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Tahir Özcan
Iskenderun Technical University, tahir.ozcan@iste.edu.tr,
Antakya-Türkiye
Burak Ali Çiçek
Eastern Mediterranean University, burak.cicek@emu.edu.tr,
Famagusta-North Cyprus
Semih Kale
Çanakkale Onsekiz Mart University, semihkale@comu.edu.tr,
Çanakkale-Türkiye

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ORCID ID	0000-0002-9278-4150	0000-0001-6144-1721
	0000-0001-5705-6935	
Corresponding Author	Tahir Özcan	

OCCURRENCE OF THE MOLE CRAB *ALBUNEA CARABUS* (LINNAEUS, 1758) (DECAPODA: ANOMURA: HIPPOIDEA) FROM THE COAST OF CYPRUS AND DISTRIBUTION IN THE MEDITERRANEAN SEA

ABSTRACT

The present paper reports the first occurrence of *Albunea carabus* time on the Levantine Sea coasts of Cyprus. This record is based on two adult males and two adult females collected by dreging on a sandy bottom at the depths between 5 and 6 m depth. Also, this 2025 review of the rare mole crab distribution along the whole Mediterrean Sea. As a result of the compilation of published studies, it is reported that this species is distributed on the coasts of 11 different Mediterranean countries, mainly in sandy areas. It was noted that the number of individuals recorded was low, with the exception of one (dead individual on the beach).

Keywords: *Albunea carabus*, Distribution, Occurrence, Decapoda, Cyprus, Mediterranean Sea

1. INTRODUCTION

The members of the Superfamily Hippoidea are commonly referred to as sand crabs or mole crabs [1 and 2]. These are marine crustaceans found along tropical and subtropical coastlines around the world, although some are found in temperate climates. Their adults are specialised in digging and living in sandy substrates [2]. Worldwide, the family Albuneidae (Hippoidea) contains 48 species in nine genera [3]. The rare mole crab *Albunea carabus* (Linnaeus, 1758) occurs also on some regions of African coasts (in the Eastern Atlantic, from Azores, Madeira, Portuguese Guinea, Liberia, Ghana, Cape Verde, southward to Dahomey), Algarve, South Portugal and in the Mediterranean Sea [4, 5 and 6]. The mole crab is the only species of the Albuneidae (Hippoidea) represented in the Mediterranean Sea [7, 8, 9 and 10]. The mole crab, *A. carabus* was first reported in the Mediterranean by Linnaeus in 1758 [11]. In the Mediterranean Sea ecosystems, the species has been distributed from the coast of Algeria [5, 12, 13 and 14], Tunisia [5, 7 and 15], Libya [16], Egypt [17], Israel [4, 5, 18 and 19], Lebanon [5], the southeastern coasts of Türkiye [20, 21 and 22], Greece [23], Italy [2, 10 and 24-33] and along the coast of Spain [2, 7 and 34-38]. It is a species of 'sand crab' that nests on sandy bottoms characterised by high turbidity and remarkable hydrodynamics, with typical habitats at depths ranging from

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0.1 to 50 m [8, 23 and 39]. The aim of this paper is to report new information on the first record of the rare mole crab, *A. carabus*, from the coast of Cyprus, to report the rarity of individuals reported from the entire Mediterranean ecosystem since Linnaeus' record date, and to provide information on the ecological preferences and barriers to its rarity in the Mediterranean. The distribution of records for the species in Mediterranean waters also needs to be updated.

2. RESEARCH SIGNIFICANCE

This study investigated the current distribution of *A. carabus* in the Mediterranean and its first record from the coast of Cyprus.

Highlights:

- The current distribution of *A. carabus* in Mediterranean Sea was determined.
- The relationship between the potential distribution of *A. carabus* and its habitat preferences has been demonstrated.
- The habitat and individual density distribution of *A. carabus* in the Mediterranean has been demonstrated.

3. MATERIALS AND METHODS

According to the available literature (Web of Sciences, Google Scholar, Researchgate, etc.), an attempt was made to determine the zoogeographic distribution and population status of *A. carabus* reported in the Mediterranean Sea ecosystem. During Cyprus benthic surveys carried out off Cyprus coast, Levantin Sea, two male and two female specimens of *A. carabus* were captured on May, 2018 on sandy bottom at a depth range between 5 and 6 m (GPS coordinates: 35°20'52.13"N -33°15'14.38"E and 35°16'58.92"N -33°56'45.84"E) (Figure 1).

Figure 1. Sampling station of *Albunea carabus* North Cyprus coast

The specimens were identified by following the studies of Boyko (2002) [5], and Falciai and Minervini (1992) [8], and photographed (Figure 2). The specimens have carapace length (CL) between 18,2 and 21.5 mm are now preserved at the Faculty of Arts and Sciences, Department of Biological Sciences (in collection of Dr. B.A. Çiçek) of the Eastern Mediterranean University, North Cyprus.

Figure 2. *Albunea carabus* (Linnaeus, 1758) male, North Cyprus, the Mediterranean Sea [photo by Dr. B.A. Çiçek]

4. RESULTS AND DISCUSSION

The species appears to be widespread in the Mediterranean (especially along the Italian coast), but it has not yet been reported from several coasts, such as the Ionian, Aegean and Adriatic Sea (Tablo 1) (Figure 3). All the records of *A. carabus* in the Mediterranean Sea, including those from our surveys and from the literature, are summarised in Table 1.

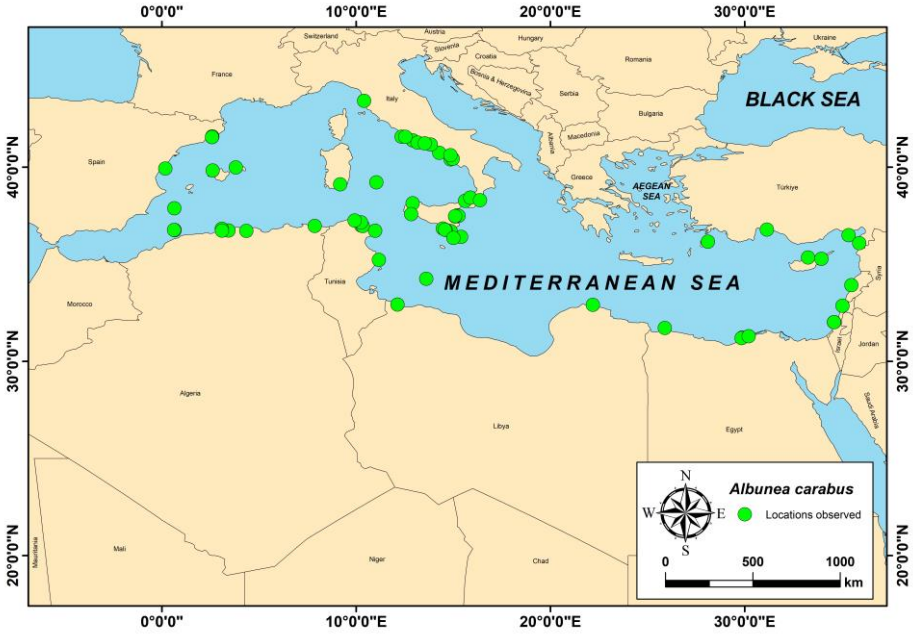

Figure 3. Location of records of *Albunea carabus* in the Mediterranean Sea coast

According to the literature review, the species was first reported from the Mediterranean in 1758 [11] and then in 1814 from the coasts of Sicily, Italy [25]. After these records it has been reported from the Mediterranean coasts of 10 different countries and the most recent record in this study is from the coast of Cyprus (Figure 3). It can be seen that most of these records come from the coasts of Italy. It can also be seen that there are no records of the species in the Aegean, Adriatic and Black Seas. Together with this study, 72 records

of this species in the Mediterranean ecosystem have been reported in a total of 37 studies published so far. Only 22 of these records gave information on the biotope in which the species was found. Rocky in one of them, sandy, mud and detritus in another, sandy muddy in another, sandy biotope in the other 17 records and biotope was not specified in all the others (Figure 4-5).

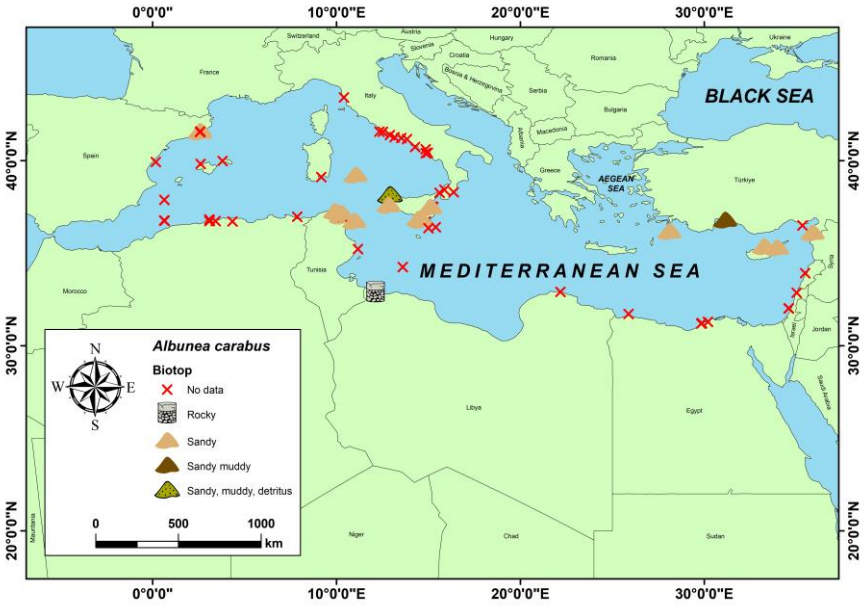

Figure 4. Biotope characteristics of the location of records of *Albunea carabus* in the Mediterranean Sea

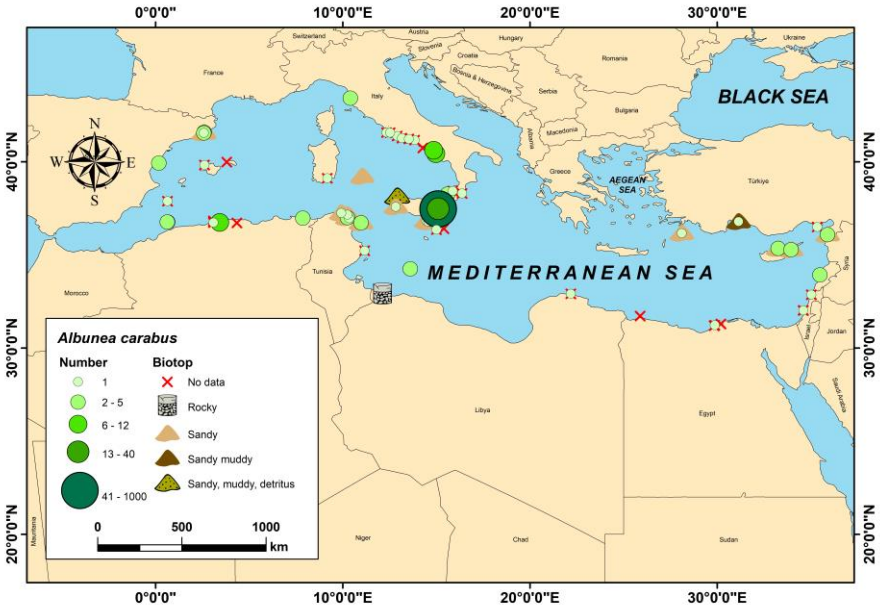

Figure 5. Number of individuals and biotope structure of the location of *Albunea carabus* records in the Mediterranean Sea

In the Mediterranean ecosystem, the number of individuals was given in 60 of the 72 records of this species. In 37 of them 1 individual, in 11 of them 2 individuals, in 2 of them 3 individuals, in 4 of them 4 individuals, in one of them 5 individuals, in one of

them 9 individuals, in one of them 10 individuals, in one of them 12 individuals, in one of them 12 individuals, in one of them 40 individuals and in one of them thousands of individuals (Sicily, Italy). In 18 of them only male, in 18 only female and in 11 both male and female individuals were given, in the others neither sex nor individual was given (Figure 6-7).

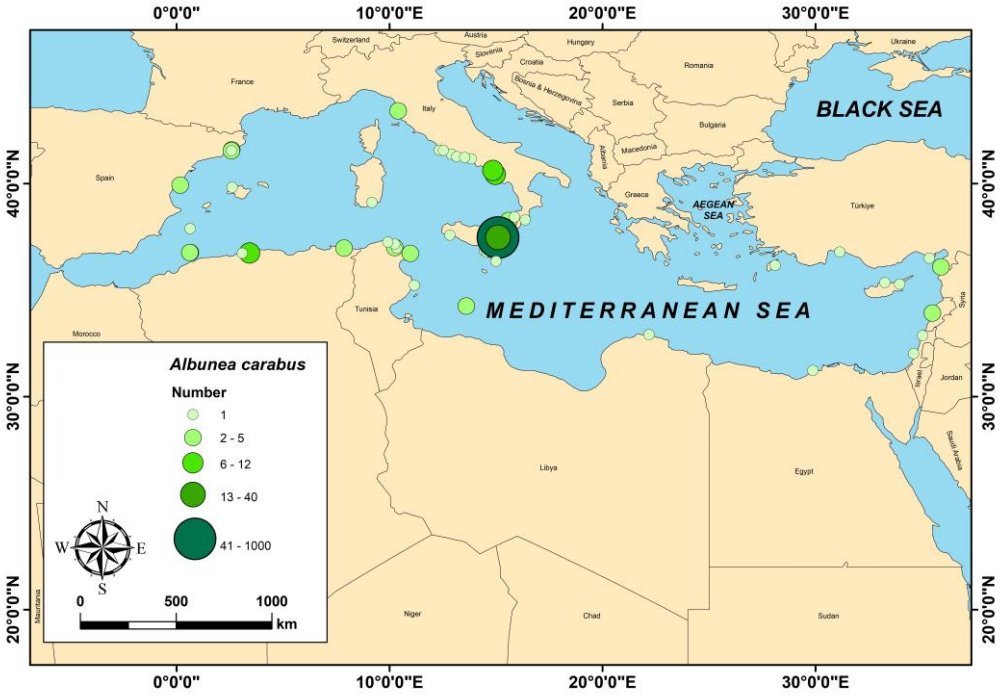

Figure 6. Number of individuals of the location of *Albunea carabus* records in the Mediterranean Sea

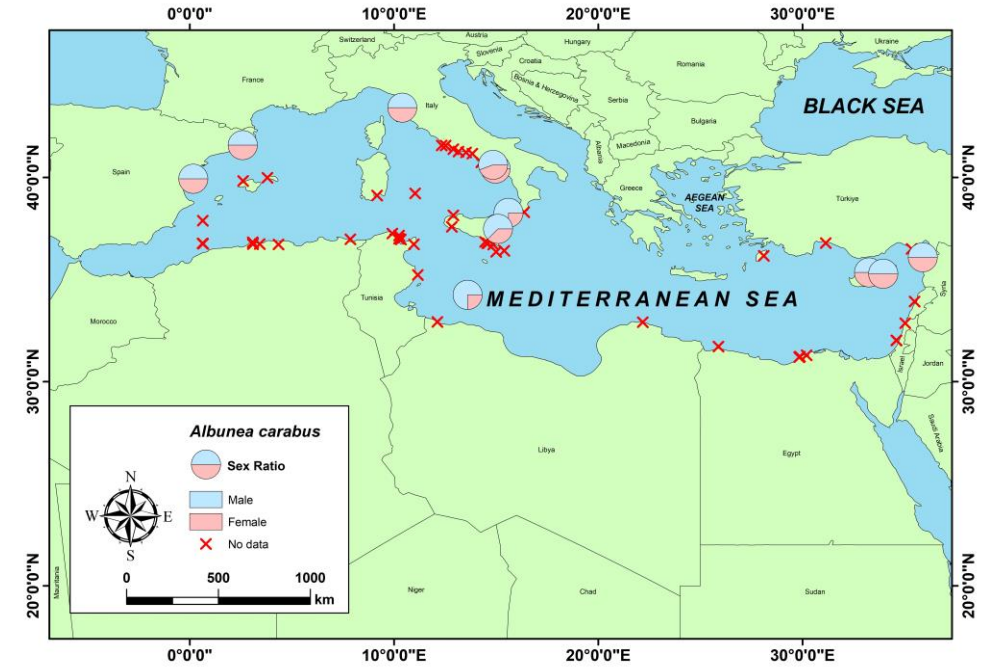

Figure 7. Sex of the location of *Albunea carabus* records in the Mediterranean Sea

Table 1. Updated Mediterranean records of *Albunea carabus* (R:Record of year; D:Depth (m); B:Biotope (S:Sand, Sn:Sandy, M:Mud, Md:Muddy, R:Rocky, Dtr:Detritus); N:Number of Individuals; M:Male; F:Female; CL:Carapace Length (mm))

Region	Country	R	L	Coordinate	D	B	N	M	F	CL
	Mediterraean	1758	1	36°47'38''N 3°05'28''E						
Kingdom of Naples	Italy		2	40°44'17''N 14°16'26''E						
Sicily	Italy	1814	3	36°24'35''N 15°23'50''E						
Cap Matifou, Alger	Algeria	1840-1842	4	36°44'28''N 3°25'15''E			5			
Cap Matifou, Alger	Algeria	1850	5	36°44'28''N 3°25'15''E	30-40		12		1	
Catania	Italy	1857	6	37°31'21''N 15°11'35''E			1			
Menorca	Spain	1874	7, 8	39°59'16''N 3°47'52''E						
Oran	Algeria	July 1881	24	35°46'00''N 0°38'25''E			2	2		12,1-13,3
Oran	Algeria	1881	24	35°45'01''N 0°38'47''E			1		1	18,6
Oran	Algeria	1881	9	35°46'00''N 0°37'02''E			2			
Rade de Bône	Algeria	1908	24	36°58'32''N 7°51'32''E	15-20		3		3	13,9-18,1
Bay of Catania	Italy		10	37°29'32''N 15°16'02''E	100-200		1			
Nahr-Rubin	Israel	1920	12, 14, 15, 24	32°01'328''N 34°36'07''E 32°01'328''N 34°35'12''E 32°01'328''N 34°35'46''E			1		1	17
Malaga	Spain	1933	11	36°43'14''N 4°20'26''E						
Unknown	Mediterraean	1938	13	36°49'46''N 3°04'39''E						
Between Lebon and Hussein	Algeria	June-July 1941	24	36°44'N 03°05'E	2-7		1	1		4,4
Playa de Castellón, Valencia	Spain	1961	16	39°56'01'N 0°10'06''E			2	1	1	
Lazio-eastcentral Tyrrhenian Sea	Italy	1969	17	14°15'N 13°36'E	3-4		4	3	1	16,5-19
Arenys de Mar, Barcelona	Spain	11 June 1971	24	41°32'56''N 2°34'21''E	3-7		1	1		18,6
Arenys de Mar, Barcelona	Spain	14 June 1971	18	41°32'56''N 2°34'21''E	3-7	S	1	1		20
Canet de Mar, Barcelona	Spain	23 June 1972	18	41°34'56''N 2°35'19''E	3-7	S	2	1	1	18-24

Table 1. Continued

Region	Country	R	L	Coordinate	D	B	N	M	F	CL
Canet de Mar, Barcelona	Spain	23 June 1972	24	41°34'56''N 2°35'19''E	5-7		2	1	1	18,4-23,5
Canet de Mar, Barcelona	Spain	November 1972	24	41°34'56''N 2°35'19''E	5		2	2		18,1-19,2
Bay of Tunis	Tunisia	10 November 1972	18	36°59'48''N 10°14'40''E		S	2			
Vicinity of Beirut	Lebanon	2002	24	33°55'30''N 35°29'03''E			2		2	16,3-16,6
Public Beach, Raouad	Tunisia	30 January 1973	24	36°57'59''N 10°20'05''E			1	1		14.0
Arenys de Mar, Barcelona	Spain	22 November 1973; March 1973; 3 August 1973	24	41°32'56''N 2°34'21''E	3-6		4	4		19,1-21,0
Arenys de Mar, Barcelona	Spain	8 August 1973	24	41°32'56''N 2°34'21''E	4-5		2	2		18,0-19,5
Arenys de Mar, Barcelona	Spain	27 August 1974	24	41°32'56''N 2°34'21''E	3-6		1	1		20,3
Haifa Bay	Israel	18 June 1987	24	32°51'51''N 35°01'36''E			1		1	16,5
Cala Romagueral, Mallorca	Spain	05 July 1987	19	39°49'51''N 2°36'32''E			1		1	
Gulf of Castellammare	Italy	1988	20, 25	38°08'41''N 12°54'04''E	10-800	S, M, Dtr				
Messina Straits	Italy	16-21 October 1992	21	38°16,7'N 15°36,3'E	5		4	3	1	20,0-25,0
Messina Straits	Italy	16-21 October 1992	21	38°26,1'N 15°52,8'E	20		1	1		23
Off Torvaianica	Italy	1993	37	41°34'06''N 12°20'09''E	2		1		1	
Rio Martino mouth	Italy	1994	37	41°23'N 12°54'E			1	1		
Strait of Sicily	Italy	September October 1996	22	37°34'83''N 12°49'73''E	2, 5	Sn	1	1		13
Strait of Sicily	Italy	September October 1996	22	36°50'26''N 14°27'13''E	5	Sn	1		1	15
Gulf of Cagliari	Italy	1997	37	39°07'05''N 9°10'15''E			1		1	
Gulf of Cagliari	Italy	1997-2000	28	39°13'00''N 11°02'00''E	0, 2-3, 5	Sn				
Near Castiglioncello	Italy	1999	23	43°25'N 10°24'E	5		2	1	1	
mouth of Irminio river (Ragusa)	Italy	3 May 2000	33	36°46.381'N 14°35.065'E	8	S	1	1		16,2
Sidi Barrani	Egypt	20 September 2000	30	31°43'16''N 25°52'59''E	65-66					
Qayet Bay	Egypt	21 January 2001	30	31°13'36''N 29°52'05''E	7, 5		1	1		18,9
Karataş, İskenderun Bay	Türkiye	13 April 2002	26	36°30'00''N 35°20'40''E	25		1	1		19

Table 1. Continued

Region	Country	R	L	Coordinate	D	B	N	M	F	CL
Eastern Harbor of Alexandria	Egypt	18 June 2002	30	31°11'44''N 29°50'06''E	11					
Samandağ	Türkiye	09 August 2002	27	36°05'21''N 35°53'18''E	15	Sn	2	1	1	
Roccella Jonica	Italy	2004	37	38°18,4'N 16°22,1' E	5		1	1		
southwestern coast of Sicily	Italy	Summer 2012	33	36°42'39"N 14°51'14"E			1		1	
Rhodes Island	Greece	16 June 2012	29	36°09'43''N 28°06'00''E	50	S	1		1	18,6
Murcia	Spain	3.09.2012	38	37°52'51''N 0°37'53''E			1			
Abu Qir	Egypt	25 November 2015	30	31°17'32''N 30°11'49''E	21					
Gulf of Antalya	Türkiye	May 16	34	36°47'0.98"N 31°7'58.66"E	10-20	Sn, Md	1	1		20
Gulf of Salerno	Italy	2016	37	40°24,6'N 14°51,22' E	6		1		1	
mouth of Irminio river	Italy	15 April 2017	33	36°46.229’N 14°35.491’E	6-7	S	1		1	16,6
Marina di Ragusa	Italy	5 May 2017	33	36°46.696’N 14°33.698’E	8	S	1		1	20,3
Catania (eastern Sicily)	Italy	Winter 2017	31	37°28’N 15°05’E		S	Thousand			
Catania (eastern Sicily)	Italy	February 2017	32	37°28’54"N 15°05'16"E	beach	S	40	25	15	21,2-40,2
Campania, southern Tyrrhenian Sea,	Italy	22 May 2018	33	36°21.505’N 14°59.816’E	3-4		1			
Zuwarah, west Libya	Libya	6 August 2018	35	32.924°N 12.123°E	5	R				
Gulf of Salerno, South	Italy	2018	37	40°26'N 14°58'E	2-3		10	5	5	
Gulf of Salerno, North	Italy	2018	37	40°36,84'N 14°50,90'E	3		9	5	4	
Baia Domizia	Italy	2018	37	41°09,74'N 13°49,94'E	2		1		1	
Gulf of Gaeta	Italy	2018	37	41°15,96'N 13°09,22'E	2		1		1	

Table 1. Continued

Region	Country	R	L	Coordinate	D	B	N	M	F	CL
Gulf of Gaeta	Italy	2018	37	41°13,36'N 13°31,24'E	1		1	1		
Off Torvaianica	Italy	2018	37	41°33,77'N 12°31,27'E	3		1		1	
Ghar el Melh beach	Tunisia	5 October 2019	36	37°09′20″N 10°14′31″E	0-1	S	1			
Rimel Beach at Bizerta	Tunisia	November 2019	36	37°15′23″N 9°54′52″E	0-1	S	1			
Ra's Al Hilal, East Libya	Libya	7 November 2019	35	32.911°N 22.177°E	20		1			
ras kapoudia Tunisia	Tunisia	1 October 2020	36	35°13′26″N 11°09′38″E	3		1		1	19,4
Menzel Horr	Tunisia	18 April 2021	36	36°43′26″N 10°58′17″E		S	3			
Cyprus	Northern Cyprus	May 18	39	35°20'52.13"N – 33°15'14.38"E 35°16'58.92"N – 33°56'45.84"E	5-6	S	4	2	2	18,1-21,5

* http://www.biodiversidadvirtual.org (visited on 10/4/2024)

1. (Linnaeus, 1758); 2. (Petagna, 1792); 3. (Rafinesque, 1814); 4. (Lucas, 1849); 5. (Lucas, 1853); 6. (Philippi, 1857); 7. (Larrinùa y Azcona, 1874); 8. (Bolivar, 1875); 9. (Milne-Edwards & Bouvier, 1900); 10. (Magri, 1911); 11. (Miranda Rivera, 1933); 12. (Aharoni, 1937); 13. (Gordon, 1938); 14. (Aharoni, 1944); 15. (Holthuis &Gottlieb, 1958); 16. (Zariquiey-Alvarez, 1961); 17. (Moncharmont, 1969); 18. (Rubió & Holthuis 1972); 19. (Garcia Socias & Gracia, 1988); 20. (Arculeo et al, 1988); 21. (Giacobbe & Spanò, 1996); 22. (Spanò et al., 1999); 23. (Silvestri et al., 2001); 24. (Boyko, 2002); 25. (Pipitone & Arculeo, 2003); 26. (Katagan & Çevik, 2003); 27. (Koçak et al., 2005); 28. (Mura and Corda, 2011); 29. (Corsini-Foka & Kalogirou, 2013); 30. (Abdelsalam &Ramadan, 2017); 31. (Scuderi et al., 2017); 32. (Scuderi et al., 2019); 33. (Zava et al., 2019); 34. (Gökoğlu et al., 2019); 35. (Bo et al., 2020); 36. (Enajjar et al., 2020); 37. (Froglia et al., 2021); 38. (C. Puerta*); 39. (This study)

All records of the species in the Mediterranean Sea from 1758 to the present day have been analysed, but information on the actual distribution of the species is still incomplete. *A. carabus* is mostly recorded on the infralittoral zone 0-50 m [23] but some records at the depths between 100 and 800 m [27, 29 and 40]. According to Corsini-Foka and Kalogirou (2013) [23] Except for one record [10] *A. carabus* populations in the Mediterranean have very low densities.

In previous studies, *A. carabus* reported in the Mediterranean Sea consisted of only a few individuals (max. 12 individuals [13]). However, more than a thousand crabs were reported washing ashore after a storm on the coast of Catania (eastern Sicily), Italy [2 and 10]. This is evidence that the species is well established on the coasts of Italy and Cyprus in the Mediterranean. In fact, the species is not very rare, but rather localised in a limited environment due to specific substrate requirements for its habitat [41] and has acquired some specific ecological habits.

The carapace length (CL) reported in all studies to date ranges from a minimum of 4.4 mm for males to a maximum of 40.2 mm for females. 40.2 mm male/female [2 and 5]. The carapace length of the male/female individuals examined in this study (between 18.2 mm and 21.5 mm) is consistent with the size of mole crab individuals previously reported from the Mediterranean coast.

Further scientific work is needed to understand whether the lack of records for the species in the Aegean, Adriatic and Black Seas is due to salinity, temperature or other barriers, or some other biological barrier.

The only known species of the family Albuneidae from the Mediterranean coast have rarely been the subject of scientific interest. Little is known about the distribution, biology and ecology of the Mediterranean coastal species *A. carabus* compared to decapod crustaceans. In conclusion, the results of this study and the information and observations provided by the scientists are undeniably valuable data for monitoring marine biodiversity.

NOTICE

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CONFLICT OF INTEREST

The authors declared no conflict of interest.

FINANCIAL DISCLOSURE

The authors received no financial support for the research.

DECLARATION OF ETHICAL STANDARDS

The authors of the article declare that the materials and methods used in this study do not require ethics committee approval and/or legal special permission.

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