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MAPPING STRANDED WHALES IN TURKISH MARINE WATERS

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ABSTRACT

*The distribution of whales in the Mediterranean is primarily known through stranding records. The present study maps the stranding records of whales in Turkish marine waters to highlight the number of whale species that strand and to determine the general distribution pattern of such strandings in Turkey. This is an important step in generating conservation measures. The primary data were obtained from the published literature, grey literature, and fieldwork. A total of 29 stranding records of whale species were found between 1964 and 2023, which were varied along coasts and mainly located in Iskenderun Bay in the Mediterranean and Muğla Bay in the Aegean coasts of Turkey. A total of five species and one genus were documented: the Cuvier's beaked whale *Ziphius cavirostris*, the fin whale *Balaenoptera physalus*, the sperm whale *Physeter macrocephalus*, the minke whale *Balaenoptera acutorostrata*, and True's beaked whale *Mesoplodon mirus* and *Mesoplodon sp.**

Key words: whale species, Cetacea, strandings, distributional mapping, Mediterranean, Turkey

MAPPATURA DELLE BALENE ARENATE IN ACQUE TURCHE

SINTESI

*La distribuzione delle balene nel Mediterraneo è conosciuta principalmente attraverso i dati degli arenamenti. Il presente studio mappa i ritrovamenti di balene spiaggiate nelle acque marine turche per evidenziare il numero di specie arenate e per determinare il modello generale di distribuzione di tali spiaggiamenti in Turchia. Si tratta di un passo importante per la definizione di misure di conservazione. I dati primari sono stati ottenuti dalla letteratura pubblicata, dalla letteratura grigia e dal lavoro sul campo. Per il periodo tra il 1964 e il 2023 sono state trovate 29 segnalazioni di arenamento di specie di balene, diverse lungo le coste e localizzate principalmente nella baia di Iskenderun nel Mediterraneo e nella baia di Muğla lungo le coste egee della Turchia. In totale sono state documentate cinque specie e un genere: lo zifio *Ziphius cavirostris*, la balenottera comune *Balaenoptera physalus*, il capodoglio *Physeter macrocephalus*, la balenottera rostrata *Balaenoptera acutorostrata* e i mesoplodonti di True *Mesoplodon mirus* e *Mesoplodon sp.**

Parole chiave: specie di balene, Cetacea, arenamenti, mappatura della distribuzione, Mediterraneo, Turchia

INTRODUCTION

Turkey has a coastline of more than 7,200 km, comprising the Mediterranean, Aegean, and Black Seas (Genç *et al.*, 2021). Ten whale species (Cetacea) are known to occur in Turkish marine waters, and they have all been protected since 1983 (Öztürk *et al.*, 2011). However, only a few efforts have been made to understand the whale fauna in the country's coastal waters. Strandings can be good indicators of the whale fauna of an area, although they may not represent the true composition of local populations. Nevertheless, as there are few sighting efforts and relatively rare species occurring, information obtained from strandings should not be ignored.

The whale species in Turkish marine waters are primarily known through stranding records, which have so far documented five whale species and one genus. The life history of Cuvier's beaked whale, *Ziphius cavirostris* (Cuvier, 1823), for example, is poorly known (Heyning & Mead, 2009). This cosmopolitan, deep-diving pelagic cetacean inhabits nearshore waters of all oceans (Reeves *et al.*, 2002). *Z. cavirostris* has the

largest distribution range of all beaked whale species (Heyning *et al.*, 2002). They are sucker feeders, often feeding on deep-sea cephalopods, and occasionally on fish and crustaceans (MacLeod *et al.*, 2003).

The fin whale, *Balaenoptera physalus* (Linnaeus, 1758), is a cosmopolitan species that primarily inhabits oceanic waters in both hemispheres and, less commonly, tropical waters. It only occasionally surfaces along coasts when the water is deep enough (Jefferson *et al.*, 2011). This is the only mysticete with a stable population in the Mediterranean Sea, which differs genetically from Atlantic populations (Giménez *et al.*, 2013). Fin whales are regularly observed throughout the western and central Mediterranean Sea, but are rarely seen in the Adriatic Sea and eastern parts of the Mediterranean Sea (Tonay *et al.*, 2020).

The sperm whale *Physeter macrocephalus* Linnaeus, 1758, has a wide geographic range (Rice 1989), encompassing almost all marine regions from the equator to high latitudes but displaying a preference for the continental slope and deeper water. Its range extends to many enclosed or partially enclosed seas, such as the Mediterranean Sea, the



Fig. 1: Fieldwork on protecting stranding *Balaenoptera physalus* (above) and *Physeter macrocephalus* (below left) and *Balaenoptera physalus* (below right) in Iskenderun Bay in north-eastern Mediterranean conducted by the Nature and Science Society and Iskenderun Technical University.

Sl. 1: Terensko delo sodelavcev iz organizacije Nature and Science Society in tehnične univerze iz Iskenderuna na naslednjih primerkih vrst *Balaenoptera physalus* (zgoraj) in *Physeter macrocephalus* (spodaj levo) ter *Balaenoptera physalus* (spodaj desno) v zalivu Iskenderun v severovzhodnem Sredozemskem morju.

Tab. 1: List of whale stranding reports on the coasts of Turkey (GL: grey literature, PO: personal observation by authors).**Tab. 1: Popis o nasedlih kitih ob obalah Turčije (GL: siva literatura, PO: lastna opažanja avtorjev).**

Species	Body Length (m)	IUCN Status Mediterranean	Location	Date	References
<i>Ziphius cavirostris</i>	5.8	DD	Çanakkale, Gökçeada	8.03.1964	Marchessaux, 1980
<i>Balaenoptera physalus</i>	-	VU	Antalya	1.01.1977	Tonay <i>et al.</i> , 2020
<i>Ziphius cavirostris</i>	-	DD	Adana, Karataş	13.09.1982	Kinzelbach, 1985
<i>Ziphius cavirostris</i>	8	DD	Antalya, Serik	1.07.1994	Öztürk & Öztürk, 1998
<i>Ziphius cavirostris</i>	3.5	DD	Muğla, Ören	19.03.1995	Öztürk & Öztürk, 1998
<i>Ziphius cavirostris</i>	-	DD	Muğla, Dalyan	1.04.1997	Öztürk & Öztürk, 1998
<i>Balaenoptera physalus</i>	14.5	VU	Aydın, Kuşadası	1.01.1998	Tonay <i>et al.</i> , 2020
<i>Balaenoptera physalus</i>	10.5	VU	Adana, Yumurtalık	2000	Tonay <i>et al.</i> , 2020
<i>Ziphius cavirostris</i>	-	DD	Mersin, Bozyazı	19.04.2001	Podestà <i>et al.</i> , 2005
<i>Ziphius cavirostris</i>	7.55	DD	Muğla, Fethiye	27.01.2002	Öztürk, 2002
<i>Physeter macrocephalus</i>	-	EN	Muğla, Fethiye	21.06.2002	GL
<i>Balaenoptera acutorostrata</i>	4	LC	Mersin, Erdemli	15.08.2005	Öztürk <i>et al.</i> , 2015
<i>Mesoplodon</i> sp.	5	-	Muğla, Fethiye	9.01.2009	Notarbartolo di Sciarra, 2009
<i>Ziphius cavirostris</i>	5	DD	Muğla, Sarıgerme	7.02.2009	Öztürk <i>et al.</i> , 2011
<i>Ziphius cavirostris</i>		DD	Not given	12.04.2012	Bachara & Norman, 2013
<i>Balaenoptera acutorostrata</i>	3.55	LC	Adana, Yumurtalık	10.04.2015	Öztürk <i>et al.</i> , 2015
<i>Balaenoptera physalus</i>	10.72	VU	Hatay, Iskenderun	8.01.2016	PO
<i>Ziphius cavirostris</i>	5.26	DD	Muğla, Gökova	3.06.2016	Öztürk <i>et al.</i> , 2016
<i>Ziphius cavirostris</i>	5.10	DD	İzmir, Seferihisar	5.06.2016	Öztürk <i>et al.</i> , 2016
<i>Ziphius cavirostris</i>	4.72	DD	Antalya, Gazipaşa	20.07.2016	Öztürk <i>et al.</i> , 2016
<i>Physeter macrocephalus</i>	18	EN	Hatay, Arsuz	21.06.2017	PO
<i>Ziphius cavirostris</i>	5	DD	Antalya, Kemer	14.11.2017	GL
<i>Ziphius cavirostris</i>	-	DD	Antalya, Serik	29.05.2018	GL
<i>Physeter macrocephalus</i>	3	EN	Muğla, Fethiye	10.07.2019	Tonay <i>et al.</i> , 2021
<i>Balaenoptera physalus</i>	13.5	VU	Edirne, Keşan	10.07.2019	Tonay <i>et al.</i> , 2020
<i>Mesoplodon mirus</i>	-	DD	Antalya, Finike	16.11.2019	GL
<i>Physeter macrocephalus</i>	1.5	EN	Adana, Karataş	10.08.2020	Tonay <i>et al.</i> , 2021
<i>Physeter macrocephalus</i>	5	EN	Antalya, Finike	14.08.2020	Tonay <i>et al.</i> , 2021
<i>Balaenoptera physalus</i>	12	VU	Hatay, Iskenderun	02.03.2021	This study

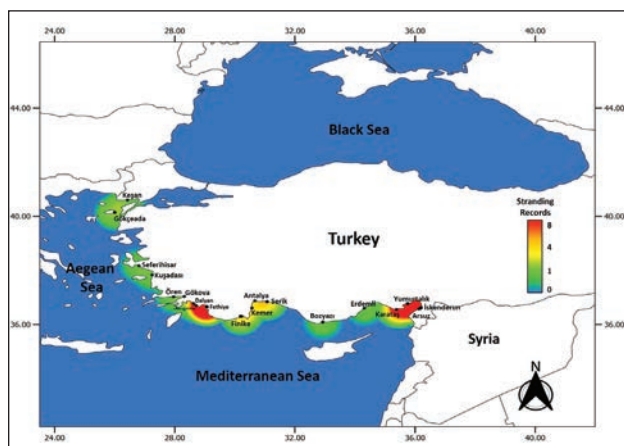


Fig. 2: Heat map of reports of all whale species stranded between 1964 and 2023 on the coasts of Turkey. The bar graph shows records in number.

Sl. 2: Zemljevid o pojavu nasedlih kitov v obdobju med 1964 in 2023 ob obalah Turčije. Stolpci se nanašajo na število primerov.

Sea of Okhotsk, the Gulf of California, and the Gulf of Mexico (Barlow & Taylor, 2005).

The minke whale, *Balaenoptera acutorostrata* (Lacepède, 1804), is the smallest species of the family Balaenopteridae. It occurs regularly in both coastal and offshore waters worldwide and mainly feeds on krill, copepods, and schools of small fish (Pierce et al., 2004). According to the IUCN red list, the minke whale is classified as Least Concern (LC) (Ibrahim et al., 2020). Very little is known about its distribution in the Mediterranean, other than it is merely a visitor in the region (Fraija-Fernández et al., 2015), and in the eastern Mediterranean a quite rare one, too (Kerem et al., 2012; Öztürk et al., 2015; Ibrahim et al., 2020).

True's beaked whale, *Mesoplodon mirus* (True, 1913), is known only from strandings in Great Britain, from Florida to Nova Scotia in the western Atlantic, and from southeast Africa and southern Australia in the Indo-Pacific Ocean. It is one of the smallest members of the beaked whale family (Ziphiidae). *M. mirus* is the only beaked whale known to have an anti-tropical distribution, with one population in the warm- and cold-temperate North Atlantic and the other in the warm and cold-temperate Southern Hemisphere. In the Mediterranean it is considered merely a rare visitor.

Stranding data can offer insight into spatial distribution and seasonal movements of whale species in the Mediterranean and inform protection measures. Therefore, the collection of stranding records is crucial. The knowledge on the stranding of whale species in Turkish marine waters is based on published literature, newspapers, and other sources. In the present study,

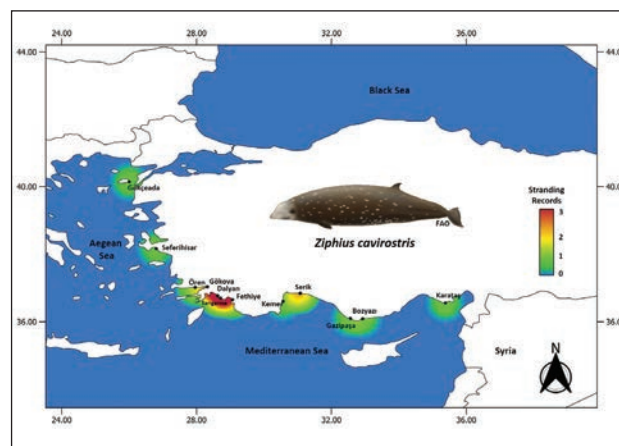


Fig. 3: Heat map of *Z. cavirostris* stranding reports on the coasts of Turkey. The bar graph legend shows records in number.

Sl. 3: Zemljevid o pojavu nasedlih kitov vrste *Z. cavirostris* v obdobju med 1964 in 2023 ob obalah Turčije. Stolpci se nanašajo na število primerov.

the stranding records of whales in Turkey were collected and mapped to visualize their general distribution pattern in Turkish marine waters.

MATERIAL AND METHODS

The primary data used in this study included occurrence points of whale species' strandings in Turkish marine waters, obtained from fieldwork, published literature, and grey literature. The geographic coordinates represent the location of stranding sites. In cases where only locality information was available, Google Earth was used to determine the coordinates. QGIS was used to map all occurrence records and produce a heat map of stranding records. The stranded whales found during fieldwork were transported to the safest location and buried upon necroscopic examination (Fig. 1). A tissue sample was also taken for further analysis.

RESULTS AND DISCUSSION

To date, 29 stranding records of five whale species and one genus have been reported from the coasts of Turkey. The species and number of strandings, listed in Table 1 together with additional information, are as follows: *Ziphius cavirostris* (14), *Balaenoptera physalus* (6), *Physeter macrocephalus* (5), *Balaenoptera acutorostrata* (2), *Mesoplodon mirus* (1) and *Mesoplodon* sp. (1). All the stranded whales were found dead. The first stranding was reported for *Z. cavirostris* from Gökçeada in 1964 (Marchessaux, 1980), whereas the most recent reported was *B. physalus* from Hatay-Iskenderun on 2 March 2021.

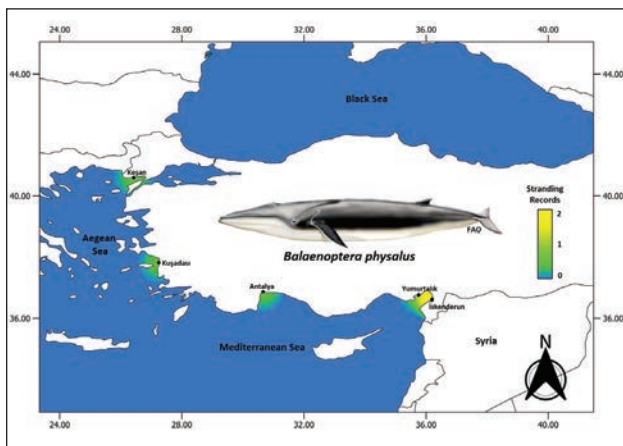


Fig. 4: Heat map of *B. physalus* stranding reports on the coasts of Turkey. The bar graph legend shows records in number.

Sl. 4: Zemljevid o pojavu nasedlih kitov vrste *B. physalus* v obdobju med 1964 in 2023 ob obalah Turčije. Stolpci se nanašajo na število primerov.

Most of the strandings were reported from the Mediterranean coasts (Marchessaux, 1980; Kinzelbach, 1985; Öztürk & Öztürk, 1998; Podestà *et al.*, 2006; Öztürk, 2002; Notarbartolo di Sciara, 2009; Öztürk *et al.*, 2011; Bachara & Norman, 2013; Tonay *et al.*, 2020). The majority of the strandings occurred in Fethiye (8), Iskenderun (7), and Antalya Bays (6) (Fig. 2). No stranded whales have been recorded in the Turkish Black Sea (Baş *et al.*, 2016).

Cuvier's beaked whales, *Z. cavirostris*, have stranded fourteen times, both in the Mediterranean and the Aegean Sea part of Turkey, with most of the strandings occurring in the Fethiye Bay in the Aegean Sea (Fig. 3). Species distribution is characterised by areas of high density, where individuals seem to be relatively abundant, such as the Alboran Sea, Ligurian Sea, central Tyrrhenian Sea, southern Adriatic Sea, and the Hellenic Trench (Canadas *et al.*, 2013; Podestà *et al.*, 2016). Occurrences of *Z. cavirostris* are rare in the Levantine Sea off Israel. A single population of *Z. cavirostris* in the low thousands is believed to exist in the Mediterranean, genetically isolated from the Atlantic population of the same species (Podestà *et al.*, 2016). *Z. cavirostris* is subject to several threats, including the anthropogenic noise produced by military and industrial activities throughout the Mediterranean, as well as bycatch, and ingestion of plastics (Podestà *et al.*, 2016).

Fin whales, *B. physalus*, have stranded six times along the Turkish coast. Three fin whale strandings were reported from Iskenderun Bay in the northeastern Mediterranean, the rest were recorded in Aydın, Antalya, and Çanakkale (Fig. 4). The Mediterranean

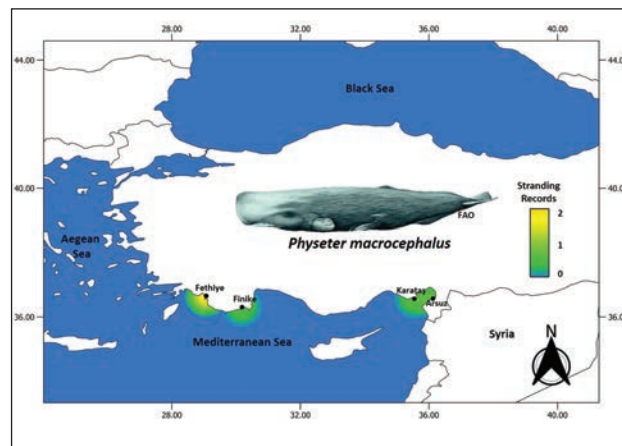


Fig. 5: Heat map of *P. macrocephalus* stranding reports on the coasts of Turkey. The bar graph legend shows records in number.

Sl. 5: Zemljevid o pojavu nasedlih kitov vrste *P. macrocephalus* v obdobju med 1964 in 2023 ob obalah Turčije. Stolpci se nanašajo na število primerov.

subpopulation of the fin whale is currently assessed as vulnerable (VU) in the IUCN Red List, with the population trend decreasing (Panigada *et al.*, 2021). *B. physalus* occurs throughout the Mediterranean Sea, but predominantly in the western basin. Of the two populations occurring in the region, one is resident, observed mostly in the area extending from the waters north and east of the Balearic Islands to the Ionian and southern Adriatic seas. Populations of *B. physalus* also enter the Mediterranean from the northeastern North Atlantic Ocean seasonally through the Strait of Gibraltar. The population size of the resident *B. physalus* is presumed to be in the low thousands at most (predicted to decline), and is exposed to several threats, including ship strikes, disturbance, noise, and chemical contaminants (Castellote *et al.*, 2012).

Sperm whales, *P. macrocephalus*, have been reported as stranded five times on the Turkish coast: two specimens in Fethiye Bay in the Aegean Sea, two specimens in Iskenderun Bay, and one specimen in Antalya Bay in the Mediterranean Sea (Fig. 5). The *P. macrocephalus* species is distributed over slope and deep waters throughout the Mediterranean Sea. A single panmictic population in the mid-hundreds is believed to exist in the Mediterranean Sea, genetically isolated from the Atlantic population of the same species (Rendell & Frantzis, 2016). This assumption supports the population's IUCN Red List status of endangered (Notarbartolo di Sciara *et al.*, 2012). Ship strikes, entanglement in driftnets, ingestion of plastic debris, anthropogenic noise, and chemical contaminants are exerting major impact on and threatening Mediterranean sperm whale populations (Notarbartolo di Sciara, 2014).

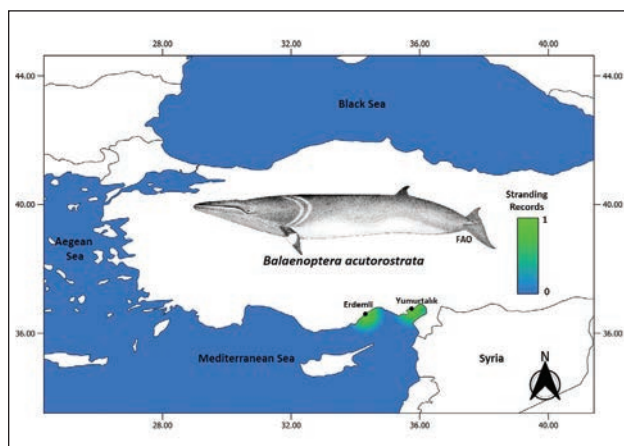


Fig. 6: Heat map of *B. acutorostrata* stranding reports on the coasts of Turkey. The bar graph legend shows stranding records in number.

Sl. 6: Zemljevid o pojavu nasedlih kitov vrste *B. acutorostrata* v obdobju med 1964 in 2023 ob obalah Turčije. Stolpci se nanašajo na število primerov.

Minke whales, *B. acutorostrata*, have stranded twice: once in the Iskenderun Bay, and once in the Mersin Bay in the northeastern Mediterranean Sea (Fig. 6). *B. acutorostrata* is a visitor from the North Atlantic Ocean, occasionally entering the Mediterranean Sea through the Strait of Gibraltar. Most of these occasional sightings and strandings have occurred in the Algero-Provençal and Tyrrhenian subregions.

True's beaked whales, *M. mirus*, have stranded in Antalya Bay on the Mediterranean coast of Turkey. The *Mesoplodon* sp. was recorded as stranding in Fethiye Bay on the Mediterranean coast by Notarbartolo di Sciarra (2009) on 9 January 2009 (Fig. 7).

The main threats to whales in the Mediterranean are ship strikes, which may even result in mortality, and noise pollution caused by ships, particularly in heavy vessel traffic areas. Seismic air guns can also have detrimental effects on fin whale populations by deterring them from feeding or breeding grounds (Castellote & Clark 2009). Other identified anthropogenic impacts on marine mammals in the Mediterranean Sea include fishing mortality, prey removal, xenobiotic contamination, climate change, and live capture (Bearzi *et al.*, 2012). Öztürk *et al.* (2015) reported a *Balaenoptera acutorostrata* stranding in Yumurtalık, Adana, where the cause of stranding and death was not evident due to the advanced stage of decomposition. Öztürk *et al.* (2016) reported *Ziphius cavirostris* stranding in three different locations; while the cause of death of two specimens could not be established, it was determined that the death of the third specimen was caused by a severe infestation with subdermal endoparasites *Pennella* sp. and plastic waste in the stomach. It has also been

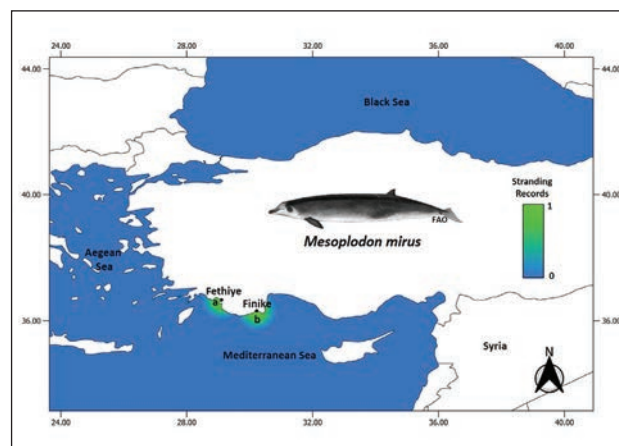


Fig. 7: Heat map of *Mesoplodon* species stranding reports on the coasts of Turkey (a: *Mesoplodon* sp.; b: *Mesoplodon mirus*). The bar graph legend shows records in number.

Sl. 7: Zemljevid o pojavu nasedlih kitov iz rodu *Mesoplodon* v obdobju med 1964 in 2023 ob obalah Turčije. Stolpci se nanašajo na število primerov.

reported that seismic surveys and military mid-frequency sonar studies should be considered as a possible cause of mortality in specimens whose cause of death cannot be determined. In the case of *P. macrocephalus* stranding in Finike in Antalya reported by Tonay *et al.* (2021) the results of necroscopy point to plastics found in the stomach of the whale as a possible reason for the stranding. Such a wide range of significant threats is worrisome because they affect cetacean populations that are already in decline, and the lack of field surveys further compromises the reliability of information about the population status of the respective species in the Mediterranean Sea.

The western and central Mediterranean Sea have been extensively studied with regard to cetacean abundance and distribution. However, studies on cetacean species in the eastern basin are scarce, and comparably fewer studies have been carried out in the northeastern Mediterranean (Frantzis *et al.*, 2003; Kerem *et al.*, 2012). The majority of cetacean studies in the eastern Mediterranean Basin have been conducted in Greek waters, in the Ionian Sea, the Hellenic Trench, and the Aegean Sea (Frantzis *et al.*, 2003). Additionally, Kerem *et al.* (2012) reported that the mean stranding frequency of whales per 100 km of coastline in Israel is twice as high as that of the well-monitored Spanish Mediterranean coastline (Cañadas, 2012). Therefore, more attention should be dedicated to the conservation of whales in the northeastern Mediterranean Sea.

Information about strandings of rare and endangered whale species significantly contributes to the understanding of their regional distribution. While an active whale stranding network covering

the nearshore waters and shoreline of Turkey would facilitate the collection of data from fresh carcasses, crowdsourcing activities as part of citizen science, as well as regular monitoring of social and local media (grey literature) could help obtain valuable information that would further improve our basic knowledge of the biology and ecology of cetaceans in Turkish waters. This would ultimately enable the adoption of better targeted conservation measures.

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POVZETEK

*Razširjenost kitov v Sredozemskem morju temelji predvsem na podlagi zapisov o nasedlih kitih. Avtorji predstavljajo zemljevide o nasedlih kitih različnih vrst in o vzorcu razširjenosti v Turčiji. Gre za pomemben korak v načrtovanju ohranitvenih ukrepov. Primarne podatke so pridobili v objavljenih delih, sivi literaturi in na podlagi terenskega dela. Skupno je bilo med leti 1964 in 2023 zabeleženih 29 primerov nasedlih kitov. Ti so se pojavljali na različnih obalah, največ v zalivu Iskenderun in v zalivu Muğla ob egejski obali. Popisali so kite petih vrst in enega rodu: Cuvierjev kljunati kit *Ziphius cavirostris*, brazdasti kit *Balaenoptera physalus*, kit glavač *Physeter macrocephalus*, ščukasti kit *Balaenoptera acutorostrata*, in severni dvozub *Mesoplodon mirus* in vrsta iz rodu *Mesoplodon*.*

Ključne besede: vrste kitov, Cetacea, nasedli primerki, zemljevidi o razširjenosti, Sredozemsko morje, Turčija

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