ACTA ZOOLOGICA BULGARICA

Acta Zool. Bulg., 73 (2), June 2021: 297-304

Conservation Biology
Research Article

Published online 30 September 2020
http://www.acta-zoologica-bulgarica.eu/002463

Line Transect Surveys of Abundance and Density of Cetaceans in the Marine Area of the Bulgarian Natura 2000 BG0001001 Ropotamo Site of Community Importance, Black Sea

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Abstract: The high conservation status of the Black Sea cetaceans in the IUCN Red List of Threatened Species, i.e. the Black Sea harbour porpoise *Phocoena phocoena relicta* and the Black Sea bottlenose dolphin *Tursiops truncatus ponticus* as Endangered (EN) and the Black Sea common dolphin *Delphinus delphis ponticus* as Vulnerable (VU) defines the importance of studies on their distribution and abundance. The paper presents results from distance sampling surveys for estimation of the density and abundance of cetaceans in the Marine Protected Area Ropotamo designated for conservation of cetaceans and marine habitats. Data were collected during five days in April and May 2016 using a motor sailing yacht. In April, all three species were observed while only harbour porpoise and bottlenose dolphin were detected in May. In all survey days, the most sighted species was the Black Sea harbour porpoise. Encounter rates varied as follows: harbour porpoise – 0.26 to 0.54; bottlenose dolphin – 0.02 to 0.07; common dolphin – 0.02 to 0.31. Density and abundance were: harbour porpoise – 1.8669 ind.km^{-2} and 1468 ind. (CV = 29.46%, 95% CI: 686–3140); bottlenose dolphin – 0.13 ind.km^{-2} and 103 ind. (CV = 45.98%, 95%, CI: 38–276); common dolphin – 0.516 ind.km^{2} and 406 ind. (CV = 101%, 95% CI: 34–4789).

Key words: Black Sea cetaceans, *Phocoena phocoena relicta*, *Delphinus delphis ponticus*, *Tursiops truncatus ponticus*, distance-sampling, abundance.

Introduction

The cetacean fauna of the Black Sea consists of three species, each of them represented by an endemic subspecies for the basin: Black Sea harbour porpoise *Phocoena phocoena relicta* Abel, 1905, Black Sea bottlenose dolphin *Tursiops truncatus ponticus* Barabash-Nikiforov, 1940 and Black Sea common dolphin *Delphinus delphis ponticus* Barabash-Nikiforov, 1935. Due to their limited range and commercial exploitation until 1983, all they are listed in the IUCN Red List of Threatened Species: the former two as Endangered (EN) (Birkun & Frantzis 2008, Birkun 2012) and the latter as Vulnerable (VU) (Birkun 2008). Being top predators in the food web, the cetaceans are an important indicator for the state of the Black Sea marine ecosystem.

EU Habitats Directive 92/43/EEC is the main legal instrument for conservation of a wide range of rare, threatened or endemic species and habitats, both on land and in the seas of the European Union. Over 1000 animal and plant species as well as 200 habitat types, listed in the annexes of this directive, are protected in various ways. For conservation of the species listed in the Annex II, it is required the core areas of their habitat to be designated as Sites of Community Importance (SCIs) and to be included in the Natura 2000 network. For the species listed in the Annex IV, it is required the strict protection in their entire natural range in EU. All the three Black Sea cetaceans are listed in Annex IV while harbour porpoise and bottlenose dolphin are listed also in Annex II (European Commission 2020).

The Ropotamo SCI has the largest marine area among all 14 SCIs for conservation of marine mammals in the Bulgarian sector of the Black Sea. The protection of two species of cetaceans, i.e. the Black Sea harbour porpoise and the Black Sea bottlenose dolphin, is among site's conservation objectives in the Natura 2000 Standard Data Form for this SCI, while the Black Sea common dolphin is listed among the other important species. The harbour porpoise is recorded as a permanent species in the category "Rare", with a general assessment of its status as good (A). The bottlenose dolphin is recorded as a permanent species in the category "Common", with a general assessment as good (A). For the harbour porpoise and the bottlenose dolphin, the quality of data is poor and no abundance estimates or reference values are available; however, the quality of available habitat is assessed as the highest class in terms of abundant trophic base, preserved ecosystems with rich biodiversity and relatively low levels of contamination with petroleum products (Ministry Of Environment and Water 2020). No management bodies are assigned to SCIs and, consequently, no regular monitoring and surveys have been conducted until now. This is an obstacle for establishing baseline and reference values for cetaceans' abundance in any of the Bulgarian Natura 2000 sites, which is an essential prerequisite for defining any conservation measures. The lack of data prevents identification of key habitats and zones for cetaceans in the sites designated for their conservation. This, in combination with generally scarce historical data on cetaceans' abundance, density and distribution in Bulgarian waters of the Black Sea, hinders defining trends in the development of the populations (Stanev 1996, Panayotova & Todorova 2015). Reconnaissance surveys using aircraft were made in 50s and 60s of 20th century when commercial exploitation of cetaceans was made (Nikolov 1963). Later on, during the next half century, no dedicated surveys were made in Bulgarian waters. The most recent dedicated survey on cetaceans in Northwestern Black Sea was conducted by an international team in July 2013. It included a vessel survey for territorial waters and an aerial survey for the rest of Exclusive Economic Zones of Bulgaria, Romania and part of Ukraine (Birkun et al. 2014). In 2014/2015, Bulgarian Executive Environment Agency implemented a project including cetaceans' studies in Exclusive Economic Area of Bulgaria in the Black Sea by means of aerial and vessel surveys. The project has not included specific surveys in SCIs but had large scale coverage. The report on reference values for cetaceans (Delov et al. 2015a) developed in that project concludes "density values obtained by the completed surveys in the project are the lowest compared to other surveys in the Black Sea, which excludes the option to use these values as reference". Instead, the values for abundance and density of Birkun et al. (2014) should be adopted as reference data. The report on information for cetaceans in the Standard Data Forms (SDFs) of marine SCIs developed in the same project using completed surveys produced following values for abundance of cetaceans in the Ropotamo SCI: harbour porpoise – 22 ind., bottlenose dolphin – 17 ind. and common dolphin – 5 ind.; however, the authors concluded that the collected data did not imply correction of existing data in SDFs (Delov et al. 2015b). A pilot combined visual and acoustic survey for the purpose to test the national cetaceans' monitoring program under EU Marine Strategy Framework Directive 2008/56/EC was conducted by the Institute of Oceanology of the Bulgarian Academy of Sciences in November 2015 in the central sector of the Bulgarian shelf in the Black Sea between Cape Galata and Cape Emine (Panayotova et al. 2017). That study area included the BG0001501 Emona SCI; however, the derived abundance and density estimations were for the entire area and not specifically for the SCI.

The present article describes the results of the dedicated line transect distance sampling surveys on the abundance and density of cetaceans in the marine area of the Natura 2000 site BG0001001 Ropotamo SCI. It aims to examine the importance of the site for marine mammals and to establish baseline values for their abundance during spring.

Materials and Methods

Study area

The marine area of BG0001001 Ropotamo SCI (881.92 km^2) consists of mosaic of different habitat types listed in annex I of EU Habitats Directive: 1110 Sandbanks, which are slightly covered by sea water all the time; 1130 Estuaries; 1140 Mudflats and sandflats not covered by seawater at low tide; 1160 Large shallow inlets and bays; 1170 Reefs; 8330 Submerged or partially submerged sea caves. The diverse underwater relief (rocky bottom made of calcareous sandstone and marl-limestone complex, medium sands) provides optimal conditions for the great diversity of marine organisms including species listed in annex II of EU Habitats Directive like cetaceans and shads (*Alosa* spp.) (MOEW 2020). The survey has not covered the entire marine area of the site but only the part within boundaries of Bulgarian territorial waters with a total area of 786.24 km^2 (89.2% of the marine area of this site). The study plan was limited by logistical and administrative reasons: the speed of the available platform, the limited number of days with favourable conditions, the border control required when leaving territorial waters, etc.

Survey design

The design was based on the available budget and platform to assure feasibility of the planned survey as the high cost and the available time with favourable weather conditions were the major limitations for marine surveys. The survey design was made using Distance 6.0 package and included four transect lines with total length of 104.9 km assuring coverage of 10.7% and equal coverage probability (Fig. 1). The design followed a zigzag shape in an east-west orientation, perpendicular to coast to assure sampling across the expected density gradient (depth) with the aim of reducing the encounter rate variability.

Data collection

Data were collected during three days in April (1st, 23rd and 24th April) and one day in May (28th) 2016 using a 12.8 m motor sailing yacht as platform. The time of surveys was selected to be in spring to coincide with start of reproduction season of cetaceans and seasonal movement from Eastern to Western Black Sea with resulting higher density in the study area. During the surveys, the standard line-transect distance sampling (Buckland 2004, Buckland et al. 2001) methodology was used deploying single platform (2 observers and one data recorder). Basically, that method included traversing along predetermined transect lines and whenever an object of interest (cetaceans in our case) was observed, the distance to the object was recorded together with the radial angle (the angle between the object and the

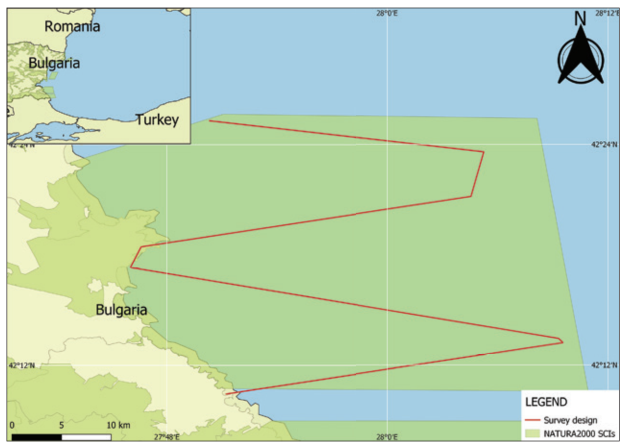

Fig. 1. Map of survey design.

Table 1. Effort, sightings and encounter rates of cetaceans by days.

Description	1.04.2016	23.04.2016	24.04.2016	28.05.2016	Total
Effort	65.7	45.5	15.2	55.5	**181.9**
Transect lines covered	1, 2 and part of 3	1 and 2	Part of 3	3 and 4	
Sightings of *P. p. relicta*	21	16	4	30	**71**
Max. group size of *P. p. relicta*	6	3	2	6	
Encounter rate of *P. p. relicta*	0.32	0.35	0.26	0.54	
Sightings of *T. t. ponticus*	1	3		3	**7**
Max. group size of *T. t. ponticus*	4	4		3	
Encounter rate of *T. t. ponticus*	0.02	0.07		0.05	
Sightings of *D. d. ponticus*	1	14			15
Max. group size of *D. d. ponticus*	4	9			
Encounter rate of *D. d. ponticus*	0.02	0.31			

transect line). The perpendicular distance between the object and the transect can be calculated using simple trigonometry (Buckland et al. 2001).

Observer's height of eyesight was approximately 2.5 m above the sea level. The effort during survey days varied (65.7 km on 1st April, 45.2 km on 23rd, 15.2 km on 24th April and 55.5 km on 28th May) due to coverage of different lines and deterioration of weather conditions. For effort, transect lines, encounter rate and maximum group size per day, see Table 1.

The average speed along all searched transects was 4–5 knots. The surveys were conducted at appropriate weather conditions (sea state less than 4 by Beaufort scale and good visibility – more than 5 km). The data on environmental conditions and the effort were also recorded during the surveys: at the start of a transect, at a rotation of observers or when a change in weather conditions occurred.

The species identity of cetaceans, group size, distance and angle of observation, behaviour and presence of calves were recorded for each sighting. The observers scanned from abeam (90°) on their side to 10° on the opposite side with naked eye; binoculars were used for identification of probable sightings and measuring distance to the animals. The distance and the angle of observations were measured using PENTAX Marine 7x50 reticle binoculars with a built-in compass. The geographic coordinates of sightings and the tracks of surveys were recorded by GPS (Garmin GPSMap 64st).

Data analysis

The abundance and density of individuals and groups were estimated by the analytical tools based on detection probability functions for distance sampling (Buckland et al. 2001), using Distance 7.3 software (Thomas et al. 2010). Density was calculated using the following formula (Buckland et al. 2015):

$$\widehat{D} = \frac{n}{2wL\widehat{P}_a} = \frac{n}{2\hat{\mu}L} = \frac{n\hat{f}(0)}{2L}$$

where $\widehat{D}$ is density; n is number of observed objects; L is sum of lengths of all transects; w is truncation distance from line; $\hat{P}$ is probability for detection; μ is effective strip (half-) width and f(0) is probability density function.

The abundance of animals occurring in clusters was calculated using the following Horvitz-Thompson estimator (Thomas et al. 2010):

$$\widehat{N} = \sum_{i=1}^{n} \frac{s_i}{\widehat{P}_i}$$

where n is number of observations; $\hat{P}$ is the estimated inclusion probability for animal i and S_i is the size of cluster i, i=1,…, n.

The encounter rate was defined as a number of sightings (groups) per kilometre of effort. The population density was estimated as a number of individuals per square kilometre. Only sightings on effort along transects were used in the analysis. The minimum value of the Akaike Information Criterion or AIC (Akaike 1974, Buckland et al. 2001) was used to choose between models. The AIC provides a relative measure of fit. The model with the smallest AIC provides, in some sense, the best fit to the data (Thomas et al. 2010). Difference more than 2 for AIC values shows better-fitting model. Results from performed analyses were compared also on basis of Goodness-of-fit tests and we used Cramér–von Mises (CvM) family of tests that are performed by DISTANCE package.

Sighting recorded during all survey days have been pooled together and the same applied for effort per transect. Since the number of sightings of the two dolphin species was low, detection function was calculated at global level for all sightings and post stratification by species was made for them. Both conventional distance sampling (CDS) and multiple covariate distance sampling (MCDS) with species and sea state used as covariates were executed.

Results

During these surveys, a total of 93 cetaceans' sightings were recorded. Highest number of sightings were registered on 23rd April and 28th May (33 each), followed by 1st April with 23 sightings. The lowest number was recorded on 24th April when, due to the weather deterioration, the survey was interrupted (Fig. 2). In April, all the three Black Sea cetacean species have been observed, while harbour porpoise and bottlenose dolphin have been detected in May only. In all the days, the highest encounter rate was recorded for the Black Sea harbour porpoise. Summarised data from all the surveys are presented in Table 2.

Black Sea harbour porpoise. It was the most often encountered species during all survey days, with a total of 71 sightings. The highest number of harbour porpoise sightings was of single animals (32 sightings, 45%) followed by groups of two (26 sightings, 37%) and three individuals (7 sightings, 10%). The maximum group size was six individuals (2 sightings, 3%) and groups of four and five animals were also observed at three occasions. The

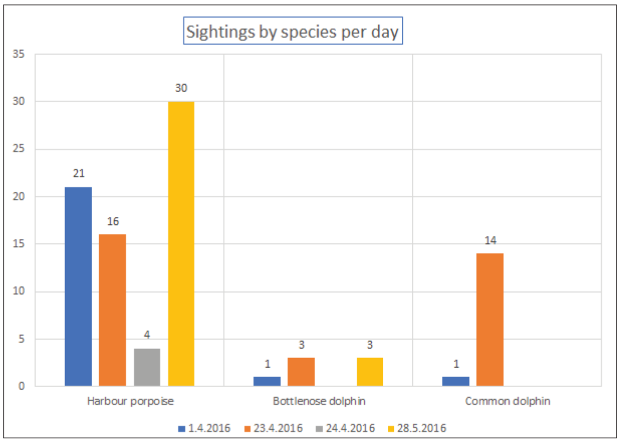

Fig. 2. Sightings by species on 1, 23 and 24 April and 28 May 2016.

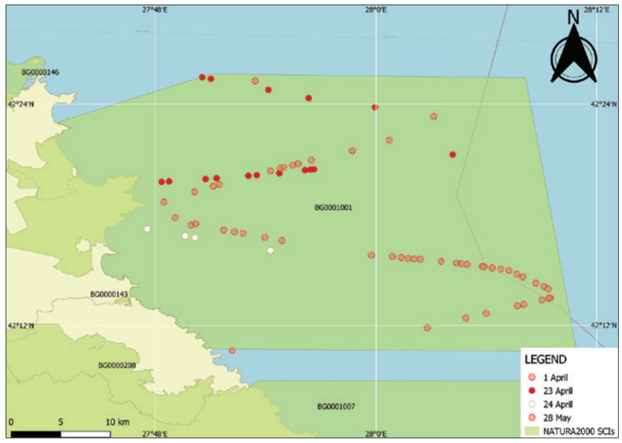

Fig. 3. Map of recorded sightings of harbour porpoises on 1, 23 and 24 April and 28 May 2016

Table 2. Sightings, mean group size and encounter rates by species.

Species	Effort (km)	Sight-ings	Mean group size	Encounter rate (groups.km^{-1})
Harbour porpoise	181.9	71	1.8873	0.39032
Bottlenose dolphin	181.9	7	3.0000	0.03848
Common dolphin	181.9	15	3.0000	0.08246

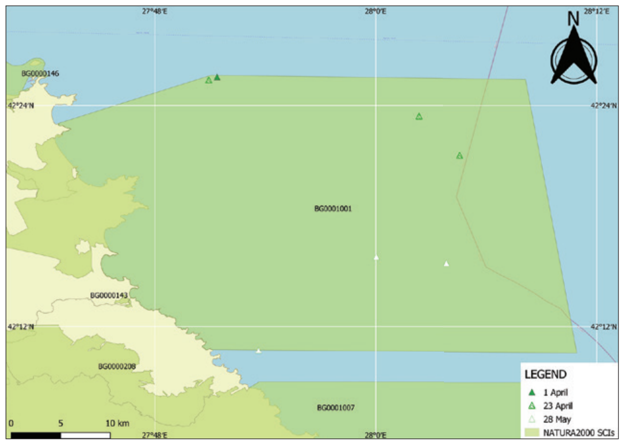

Fig. 4. Map of recorded sightings of bottlenose dolphins on 1 and 23 April and 28 May 2016.

spatial distribution of harbour porpoises in April surveys had a similar pattern, with more sightings in coastal waters and less in the offshore area. In May, the pattern was different, with higher density in the offshore part and less encounters inshore (Fig. 3). The encounter rate (sightings per km of effort) was 0.39 (CV=26.44%). The high number of sightings for that species provided a good basis for a robust estimate of the abundance and density. Analyses of the conventional and multiple covariate distance sampling with the sea state and the species have been performed. Three models of key function were used plus different series expansions. Half-normal and hazard rate key functions have shown best results as judged by AIC and values of CvM goodness-of-fit tests: the latter being used to see if model fits data or not. The lowest values of CV were for the CDS Half-normal key function with cosine series expansions. The best estimation for abundance of the harbour porpoise was 1468 individuals (CV = 29.46%, 95% CI: 686–3140) (Table 2).

Black Sea bottlenose dolphin. It was encountered at only seven occasions – four in April and three in May. The highest share was for groups of three individuals (three sightings, 43%), with the remaining sightings being for groups of two and four individuals. The spatial distribution was relatively even, with just slightly more sightings in offshore waters (Fig. 4). The encounter rate was 0.04 (CV=31.63%). During the transfer passage on 2nd April made in unfavourable weather conditions (sea state > 5), two groups with calves have been encountered suggesting the use of this site for rearing juveniles. Another large group (more than 30), with at least 5 calves, was observed feeding around a trawler during the transfer on 23rd April, just outside site's northern border. The sightings of all species have been pooled together for better fit of detection function with post-stratification by species. Half-normal and Hazard rate key functions have shown best results as judged by AIC and values of CvM goodness-of-fit tests ($p > 0.9$). Adding covariates species and sea state has not improved the model. The lowest values of the CV were for the CDS Half-normal key function with cosine series. The abundance of the bottlenose dolphin was 146 individuals (CV=34.75%, 95% CI: 59 – 362) (Table 4).

Table 3. Results for estimations of abundance and density of Black Sea harbour porpoise.

Model	AIC	CvM	Density			Abundance		
		p	ind. km^{-2}	CV %	95% CI	ind.	CV %	95% CI
MCDS Half-normal cosine + sea state	851.08	p>0.8	1.873	29.26	0.87367–4.0152	1473	29.26	687–3157
CDS Half-normal cosine	850.84	p>0.9	1.8669	29.46	0.87253–3.9943	1468	29.46	686–3140
CDS Hazard rate simple polynomial	850.50	p>0.8	1.7072	30.9	0.80409–3.6249	1342	30.9	633–2850

Table 4. Results for estimations of abundance and density of Black Sea bottlenose dolphin.

Model	AIC	CvM	Density			Abundance		
		p	ind. km^{-2}	CV %	95% CI	ind.	CV %	95% CI
MCDS Half-normal cosine + species	1129.67	p>0.9	0.13	45.98	0.0485–0.3508	103	45.98	38–276
MCDS Hazard rate simple polynomial + sea state	1129.33	p>0.9	0.196	47.09	0.0716–0.5358	154	47.09	56–421
CDS Half-normal cosine	1127.83	p>0.9	0.185	34.75	0.0747–0.4598	146	34.75	59–362
CDS Hazard rate simple polynomial	1127.92	p>0.9	0.179	35.72	0.0728–0.4396	141	35.72	57–346

Table 5. Results for estimations of abundance and density of Black Sea common dolphin.

Model	AIC	CvM	Density			Abundance		
		p	ind. km^{-2}	CV %	95% CI	ind.	CV %	95% CI
MCDS Half-normal cosine + species	1129.67	p>0.9	0.516	101.00	0.04368–6.0908	406	101.00	34–4789
MCDS Hazard rate simple polynomial + sea state	1129.33	p>0.9	0.471	100.74	0.03958–5.5978	370	100.74	31–4401
CDS Half-normal cosine	1127.83	p>0.9	0.549	99.34	0.04421–6.8107	431	99.34	35–5355
CDS Hazard rate simple polynomial	1127.92	p>0.9	0.53	99.69	0.04315–6.5009	416	99.69	34–5111

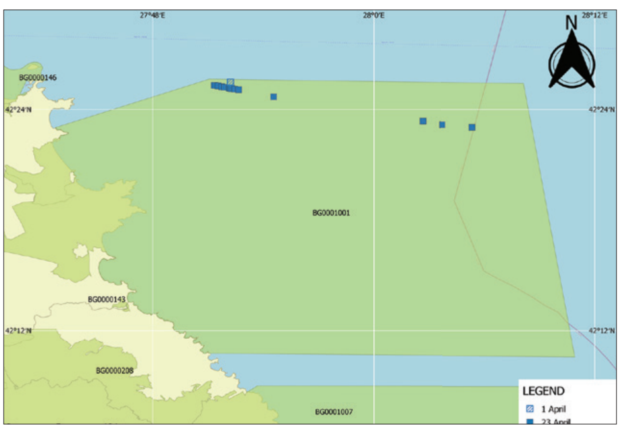

Fig. 5. Map of recorded sightings of common dolphins on 1 and 23 April 2016.

Black Sea common dolphin. This species was ranked second in terms of number of sightings but almost all the observations (14 out of 15) were registered on one day, i.e. on 23rd April, and along only one transect. It was not encountered during two of the survey days, including in May. The encounter rate in April varied between 0.02 and 0.31. The group sizes varied between 1 and 9, with the most frequent encounters of pairs (six sightings, 40%) followed by groups of three (three sightings, 20%); single animals and groups of four (each recorded twice, 13%). Groups of five and nine animals were observed only once. The spatial distribution showed a clear preference for the Northern part of the site; more specifically, all the sightings were made while travelling along transect line 1 (Fig. 5). That concentrated occurrence along only one line was the most probable reason for the high variance of estimated abundance (99–100%) as proven by the highest share of the encounter rate in the percentage of variation (95.1%) and the high CV of the encounter rate (97.23%). Just like the other dolphin species, the CDS Half-normal key function with cosine series expansions was the best fitting model with the lowest CV. The obtained abundance was 431 individuals (CV = 99.34%, 95% CI: 35–5355) (Table 5).

Discussion

Good examples for long-term monitoring and assessment of the status at the site-level are the programs at the Cardigan Bay SAC (Feingold & Evans 2012) and the Moray Firth SAC (Cheney et al. 2018) in the UK. They deploy a combination of line transect and photo-identification (Mark-Recapture) surveys. In the case of the Ropotamo SCI and other Bulgarian Natura 2000 sites, where such programs have not been developed, the first stage has to be to establish a baseline for the use of sites by marine mammals. Executing surveys combining the above-mentioned methods for a period of at least three years can provide an evidence for the role that the designated sites perform, e.g. migration corridor, rearing of calves, breeding site, etc. The follow-up regular monitoring by different methods can assure the needed data to assess the conservation status and the trends in the development of the populations at these sites. Since the historical data on the abundance of cetaceans in different waters around Europe are scarce (Bijlsma et al. 2018), which is especially valid for the Black Sea, the establishment of reference values is recommended to be set on the basis of the best estimate of the current value.

Buckland et al. (2001) recommend a minimum of 10-20 replicate lines to allow the reliable estimation of the variance of the encounter rate and to assure the required minimum of 60-80 sightings for the reliable estimation of the detection function. In our case, performing the first dedicated effort for the site and having in view the existing restrictions, it has been considered that the coverage of 10.7% is a decent compromise with restrictions imposed by the available platform and the budget. Our surveys have shown the presence of two target species for the site – harbour porpoise and bottlenose dolphin – in spring, with slight variation in the encounter rate between the survey days. A similar pilot survey that has been conducted in April and May in the same year in the adjacent BG0001007 Strandzha SCI situated to the south of the Ropotamo SCI has shown much lower density (0.871 ind.km^{-2} in April and 0.369 in May) and abundance (April – 328, CV=33.8%; May – 139, CV=50%) of the Black Sea harbour porpoise (Popov et al. 2020). The comparison of the quantitative estimations (1.8669 ind. km^{-2}) for Ropotamo SCI with results from similar surveys in other parts of the coastal Black Sea waters shows higher densities in that site than in others, with the exception of the survey in coastal waters of the Southeastern Crimea in April 2011 – 4.86 ind.km^{-2} (Krivokhizhin et al. 2012) and in the Romanian Southern territorial waters in June 2017 – 5.359 ind. km^{-2} (Paiu et al. 2019). Other surveys have reported lower densities: Bulgarian territorial waters – 0.144 ind.km^{-2}, Romanian territorial waters – 1.205 ind. km^{-2}, Ukrainian territorial waters – 0.273 ind.km^{-2} for July 2013 (Birkun et al. 2014), Central Bulgarian sector in November 2015 – 0.150 ind.km^{-2} (Panayotova et al. 2017), Dzharylgach area in Ukraine in June 2017 – 1.51 ind.km^{-2} (Gladilina et al. 2017) and Southeastern Crimea in November 2011 – 1.67 ind.km^{-2} (Krivokhizhin et al. 2012).

The density of the Black Sea Bottlenose Dolphin was 0.185 ind.km^{-2} while, in neighbouring Strandzha SCI pilot surveys at the same period, derived of densities 0.73 and 0.107 ind.km^{-2} for April and May, respectively (Popov et al. 2020). In July 2013, it was 0.696 ind.km^{-2} for the Bulgarian territorial waters (Birkun et al. 2014) and 0.323 ind.km^{-2} in the Central Bulgarian sector in November 2015 (Panayotova et al. 2017). In July 2013, the densities in the Romanian and Ukrainian territorial waters were respectively 0.217 and 0.343 ind.km^{-2}. In Dzharylgach area of Ukraine in June 2017, it was 0.22 ind. km^{-2} (Gladilina et al. 2017) and in the coastal waters of Southeastern Crimea (Krivokhizhin et al. 2012) in 2011 the densities were 1.47 ind.km^{-2} (April) and 2.54 ind.km^{-2} (June). In the Romanian Southern territorial waters, the densities of that species were 0.627 ind.km^{-2} in March and 0.424 ind.km^{-2} in June 2017 (Paiu et al. 2019). All these results show that we have registered the lowest densities of bottlenose dolphins in the Ropotamo SCI compared to the other surveys in Black Sea coastal waters.

In the present study, the estimated density of the Black Sea common dolphin is 0.549 ind.km^{-2}. This is similar to the Dzharylgach area of Ukraine with 0.51 ind.km^{-2} (Gladilina et al. 2017) and is higher than in the Romanian Southern territorial waters in summer of 2017 – 0.153 ind.km^{-2} (Paiu et al. 2019). We can also compare the encounter rates that vary between 0.02 and 0.31 with those in the Strandzha SCI where 0.1 and 0.02 have been recorded in April and May 2016, repectively (Popov et al. 2020). In June 2017, the encounter rate in the Dzharylgach area of Ukraine was 0.11 (Gladilina et al. 2017). Given the fact that the common dolphins are considered more offshore species compared to harbour porpoise and bottlenose dolphins, these low densities are not surprising. Comparing results from all these surveys are to be considered with caution in view of the different seasons and years of their implementation, suggesting different environmental parameters and variations in the availability of prey as fish in the Black Sea is highly migratory for the coastal waters. Seasonal variations could be significant as shown for Southeastern Crimea (Krivokhizhin et al. 2012).

The abundance, distribution, seasonal variation and trend are among the most important parameters for assessment of the status of populations of species of conservation concern like cetaceans. Combined with threats that derive mainly from human activities, these provide basis for identification of required measures for conservation. The EU Habitats Directive 92/43/EEC, which is the basis for the Natura 2000 establishment, requires member states to undertake management measures to ensure populations of species listed in the Annex II to be maintained at (or restored to) a favourable conservation status throughout their natural range in the EU (European Commission 2020). Given the fact that cetaceans are highly mobile species, the approach for defining conservation status is considered to be more appropriate at the basin level rather than at the national and the site level. The high cost of the basin-wide surveys makes them rare; therefore, local surveys are definitely beneficial to collect data on various population parameters.

Conclusions

This study has established the baseline in terms of approach and methodology for conducting distance-sampling surveys for the assessment of the abundance, density and distribution of cetaceans in marine areas of Natura 2000 sites in Bulgarian waters of the Black Sea.

● The improvement of the design through the increase of the coverage and the number of transects could be made (e.g. six zigzag lines increase the coverage three times) in a case that regular monitoring is organised and funded by the competent authorities. The spatial distribution of the encounters and the relatively small size of the study area do not suggest that stratification is required.

● The collected data represent contemporary information on the abundance and the density of the two target Black Sea cetacean subspecies for the SCI requiring conservation in a region where historical data are missing or scarce.

● In April and May, overlapping of habitats of the harbour porpoise and the bottlenose dolphin is observed; in April, the same was valid for the habitats of the harbour porpoise and the common dolphin.

● The common dolphin has been encountered only in April, concentrated at the Northern part of site.

● Line transect surveys are an efficient and relatively cheap tool for monitoring cetaceans in marine Natura 2000 sites. They should be conducted in different seasons to obtain data for estimation of the reference numbers and for detection of seasonal variations of target species.

● Results of this survey have shown that for improving data collection, a better platform is required with higher cruising speed of min. 6 knot.

The obtained abundance estimations show that the most abundant is the harbour porpoise, with a population exceeding 1000 ind.; bottlenose dolphins are around 100 individuals. These data underline the importance of the site for both target species in this SCI.

● The high density and abundance of the Black Sea harbour porpoise suggest the high importance of the site for this species. Further surveys should be made to identify whether such high density is maintained throughout the year or this area is a migratory corridor.

● The encountered groups of the Black Sea bottlenose dolphins with calves indicate the importance of the site for rearing of offspring and a more intensive photo-identification survey would provide evidence for the extent and duration of occurrence of such important groups at the site.

Acknowledgements: This paper is result of efforts implemented within different projects. Data were collected within the project **Citizens' support for study of Black Sea cetaceans along Bulgarian coast** funded by the Program BG03 in Bulgaria of FM of EEA 2009–2014. The analysis of the data was made thanks to support by ACCOBAMS Secretariat, EC (CeNoBS project) and OceanCare. We are grateful to all the volunteers participating in the pilot surveys, Prof. Phil Hammond, Sea Mammal Research Unit, University of St. Andrews, for training us in distance sampling, and Dr. Georgi Popgeorgiev of BSPB and NMNH-BAS, for the advice during revisions of manuscript.

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Received: 21.05.2020
Accepted: 22.08.2020