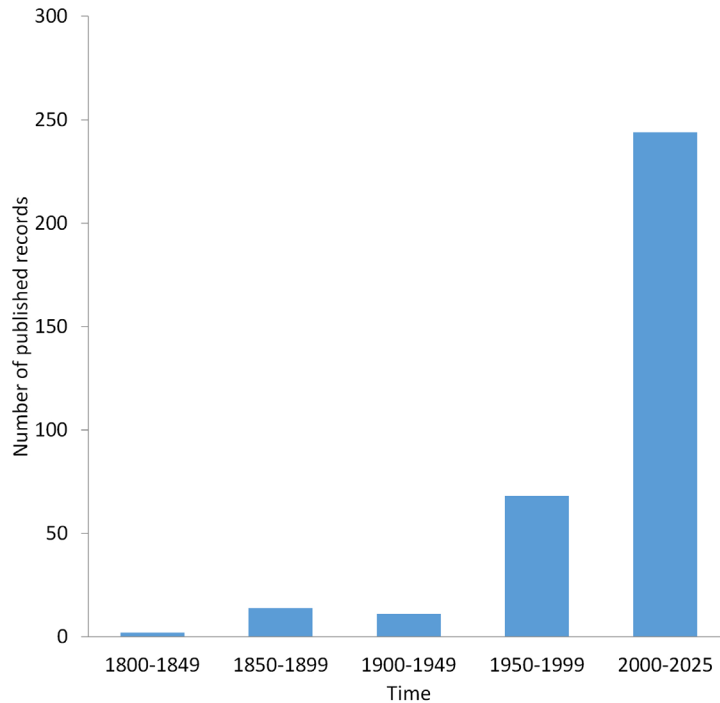


Fig. 8. Total number of published records of elusive species of gobies (Table 1) and of those previously considered rare (Table 2) presented in half centuries. Note that the last period covered only half of that time range.

knowledge and can be rejected with the updated information. Although rareness is assigned to species based on the available data (Rabinowitz, 1981), in ultimate consistency with the scientific principle of falsifiability, species' rareness can only be positively disproved and not proved. Contrary to the theoretical problem of recognizing rareness, species' elusiveness can be proved considering a low number of published findings as a metric, but it is confronted with the practical problem for rejection of elusiveness. Many published findings are needed for evidence-based rejection of species elusiveness. Manuscripts with positive species new records as a single piece of information are hardly publishable, except if the record expands a species' geographic distribution and those published extensions of the species' geographic distribution are usually not numerous to dismiss the species as being elusive.

Numerous examples regarding Mediterranean gobies have shown that species remain to be known from just a few reported individuals over decades (Tables 1 and 2). Collective papers with the multispecies records (collective ichthyological articles for France in Cybium like from Iglésias *et al.*, 2025 or collective articles on new records of Mediterranean flora and fauna in Mediterranean Marine Science like from Tsagarakis *et al.*, 2021), papers focused on the single species distribution (e.g., Kovačić *et al.*, 2023b), and papers based on the extensive survey of a particular fish family from numerous localities in a particular area (e.g., family Gobiidae

in Engin *et al.*, 2016a) could be a means to increase the published knowledge on the presence of Mediterranean fish species and, consequently, potentially dismiss their elusiveness. In recent years, the increased focus of SCUBA divers interested in small benthic fishes, both ichthyologists and interested amateurs, is reflected in these publications (Kovačić *et al.*, 2022a; Tables 1 and 2, Fig. 7). The present review represents also the rigid scrutinization (see Material and methods) of positive Mediterranean records for the species of gobies that are presented in Table 1 and 2, which all together represent about half of the total known Mediterranean species richness of gobies. Hopefully, the increase of our knowledge on small cryptic Mediterranean fishes remains fast enough to render the data for some of the listed species in the present work soon already outdated.

ACKNOWLEDGMENTS

I thank Harald Ahnelt, Lovrenc Lipej and Ulrich K. Schliewen for the valuable comments and advices on the manuscript. I am sincerely grateful to the reviewers and to the editors for their effort and time invested in the improving and correcting of the manuscript. I thank the following colleagues for their photos: Mark-Anthony Falzon, Francisc Ordines and Jim Van Tassel. The present work has been supported by the grant of the Croatian Science Foundation under the project IP-2022-10-7542.

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