

Studying of the distribution and abundance of marine mammals in the Bulgarian Black Sea area by combination of visual and acoustic observations

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Абстракт

Изследвани са разпространението и числеността на китоподобните в българската акватория на Черно море, ограничена между н. Галата и н. Емине на дълбочини до 100 m през периода 04 – 09.11.2015 г. Проведените две последователни изследвания имат пилотен характер и комбинират преки визуални наблюдения за присъствие на китоподобни, извършени на борда на плавателен съд с акустично наблюдение чрез използването на буксируема система от хидрофони. По време на изследванията бяха наблюдавани само видовете P.p. relicta и T.t. ponticus, а D.d. ponticus не беше регистриран. Направени са общо 60 визуални наблюдения на китоподобни с обща численост от 163 индивида. Регистрирани са 43 акустични срещи, които включват 27 засичания на P.p. relicta и 16 – T. t. ponticus. Изчислени са популационните параметри (численост, плътност, численост на групите, честота на срещане) за всеки от наблюдаваните видове, като са използвани събраните визуални и акустични данни. Абсолютната численост на афалата в изследвания район е изчислена на 819 индивида, а на морската свиня - на 380 индивида.

Keywords: cetaceans, sightings, line transect method, acoustic detections, abundance, Bulgarian Black Sea area

Introduction

Marine mammals are important component of the biodiversity and occupy the top of the Black Sea food web as the largest predators. Cetaceans are highly mobile and migrate over vast areas. Three cetacean species are resident in the Black Sea, nominated as separate subspecies – the common bottlenose dolphin (*Tursiops truncatus ponticus* Barabash-Nikiforov, 1940), the short-beaked common dolphin (*Delphinus delphis ponticus* Barabasch-Nikiforov, 1935) and the harbour porpoise (*Phocoena phocoena relicta* Abel, 1905)[1]. All three species are protected by both national legislation and international agreements including the EU Habitats Directive and the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS) and their catch is prohibited. The studies about the distribution of marine mammals in the Bulgarian Black Sea area are scarce and the known distributional patterns were derived mostly from opportunistic sightings during the research cruises with other goals [2, 3, 4, 4]. According to the available information about distribution of marine mammals in the Bulgarian Black Sea waters and their ecological preferences, in general could be summarized, that the harbor porpoise inhabits shallower waters (0 – 200 m) over the shelf, but often was recorded in the open sea areas [1] depending on the distribution of the food resources – pelagic and demersal fish species. Short-baked common dolphin occurs predominately in offshore areas, but visits also coastal waters [1, 2, 3, 4], following the seasonal migrations of the major food prey – agglomerations of schooling pelagic fish species. Bottlenose dolphin resides in both coastal and open sea waters [1]. Recent distributional data about the three cetacean species were collected during the research cruises within the period 2006 – 2014 [2, 3]. During the period 2013 – 2015, two surveys dedicated to the estimation of abundance, density and distribution of small cetaceans in the Bulgarian Exclusive Economic Zone were conducted, but the obtained results were significantly different and incomparable probably due to different methodological approaches and surveys design [6, 7].

The aim of the present study is to collect new data about the distribution and abundance of the three small cetacean species in the Bulgarian Black Sea area by conducting of pilot survey, which combines vessel based visual and acoustic observations.

Material and methods

The pilot visual and acoustic survey on board of small vessel was conducted during the period 04.11.2015 – 09.11.2015. The study area of 2540.13 km² was covered twice during the two consecutive pilot surveys with total length of the transect lines of 229.65 km and observation effort of 35 hours – Fig. 1. Pre-determined track-lines were designed using Distance 6.2 software (Fig. 1), following the principles of line transect sampling deploying equal spaced zigzag design [8, 9]. Acoustic data were collected and analyzed by software PamGuard.

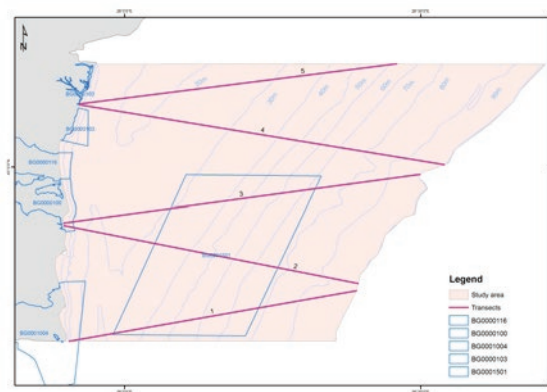


Figure 1. Survey area, showing the planned pre-determined track-lines for visual and acoustic observations in the Bulgarian Black Sea area.

Visual observations were carried out during the daylight hours, in suitable sea states (sea state ≤ 4) and visibility conditions more than 1000 m, applying the single platform method where the observers were positioned at height of 2.50 m above the sea level. Two observers maintained continuous visual effort and scanned the sea with the naked eye to a distance of 500 m in an arc from 0° to 90° either side of the vessel. Binoculars were used for species identification and measuring the distance and angle to the observed animals. Upon sighting a marine mammal, the observer recorded the date, time, angle and distance, species, abundance, behavior and number of groups. GPS data were logged automatically to the database continuously, including date, time, and vessel position (latitude, longitude). Records of estimated environmental variables (such as sea state, wave and swell height, wind direction) and survey effort were also collected throughout the survey.

Acoustic sampling was conducted using towed hydrophone array containing two broadband elements with 2 kHz and 150 kHz bandwidth, towed 200 m be-

hind the vessel. Two -channel 16-bit wav files were recorded continuously using PamGuard. In parallel, a database was created for recording of cetaceans' vocalizations, the registration time and the GPS coordinates, the depth data and the configuration of the system.

Results and Discussion

Only two cetacean species were observed visually and acoustically during the pilot surveys - *P. p. relicta* and *T. t. ponticus*. Common dolphin - *D. d. ponticus*, was not recorded. The spatial distribution of sightings by species during the two pilot surveys is presented on Fig.2.

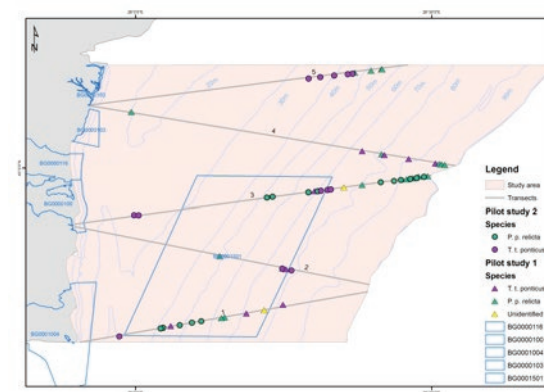


Figure 2. Map, showing the locations of observations of marine mammals by visual method during the Pilot study 1 (04.11.2015 – 06.11.2015) and Pilot study 2 (07.11.2015 – 09.11.2015).

During the Pilot study 1, 32 sightings of marine mammals were recorded with total number of 101 individuals. During the second study, 62 animals were observed in 28 sightings. The most of the observations were made outside the territorial sea at depths of 40 m in the NATURA 2000 site “Emona” (BG0001501) and in the closest area.

Population parameters of harbour porpoise and bottlenose dolphin (abundance, density, cluster size) were calculated by Distance 6.2 software. Due to low number of sightings per species during each pilot study, survey data from both pilot studies were combined and analyzed together. Obtained results are presented on Table 1.

Table 1. Estimates of population parameters of bottlenose dolphin and harbour porpoise during the pilot studies based on visual data.

Parameters	<i>T.t. pontucus</i>	<i>P.p.relicta</i>
Area, km ²	2540.13	2540.13
Observation effort (total length of transect lines), km	228.33	228.33
Encounter rate (ER; n/L)	0.066	0.057
Coefficient of variation (CV), %	8.15	25.68
Estimate of density of clusters/groups (DS)	0.1075	0.057
Coefficient of variation (CV), %	18.86	36.54
Estimate of expected value of clusters/group size ($E(S)$)	3	2.615
Coefficient of variation (CV), %	17.21	23.53
Average cluster size	3	2.615
Coefficient of variation (CV), %	17.21	12.6
Estimate of density of animals (D , individuals/km ²)	0.323	0.150
Coefficient of variation (CV), %	25.54	43.46
Estimate of number of animals in surveyed area (N)	819	380
Coefficient of variation (CV), %	25.54	43.46

Bottlenose dolphins - *T.t. pontucus*, (23 sightings, 65 animals) were distributed unevenly in the studied area, from the shallower waters below 30 m to the open sea areas up to 100 m depth (Fig.2). Bottlenose dolphins have been observed as single animals (5 sightings; 7% of total individuals) or groups of two (7 sightings; 22% of total individuals), three (5 sightings; 23% of total individuals) or more individuals (6 sightings; 48% of total individuals). The largest group size consisted of 7 animals. According to the expected value of group size ($E(S)$) of 3 individuals (Table 1), 48% of the observed groups were bigger. The estimated values for density of *T.t. pontucus* groups (DS) and for single animals (D) were 0.108 groups.km⁻² and 0.322 ind.km⁻² (Table 1). Absolute abundance (N) was estimated as 819 individuals in the study area and the encounter rate (ER) - as 0.066 ind.km⁻¹ (Table 1).

Harbour porpoises – *P.p. relicta* (35 sightings; 95 animals) were observed in the shelf area, mostly in the offshore areas at depths more than 40 m (Fig. 2). Harbour porpoises have been observed as solitary animals (14 sightings; 14.74% of total individuals), groups of two (5 sightings; 10.53% of total individuals), three (6 sightings; 18.95% of total individuals) and more animals (10 sightings; 55.79% of total individuals). The biggest group was composed of 9 individuals. The esti-

mated value of the group size ($E(S)$) was 2.615 individuals – Table 1. Density of *P.p.relicta* groups (DS) and single animals (D) was 0.057 groups.km⁻² and 0.15 ind.km⁻². Absolute abundance (N) was estimated as 380 individuals in the surveyed area, and encounter rate (ER) - as 0.057 ind.km⁻¹ (Table 1).

At total, 89 acoustic detections were registered during the pilot studies, which correspond to 43 acoustic occasions after applying the rule for separation by at least 10 minutes between acoustic detections. Acoustic occasions include 27 detections of harbour porpoise and 16 – of bottlenose dolphin - Fig.3. During the analysis of the acoustic data, no traces were found that would meet the criteria for the common dolphin. All acoustic detections were accompanied by visual encounters. The most of the detections were located in the shelf area (Fig. 3).

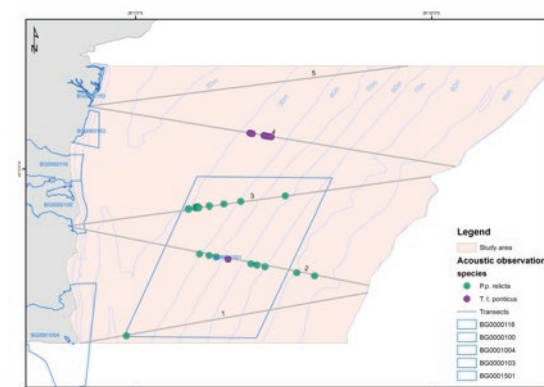


Figure 3. Acoustic detections of marine mammals during the pilot studies (05.11.2015 – 09.11.2015).

Relative estimation of population parameters of small cetaceans (number of acoustic detections/individuals per unit effort) based on acoustic data was conducted. The results are obtained as number of individuals per kilometer of the transect line and presented on Table 2. The harbour porpoise has the higher encounter rate, very close to those estimated from visual data (Table 1).

Table 2. Results from relative assessment of population parameters of *T.t. ponticus* and *P.p.relicta* during the pilot studies based on acoustic data.

Species	Number of detections	No of ind.	Encounter rate/ km	No per km
<i>T. t. pont icus</i>	8	25	0.034	0.054
<i>P. p. relicta</i>	2	64	0.058	0.139

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