J. Black Sea/Mediterranean Environment
Vol. 26, No. 1: 26-47 (2020)

RESEARCH ARTICLE

Preliminary results of cetacean sightings in the eastern Mediterranean Sea of Turkey

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Abstract

Lack of baseline knowledge is often the principal conservation barrier, especially if the species of concern shows steady decline. The primary goal of the current project is to fill the knowledge gaps in understudied cetacean populations through dedicated visual and acoustic surveys in the Eastern Mediterranean Sea of Turkey. The surveys were conducted over six seasons, following 4384.76 km in 49 days between April 2018 and July 2019. Cetaceans were detected on 39 days (146 sightings), with the highest sightings belonging to delphinids (bottlenose, common and unidentified dolphins) followed by sperm whales (*Physeter macrocephalus*) and a single acoustic detection of a beaked whale. Fethiye Canyon held the highest cetacean concentration and thus is identified as an "important habitat". Reported encounter rates were higher than previous studies, with 2.78 and 0.55 groups/100 km for delphinids and sperm whales, respectively. Despite the lack of significant variation in cetacean presence due to season and diurnal effects, there was a noticeable increase in summer sightings for sperm whales, where they were encountered as solitary individuals and social units with calves. The current research presented the first seasonal survey results of the Turkish Mediterranean and underlines the importance of local research efforts for valid conclusions in an understudied environment that holds not only unrecognized cetacean habitats but also a wide range of human pressures.

Keywords: Sperm whales, delphinids, acoustic, encounter rates, distribution, eastern Mediterranean Sea

Received: 09.12.2019, **Accepted:** 19.04.2020

Introduction

The Eastern Mediterranean Sea has been considered to have a low cetacean diversity and abundance because of unfavourably warm, highly saline and oligotrophic oceanic conditions (Simmonds and Nunny 2002; Frantzis *et al.* 2003; Kerem *et al.* 2012). This remained an unchallenged assumption due to the absence of dedicated survey efforts within the region up until the early 2000s (Goffman *et al.* 2000; Lewis *et al.* 2007; Boisseau *et al.* 2010; Öztürk *et al.* 2011; Ryan *et al.* 2013). The majority of scientific data has been collected in the western and central basins since the 1990s (Frantzis *et al.* 2003; Podestà *et al.* 2006; Dede *et al.* 2012; Kerem *et al.* 2012). The regional extent of most studies consists of only a handful of basin-wide research efforts, hindering an accurate, basin-wide interpretation of the species distribution and population status for cetacean species. This leaves a gap in even baseline knowledge of the eastern and southern Mediterranean Sea (Mannocci *et al.* 2018).

The available information on species distribution and abundance within the Eastern Mediterranean Sea is largely derived from the opportunistic sightings and stranding events recorded since the early 1980s (Marchessaux 1980; Kinzelbach 1986; Öztürk *et al.* 2011, 2013). This was supplemented with occasional survey efforts in the early 1990s and it has only been within the last decade that a limited number of dedicated surveys have started to be conducted (Frantzis 1996; Frantzis *et al.* 1999, 2014; Öztürk *et al.* 2007, 2012; Öztürk *et al.* 2013; Dede *et al.* 2012; Güçlüsoy *et al.* 2014; Baş *et al.* 2016a, 2016b; Diogou *et al.* 2019). The Hellenic Trench and the Aegean Sea are notable exceptions where systematic surveys have been conducted since the early 1990s (Frantzis 1996; Öztürk and Öztürk 1998; Frantzis *et al.* 1999, 2001, 2003, 2014; Carpentieri *et al.* 1999; Altuğ *et al.* 2011; Cañadas and Notarbartolo di Sciara 2018). Recent surveys mainly focused on the effects of marine pollution on cetaceans within the Eastern Mediterranean (Shoham-Frider *et al.* 2016; Bigal *et al.* 2018; Marsili *et al.* 2018; Alexiadou *et al.* 2019). Each of the aforementioned studies have highlighted that despite the scarce dedicated survey effort, Eastern Mediterranean Sea is likely to hold potential important habitats for cetaceans yet to be discovered (Goffman *et al.* 2000; Dede *et al.* 2016; Kerem *et al.* 2012; Bigal *et al.* 2018; Farrag *et al.* 2019).

Currently, almost 60% of cetacean species are globally identified as either threatened or data deficient (Polidoro *et al.* 2008). This is mainly the result of anthropogenic pressures, including intentional takes (until the 1980s), habitat degradation, by-catch, overfishing, ship strikes, chemical and noise pollution, marine debris and climate change, which have been identified as the main drivers of cetacean decline (Aguilar *et al.* 1999; Harwood 2001; Öztürk *et al.* 2001; Drouot *et al.* 2004; Taylor *et al.* 2007; Öztürk 2009; Coll *et al.* 2010; Costello *et al.* 2010; Aguilar de Soto 2012; Bearzi *et al.* 2012; Hammond *et al.* 2013; Borrell *et al.* 2014; Pinzone *et al.* 2015; Laran *et al.* 2017). Due to these

threats, the Mediterranean subpopulation of short-beaked common dolphins (*Delphinus delphis*) and sperm whales are now classified as Endangered in the IUCN Red List with the former showing more than a 50% decline in the last 30 years (Bearzi 2012; Bearzi *et al.* 2016). Sperm whales in the Mediterranean consist of a mature population of approximately 2500 individuals, making up less than 45% of the entire population (Notarbartolo di Sciara *et al.* 2012; Frantzis *et al.* 2014; Notarbartolo di Sciara 2014). Bottlenose dolphins (*Tursiops truncatus*) and striped dolphins (*Stenella coeruleoalba*) have been categorised as Vulnerable in the IUCN Red List with a 50% decline in the last 50 years (Forcada and Hammond 1998; Bearzi *et al.* 2012; 2016). Cuvier's beaked whales (*Ziphius cavirostris*) have also been recently categorised as Vulnerable in the IUCN Red List with the biology and ecology of the species is largely unknown (Podestà *et al.* 2016; Cañadas and Notarbartolo di Sciara 2018). Lastly, Risso's dolphins (*Grampus griseus*) are categorised as Data Deficient in the IUCN Red List (David 2002; Shoham-Frider *et al.* 2002; Bearzi *et al.* 2011; Gaspari and Natoli 2012), yet they are one of the least studied species within the Mediterranean Sea (Frantzis *et al.* 2011; Podestà *et al.* 2016).

Turkish waters of the Eastern Mediterranean Sea potentially include a range of unidentified cetacean habitats, while it also holds "Ecologically or Biologically Significant Marine Areas (EBSAs)", "Specially Protected Areas (SPAs))" and "Area of Interest for Important Marine Mammal Areas (AoI-IMMA)" (Würtz *et al.* 1992; Öztürk *et al.* 2007, 2012). The same habitats are facing with a wide range of unregulated and uncontrolled human activities, including fishery practices and more recently an increase in oil and gas exploration activities (Coll *et al.* 2012; UNEP/MAP 2012; Turan *et al.* 2016; Özgür 2017; Fylaktos and Papanicolas 2019). The current on-going study aims to identify key cetacean habitats through examination of the spatial and temporal distribution of cetaceans in the Eastern Mediterranean Sea. We present the first results of seasonal dedicated surveys, covering two years, providing a baseline for future research and supporting the development of conservation and management strategies within the Eastern Mediterranean Sea.

Materials and Methods

Survey Area

The survey was designed to cover a 23,438 km² corridor extending to 20 nm offshore and approximately 370 km along the Turkish Mediterranean coast from Marmaris to Anamur. The survey area was sampled using equal-spaced zig-zag lines, consisting of 644 km trackline on 22 transects (Figure 1).

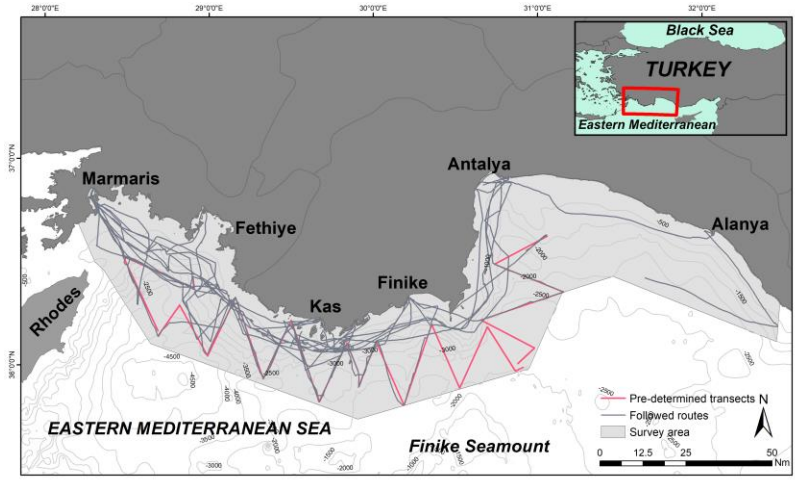

Figure 1. Pre-determined survey transects and routes followed by dedicated surveys in this study

Data collection

The surveys were conducted over a minimum of five days in each season with a team of eight researchers. A 14.98 m sailing boat with a 100 hp diesel engine was used as a research boat, following the selected transects as well as the 1000 m contour line (to increase the sighting possibility of sperm whales) with an average speed of 4 knots. Logger 2010 software was used to record the boat route, sighting information and environmental and effort statuses and ran 24 hours/day for the full duration of each survey. The research boat was only considered as 'on effort' when it was travelling at 4 knots and within 2 km of the determined transect (Thomas *et al.* 2010).

Visual effort started half an hour before sunrise and finished half an hour after sunset. Two researchers with binoculars (7x50 with compass and reticles) were positioned on the bow, one scanning to port (270 to 10 degrees) and the other to starboard (350 to 90 degrees). Visual observations were carried out only up to Beaufort Sea state 4. Two observers were responsible for reporting the sightings and anthropogenic presence (boat type and activity and large areas (>10m^2) of litter) in the area to a researcher designated as the data logger. Focal groups were defined using a 100 m chain rule (each individual swam within 100 m of its nearest group member) and if the group was not visually or acoustically detected for a minimum of one hour, the new sighting was recorded as a new group. When a visual sighting took place, the focal group was approached for photo-identification using a Canon 7D with a 70-300 mm lens.

A towed hydrophone array was deployed near-continuously for 24 hours during surveys (except the autumn survey). The hydrophone array (Vanishing Point,

UK) consisted of four omni-directional broadband hydrophone elements for high and low frequency monitoring mounted within a streamlined housing and towed on a 200 m strengthened cable. The hydrophone elements were sensitive to signals between 100 Hz and 200 kHz. The hydrophone was amplified and conditioned using a customized hydrophone interface (Magrec HP27) and digitised using a Behringer U-Phoria UMC404HD sound card sampling up to 192 kHz. PAMGuard software ran on a laptop computer making continuous full bandwidth recordings. One survey team member acting as the PAM operator was responsible for logging the species presence and environmental and anthropogenic noise of the area every 15 minutes, along with the vessel speed.

Data Analysis

Acoustic and visual detections of cetaceans were pooled under the same dataset while post-acoustic analysis is yet to have been carried out. If a group was both acoustically and visually recorded at the same time, only their visual recording was considered to avoid over-estimating the data. A multiple logistic regression model with backward elimination of variables was used to assess the impact of season, diurnal time, cetacean type (small and deep-diving cetaceans) and their interactions on the dependent variable, presence and absence of cetaceans. Survey time (hours) was also included in the model since it differed between each survey day. Further, the effect of the above explanatory variables on the encounter number of cetaceans was analysed with a Quasi-Poisson regression with survey effort (hours) as an offset. Post-hoc analyses were conducted by least square means comparisons. Due to the small sample size, Delphinidae species were grouped under "small cetaceans", while sperm whales and single beaked whale recordings were grouped under "deep diving cetaceans". Diurnal time was categorized into two levels: day represented the time between sunrise and sunset, while night covered the time between sunset and sunrise. The significance level was set to $\alpha = 0.05\%$ for all statistical tests.

All the aforementioned analyses were performed with the statistical software R (version 3.6.0) and were based on the preliminary dataset. In addition, boat routes and detected species were mapped using ArcGIS (version 10.3) and the encounter rate was calculated as the number of sightings per 100 km. Photo-identification data of sperm whales were examined using Discovery software (version 2.0.0.43).

Results

A total of 4384.76 km in 49 days (697:20 min) were covered between 14 April 2018 and 26 July 2019 (Figure 1, Table 1). The survey effort (hours) varied between seasons and diurnal time due to the variation of daylight hours.

Table 1. Survey effort, species presence and encounter numbers for each season

Season	Survey effort in days (hours)	Days with sightings	Number of groups sighted
Spring (14.04-06.05.2018; 26.04-05.05.2019)	20 (321)	15	53
Summer (04.06-08.06.2018;13.07-26.07.2019)	15 (242)	11	63
Autumn (14.10-22.10.2018))	9 (51)	3	6
Winter (14.02-18.02.2019)	5 (82)	5	24
Total	49 (697)	34	146

Cetaceans were sighted on 146 encounters, of which 123 were acoustic detections, on 34 different days (Tables 1 and 2). Overall, the encounter rates were 2.78 groups per 100 km for small cetaceans and 0.55 groups per 100 km for sperm whales. 84.2% of the encounters were detected acoustically, which limited the species level identification for Delphinidae species. Delphinidae species were responsible for most of the detections with year-round presence, among which 17 and 7 groups of bottlenose dolphins and common dolphins, respectively, were confirmed visually. Sperm whales were detected on 23 occasions during spring, summer and autumn, of which five of them were visually recorded in spring and summer. Lastly, there was a single beaked whale encounter in summer (Table 3).

Regarding the group size, bottlenose dolphin sightings ranged from single individuals to a group of 10 individuals, common dolphins varied between four and 20 individuals. Sperm whales were generally detected as solitary individuals, yet their group size ranged up to five individuals and in two encounters, calf presence was noted. Five sperm whale individuals were identified based on fluke photographs and one of these was sighted on two consecutive days (Figure 2) while photo-identification of Delphinidae species is yet to have been carried out.

Table 2. Seasonal variation in species encounters

Species	Season				
	Autumn	Spring	Summer	Winter	Total
Bottlenose dolphins	2	8	7	0	17
Common dolphins	0	3	4	0	7
Unidentified delphinids	3	34	37	24	98
Sperm whales	1	8	14	0	23
Beaked whales	0	0	1	0	1
Total	6	53	63	24	146

The backward elimination of variables revealed that neither ‘season’ nor the interactions between the variables (with the exception of the interaction, diurnal time*species) had an effect on the presence of cetaceans and was therefore eliminated from the later model which was built only considering diurnal time, species, survey effort and the interaction between diurnal time and species. The

results of the pooled dataset (visual and acoustic detections) indicate that the odds of small cetaceans being present is 9.17 times higher than for deep diving species, however, there is no significant difference between diurnal time (Table 3). The survey effort (hours) has a significant impact, with every hour, the odds of spotting a cetacean increase by a factor of 1.26 (Table 3).

Table 3. Backward variable selection results of the logistic regression for absence/presence of cetaceans
(OR stands for odds ratio and CI represents its 95%-confidence interval.)

Variable	Estimate	OR	CI	*p*
(Intercept)	-3.96	0.02	0-0.1	< 0.001
Diurnal Time (Night vs. Day)	-0.66	0.52	0.09-2.83	0.4474
Species (Small vs. Deep diving)	2.22	9.17	3.18-26.4	< 0.001
Survey effort	0.23	1.26	1.12-1.42	< 0.001
Diurnal Time (Night): Species(Small)	1.34	3.82	0.58-24.96	0.1616

The quasi-Poisson regression revealed a significant difference in the encounter rate between small and deep diving cetaceans. The expected encounter rate is 3.14-times higher for small cetaceans than for deep diving ones. Moreover, a significant interaction between diurnal time and species type (small/deep diving) was found (Table 4) which is due to a significantly higher encounter rate of deep diving species during daytime hours than night (Estimate=1.83, p=0.036), whereas no significant difference in diurnal time was observed for small species (Estimate=-0.31, p=0.15) (Table 4).

Table 4. Quasi-poisson regression results for the dependent variable encounter number (Est is estimate, Exp.Est. is the exponential estimate, and CI represents its 95% confidence interval.)

Variable	Est.	Exp. Est.	CI	p
(Intercept)	-2.79	0.60	0.04-0.1	< 0.001
Diurnal Time (Night vs. Day)	-1.83	0.16	0.03-0.89	0.0657
Species (Small vs. Deep diving)	1.14	3.14	1.78-5.53	0.0033
Season (Autumn vs. Summer)	-0.80	0.45	0.17-1.21	0.1487
Season (Spring vs. Summer)	-0.46	0.63	0.41-0.98	0.0684
Season (Winter vs. Summer)	0.10	1.11	0.64-1.94	0.7214
Diurnal Time (Night): Species (Small)	2.13	8.45	1.45-49.11	0.0415

Small cetaceans were present throughout the survey area and deep-diving species were predominantly recorded in the western waters between Rhodes and Kas, with a single detection in Antalya Bay (Figures 3 and 4). Small cetaceans showed a variation in their depth preferences from 10 m (24 m from the nearest shore) up to 4000 m (54 km from the nearest coast) (Figure 3), whereas sperm whales were detected between 500 m to 2500 m depth (Figure 4).

ID001

ID002

ID003

ID004

ID005

Figure 2. Photo-identified sperm whales during the surveys in the Turkish territorial waters of the Mediterranean Sea

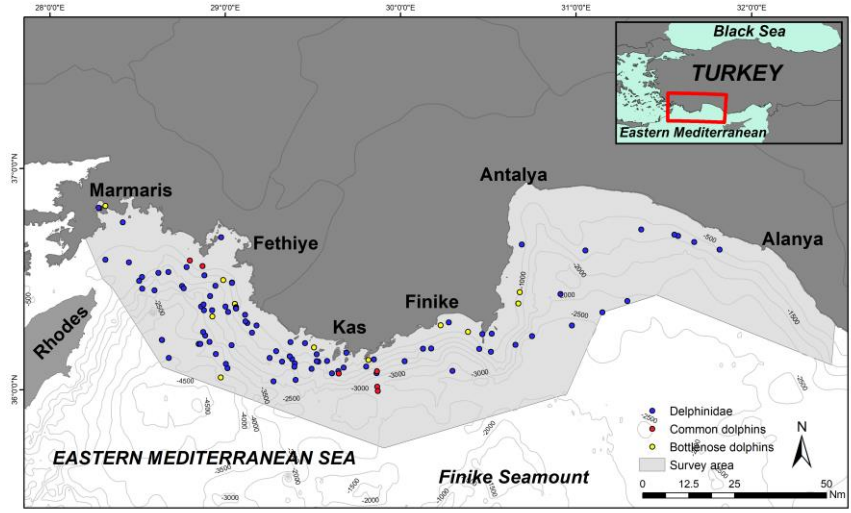

Figure 3. Encounters of small cetaceans in the surveyed area

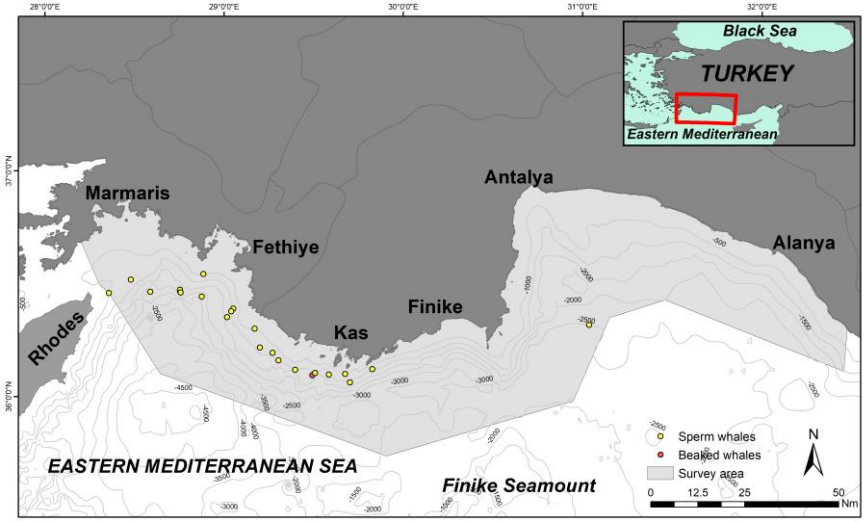

Figure 4. Encounters of deep diving species in the surveyed area

Discussion

The current study represents the first dedicated seasonal survey effort in the Eastern Mediterranean Sea along the Turkish coast and documented the year-round continuous presence of Delphinidae species and sperm whales as well as a single detection of a beaked whale in summer. Even though the highest cetacean presence was recorded in the warmer seasons, when the effect of

survey effort was evaluated, neither season nor diurnal time revealed a significant effect on the presence of small and/or deep diving cetaceans. Previous studies indicated the Eastern Mediterranean Sea, excluding the Hellenic Trench, as an area with lower cetacean abundance and species density compared to the rest of the basin (Lewis *et al.* 2007; Boisseau *et al.* 2010; Ryan *et al.* 2014). Nevertheless, the current study reveals a comparatively higher encounter rate than the previous records, with 2.78 and 0.055 sightings per 100 km of delphinids and sperm whales, respectively. While previously Boisseau *et al.* (2010) had a sighting rate of 0.68 cetaceans per 100 km, lower encounter rates were reported by Ryan *et al.* (2014) with 0.008 encounters per 100 km in the Turkish part of the Mediterranean in 2013, whereas Dede *et al.* (2012) reported a higher encounter rate of 0.97 sightings per 100km within the Eastern Mediterranean Sea in a study conducted in 2008. Given that the previous studies were based on single summer survey efforts and considering the biological and ecological needs of species of concern, single survey efforts can provide general baseline information but cannot provide an accurate picture of movements, density patterns or population sizes within the understudied regions of the Mediterranean Sea. It is also important to keep in mind that it is likely to be more species detections after post-acoustic analyses are carried out. The documented year-round presence of Delphinidae species with relatively high encounter rates, as well as the presence of a beaked whale and sperm whales with calves, has underlined both the importance of dedicated survey efforts and the potential for important cetacean habitats with the possibility of breeding and calving grounds in the north-western part of the Turkish Mediterranean coast.

Bottlenose dolphins were previously recorded as the most abundant species of the eastern Mediterranean Sea (Carpentieri *et al.* 1994, 1999; Dede *et al.* 2012; Kerem *et al.* 2012; Scheinin *et al.* 2014; Farrag *et al.* 2019) and current results confirmed the continuous coastal presence of bottlenose dolphins and unexpected offshore sighting. Bottlenose dolphins prefer coastal waters in the Mediterranean Sea (Cañadas *et al.* 2002; Marini *et al.* 2015) and their offshore presence has rarely been recorded (Kerem *et al.* 2012). The offshore sightings may indicate the presence of offshore populations (Oudejans *et al.* 2015; Milman *et al.* 2017) or may link to their movement patterns, as they were recorded covering long distances, with the longest recorded as 400 km between the French and Spanish Mediterranean coast (Lockyer and Muller 2003). To fill this knowledge gap on their movement pattern, a transboundary photo-identification study has to be implemented in the eastern Mediterranean Sea. The only existing photo-identification study to our knowledge was implemented in Antalya Bay in 2015 which catalogued 50 individuals (Baş *et al.* 2016a).

The current study failed to record both bottlenose dolphins and beaked whale presence in the previously defined critical habitats in Antalya (Baş *et al.* 2016b, 2018). The absence of these threatened species is concerning, considering the uncontrolled increase in habitat destruction ranging from tourism activities to

increased naval exercises and sonar practices in the same locations (Elçin 2019; Kasapoğlu 2019) that was identified as "a critical habitat" for the species of concern. Within the last five years, five beaked whale strandings were recorded within the region (Öztürk *et al.* 2016; 2018). The survey effort in the area must be increased with additional threat assessment to understand the population trend of bottlenose dolphins and Cuvier's beaked whales in order to produce effective strategies to curtail the possible population decline in Antalya Bay.

Additionally, endangered common dolphins were recorded with their calves off the coast of Fethiye and Kas. The sightings took place in between the 500 m and 3000 m isobath which corresponds with the depth preferences of their Mediterranean populations (Notarbartolo di Sciara *et al.* 1993; Frantzis and Harzing 2002; Gannier 2005). Further, there were a considerable number of unidentified Delphinidae species acoustically recorded during the current survey which is likely to reveal higher numbers of detected species and additional species such as striped dolphins and Risso's dolphins. Therefore, post-acoustic analysis, when sufficient detections of known species are acquired, will lead to a better understanding of Delphinidae distribution at a species level.

Lastly, the current study documented the continuous presence of sperm whales, concentrated along the 1000 m isobath of the Fethiye Canyon. While the majority of the sightings likely belong to solitary individuals, social units with calves were also documented during the spring and summer survey. It is known that sperm whale distribution is affected by their foraging preferences for mesopelagic cephalopods which are known to be of highest concentrations on continental slopes and deep waters (Alberini 2018). Indeed, there are at least 14 cephalopod species identified in the stomach contents of Risso's and striped dolphins bycaught off Fethiye (Öztürk *et al.* 2007). Nevertheless, further studies are needed to understand the foraging behaviour and habitat choice of the endangered sperm whales within the eastern Mediterranean. Previous summer survey efforts also documented the sperm whale presence in locations similar to the current study in the Fethiye Canyon and Finike Basin (Öztürk *et al.* 2013; Dede *et al.* 2012), underlining the continuous area usage of sperm whales in the same habitats between and within years. The Hellenic Trench which lies in the waters west of the Fethiye Canyon is known to host one of the highest densities of the sperm whales within the Mediterranean Sea with year-round presence and high site fidelities, yet the same area holds highly used shipping lines for marine transportation, forming the main threat in the Mediterranean Sea through increased mortality rates by the ship strikes. (Frantzis *et al.* 2011; 2019). Therefore, it is possible that the home range of sperm whales in the Hellenic Trench may extend into the Turkish Mediterranean. This prospect is supported by existing photo-identification studies revealing movement patterns between the Hellenic Trench and Cyprus (Frantzis *et al.* 2011). The population size of Mediterranean sperm whales is estimated to be less than 2500 adults, with a high level of isolation from the other populations (Reeves and Notarbartolo di

Sciara 2006), therefore every stronghold of the species must be protected with effective management strategies to prevent a critical decline in their population size.

Despite the comparably high encounter rates of Delphinidae species and sperm whales throughout the survey, it is important to highlight that post-analysis has yet to be carried out thus new detections are likely to be added to the database during the post-analysis, including the possibility of Cuvier's beaked whales which are known to have previously been present in the area (Baş *et al.* 2016b). Lastly, the autumn 2018 survey was conducted with visual survey effort only. Considering the high acoustic detection rate compared to visual sightings (Gannier *et al.* 2002), it is highly likely that there were animals in the area that were not visually detected by researchers. Therefore, it is important to keep in mind that the interpretation of the data is based on these preliminary results.

Over half of the Mediterranean populations of cetacean species are listed as threatened (vulnerable, endangered or critically endangered) by the IUCN Red List. The existing regional efforts are highly skewed to the western basin. As a result of increase in human population, marine transportation, marine surveys for industry, and sonar use, negative anthropogenic pressures on marine biodiversity have increased substantially (Coll *et al.* 2010). With ever increasing human impacts, including the recent rise in oil and gas exploration and navy exercises on the fragile system of the eastern Mediterranean, these under-studied, threatened populations of cetaceans should be at the forefront of research and conservation strategies.

Acknowledgement

We would like to thank the Rufford Small Grant Foundation, WWF-Turkey and MAVA species fund for their financial support and all the volunteers of DMAD-Marine Mammals Research Association for their endless support.

Türkiye Doğu Akdeniz'nde setase gözlemlerinin ön çıktıları

Öz

Mevcut duruma dair türe yönelik bilimsel veri eksikliği, özellikle tehdit altında olan türlerin populasyonlarının istikrarlı azalma göstermesi halinde, türün etkin korunmasına da engel oluşturmaktadır. Mevcut projenin ana amacı, Türkiye'nin doğu Akdeniz sularında görsel ve akustik mevsimsel gözlemler gerçekleştirerek setase populasyonlarını üzerine var olan bilgi eksikliklerini tamamlamaktır. Araştırma seferleri, Nisan 2018 ve Temmuz 2019 tarihleri arasında altı mevsimi kapsayarak, 49 günde tamamlanmıştır ve toplamda 4384,75 km'lik bir hat taranmıştır. Seferin 39 gününde setase türleri gözlemlenirken (toplam 146 gözlem), en yüksek gözlem sayısı yunus türlerine aittir. Bu gözlem sayısını kaşalot türü (*Physeter macrocephalus*) takip etmektedir ve bir adet

gagalı balina da akustik olarak kayıt edilmiştir. Fethiye Kanyonu, en yüksek setase yoğunluğuna sahip olması nedeniyle "önemli habitat" olarak önerilmiştir. Kaydedilen karşılaşma oranları önceki çalışmalara göre daha yüksektir, bu oran yunus ve kaşalot balinalar için sırasıyla 2.78 ve 0.55 grup/100 km'dir. Setaselerin alandaki mevcudiyetleri üzerine gece/gündüz ve mevsim faktörlerinin istatistiksel bir değişime neden olmamış olmalarına ragmen, yazın kaşalotların tek birey ve yavrulu sosyal gruplar halinde gözleminde artış gözlenmiştir. Mevcut araştırma, Türkiye'nin Akdeniz sularındaki ilk mevsimsel inceleme sonuçlarını sunmakta ve henüz belirlenmemiş setase habitatlarının yanı sıra insan baskısına da sahip ve az çalışılmış olan bu habitatlarda yerel ve sürekliliği olan araştırmaların öneminin altını çizmektedir.

Anahtar kelimeler: Kaşalot, ispermeçet balinası, delphinids, akustik, gözlem oranı, alan dağılımı, Doğu Akdeniz

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