

Occurrence of *Physeter macrocephalus* and *Ziphius cavirostris* in the North Ikaria Basin, Aegean Sea

Patrice Hostetter¹, Alexandra Koroza¹, Thodoris Tsimpidis¹, Guido Pietroluongo¹, Roberto Carlucci², Giulia Cipriano²

¹ *Archipelagos Institute of Marine Conservation, P.O. Box 42, Pythagorio 83 103 Samos, Greece, p.hostetter@archipelago.gr; aleksandra24koroza@gmail.com, t.tsimpidis@archipelago.gr*
guido.p@archipelago.gr

² *Department of Biology, University of Bari, Via Orabona 4, 70125 Bari, Italy, e-mail: roberto.carlucci@uniba.it; giulia.cipriano@uniba.it*

Abstract – The presence of two of the eight regular cetaceans of the Mediterranean Sea, the sperm whale (*Physeter macrocephalus*) and Cuvier's beaked whale (*Ziphius cavirostris*) is well-documented in the Western and Central Mediterranean Sea. In contrast, little information is available on their distribution in the Eastern Mediterranean, especially in the North Ikaria Basin (Greece), an underestimated important habitat for both species. Seasonal opportunistic visual surveys were conducted in this area from 2017 to 2019 to investigate their distribution. Out of 16 surveys, 4 sightings of *P. macrocephalus* and 2 sightings of *Z. cavirostris* were recorded. This is the first published, confirmed visual record of *Z. cavirostris* in this area. The documentation of both species in this preliminary study represents a significant contribution to consider efficient conservation action in this important area.

I. INTRODUCTION

The Mediterranean Sea is a hotspot of biodiversity [1,2] with around 17,000 species; out of which 1/5 are considered threatened (listed as either Critically Endangered, Endangered or Vulnerable by the IUCN) [3]. Among cetacean species regularly occurring in the Mediterranean Sea [4,5], the sperm whale, *Physeter macrocephalus*, and Cuvier's beaked whale, *Ziphius cavirostris* are deep-diving species, that due to their short surface period and long dive time, make difficult their field observation at sea [6,7,8].

The Mediterranean subpopulation of sperm whale is genetically distinct from the Atlantic one [9] and has been classified as Endangered by the IUCN [10]. Though no accurate population estimate exists in the basin, there is an estimated decrease in its population size due to anthropogenic impacts, such as entanglements in fishing nets and ship strikes [10].

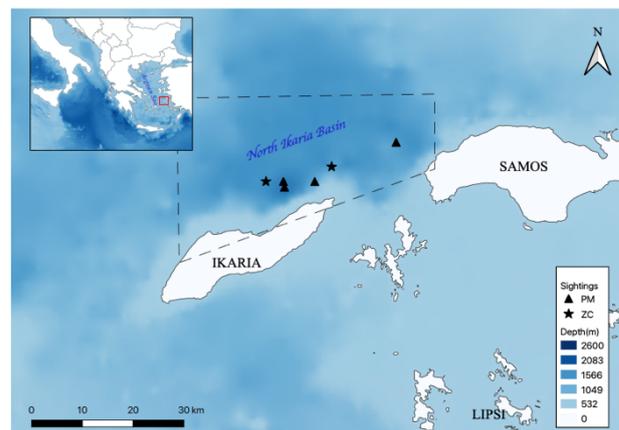


Fig. 1. Sightings of *P. macrocephalus* (represented by triangles) and *Z. cavirostris* (represented by stars) in the study area in the North Ikaria Basin, Aegean Sea from 2017 to 2020. Bathymetry data obtained from EMODnet Digital Bathymetry (DTM) [41].

Cuvier's beaked whale is the only beaked whale recorded in the Mediterranean [11] and much of the knowledge on its presence and distribution has come from stranding data. Recently, its Mediterranean subpopulation was classified as Vulnerable by IUCN [12] and estimated roughly 5800 individuals occurring in few, high-density areas [13].

Although these two odontocete species inhabit both the Western and Eastern Mediterranean basin, knowledge on their distribution is mainly referred to the western region, resulting in limited and fragmented information on their distribution in eastern basin especially in the Aegean Sea [13,14,15]. Here, most of the knowledge on *P. macrocephalus* originates especially from acoustic

surveys [16,17], followed by sporadic sightings and strandings data [18,19], while information on *Z. cavirostris* derives especially from strandings data and acoustic survey [11,14,16,20]. Therefore, the aim of this study is to provide updated information on the presence of these two deep pelagic species in the North Ikaria Basin, Greek Aegean Sea. In addition, preliminary information on their surface and dive behaviour are provided.

II. METHODS

A. Study Area

The North Ikaria Basin, in the central Aegean Sea, is characterised by an extended plateau with small underwater depressions up to 1000 m in depth [21] and featuring a deep trench that reaches up to 1200 m in depth [22].

B. Data Collection

Sighting data were collected in the North Ikaria Basin during seasonal vessel-based surveys carried out along opportunistic line transects from the islands of Samos and Lipsi to the island of Ikaria from March 2017 to October 2019 (Fig. 1). The sampling effort was set at about 5 h/day along 30 kilometres approximately. Speed was maintained at 6 knots and trips occurred only in favourable sea-weather conditions (Douglas scale ≤ 3 and Beaufort scale ≤ 4).

Four trained observers actively searched for cetaceans, using visual techniques by scanning the sea surface 360° around the research vessel, although observers focused the majority of their effort ahead of the vessel at the track line [23]. When a sighting occurred, data including time of first contact, depth (m) and group size (number of individuals) were collected and GPS coordinates were recorded every 3 minutes. In addition, weather conditions, the occurrence of other species or other nearby vessels, was also recorded.

Behavioural data were collected every 3 minutes for at least 30 min or until individuals exhibited negative behaviour, adopting the focal-group method with instantaneous scan sampling [24]. Behavioural variables recorded included distance from boat, speed, aerial displays, and activity [24,25]. When possible, photos were taken using a Canon EOS 1300D with an EF 75-300mm ZOOM Lens and a video recording was taken using a JVC EverioR camcorder.

III. RESULTS

A total of 16 surveys were carried out in the North Ikaria Basin, applying an effort of approximately 54 hrs of observation covering 494 km. Four sightings of *P. macrocephalus* and two sightings of *Z. cavirostris* were recorded during the study period at a mean depth ranging from 981 to 1200 m (Table 1).



Fig. 2. *P. macrocephalus* recorded on 02/09/2019 in the North Ikaria Basin. ©2019 T. Tsimpidis, Archipelagos Institute of Marine Conservation.

A. *Physeter macrocephalus*

From March 2017 to October 2019, a total of 7 *P. macrocephalus* were recorded, 2 in 2017 and 5 in 2019 (Table 1). Sightings occurred at a mean depth of 1138 ± 362 m and at a mean distance from shore of 6.2 ± 2 km (Table 1). Two sightings occurring in 2017 and 2019 lasted over an hour.

The first occurring on September 13th, 2017 had a duration of 150 minutes in which 2 sperm whales spent approximately 57% of the sighting resting, characterised by slow-swimming surface movements, 37% in short dives (<5 mins) with 2-4 minutes surface interval between each dive and 5% of the time swimming moderately fast. In addition, 3 breaches and 4 fluking events, which occurred before the final long dive towards the end of the sighting, were observed.

The second sighting of 3 sperm whales occurring on September 2nd, 2019 had a duration of 70 minutes. During the sighting, 2 of the larger whales dove near the beginning of the sighting and were not re-sighted. The third smaller whale (Fig. 2) spent approximately 62% of the sighting resting, characterised by slow-swimming surface movements, and 38% of sighting swimming towards and circling the research vessel. A breach event, as well as 4 fluking events, a head slap and 2 tail slaps were observed.

Two additional sightings on August 29th, 2019 and October 30th, 2019 lasted less than 5 minutes and therefore no behavioural data was collected.

B. *Ziphius cavirostris*

In the same study period, a total of 4 individuals of *Z. cavirostris* were recorded, 2 per sighting (Table 1). Sightings occurred at a mean depth of 1091 ± 159 m and at a mean distance from shore of 8 ± 3 km (Table 1).

Both sightings lasted less than 10 minutes, in 2017 the sighting had a duration of 9 minutes, while in 2019 both whales dove immediately after being sighted. Unfortunately, due to distance and the short observation

time, no behavioural data was collected.

Table 1. Sampling period, number of surveys, effort (hours and kilometres), mean depth of sightings (m), number of sightings and individuals of P. macrocephalus and Z. cavirostris occurred in the North Ikaria Basin, from 2017 to 2020. Depths obtained from EMODnet Digital Bathymetry (DTM) [41].

Sampling period	# of survey	Effort		# of sightings		# of individuals		Mean Depth (m)	
		hours	km	PM	ZC	PM	ZC	PM	ZC
Mar-Oct 2017	5	13:24	187.8	1	1	2	2	1020	981
Mar-Oct 2018	6	20:06	166.6	-	-	-	-	-	-
May-Oct 2019	5	20:48	139.4	3	1	5	2	1176	1200
Total	16	54:18	493.8	4	2	7	4	1138	1091

IV. DISCUSSION

This preliminary study provides reliable evidence of the occurrence of *P. macrocephalus* and *Z. cavirostris* in the North Ikaria Basin and provides an update on current knowledge of their distribution in a data-deficient area [14].

A. *Physeter macrocephalus*

Available published data until now showed that the occurrence of *P. macrocephalus* in the North Ikaria Basin resulted in 4 sightings recorded from 2004 to 2012 [13] and by acoustical surveys carried out in 2013 [14]. The addition of 4 sightings of 7 individuals in this area contributes significantly to knowledge base in this data-deficient area.

Distribution of *P. macrocephalus* is highly dependent on prey availability, which is found at depths of 500-1000 m [26]. In the Eastern Mediterranean, most records of *P. macrocephalus* occurred at depths ranging from 500-1500 m [14], though some have been recorded at depths as low as 3600 m [16] which is consistent with the sightings in this study. In addition, as with previously recorded sightings [18], sperm whales recorded here in 2017 and 2019 occurred during the fall and winter months. The proximity of the North Ikaria Basin to core habitats [11,15] suggests the hypothesis of migratory routes of the species.

The exact purpose of surface activity of *P. macrocephalus* is unknown, though it hypothesised have a social function [27-29]. Whales engaging in social or resting behaviour generally follow the same surfacing pattern, in which longer surfacings are interspersed with short, shallow dives [30-32]. The whales sighted on

September 13th, 2017 were likely engaging in social activity, further confirmed by the observation of breaches and fluking events [28]. The second prolonged sighting on September 2nd, 2019, is more difficult to analyse due to a lack of data available on the age class of the three sperm whales recorded; however, the smaller whale remained at the surface and was observed tail slapping, breaching, and head slapping, which has been known to be used for communication purposes [27-32].

B. *Ziphius cavirostris*

The occurrence of 2 sightings of two individuals of *Z. cavirostris* represents the first published visual record of this species in this area, where it was only detected acoustically [16]. Interestingly, the 2017 sighting is in close proximity to where they were acoustically detected in 2013 [16]. Moreover, the presence of 2 individuals together in both sightings recorded in the study area, provides more discussions about the hypothesis of habitat use and social structure of the species in the study area. This also suggests that the North Ikaria Basin is an important area for *Z. cavirostris*; which is further highlighted by the presence of the steep slope in the sea floor, providing suitable habitat for hunting prey [14,33,34].

V. CONCLUSION

This study provides updated occurrence data of *P. macrocephalus* and *Z. cavirostris* in the North Ikaria Basin. Though limited by the lack of regular and dedicated survey effort to this area, it confirms the presence and distribution of these odontocete species in this part of the Aegean Sea providing, in addition, preliminary information on their surface behaviour.

The presence of these top predators is an important factor in maintaining a well-functioning ecosystem [35,36]. Due to their body size, these species can consume hundreds of kilograms of food per day [36,37]. As most of their diet consists of the widely distributed mesopelagic squid [19,34,37-40], the abundance of *P. macrocephalus* and *Z. cavirostris* help manage lower trophic levels.

To better understand their ecological role, it is crucial to understand species distribution in areas like the North Ikaria Basin. In order to fill in these important knowledge gaps that exist for these species, it is necessary to conduct more frequent dedicated surveys. Areas for future study are the establishment of migratory routes, feeding grounds, as well as seasonal distribution. Furthermore, future management and conservation measures rely on accurate population estimates and distribution. The information presented here is a prerequisite for developing efficient conservation action focused on these species.

VI. REFERENCES

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