

Greenpeace Research Laboratories Analytical Results Report 2021-05

Visual-acoustic Survey for Cetaceans of Hellenic Trench 2021

Greenpeace Arctic Sunrise Research

Field Research: 20th August to 11th September 2021

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Summary

A visual-acoustic survey was conducted by the Arctic Sunrise between the 20th August 2021 and 11th September with the aim of investigating the presence of cetaceans within the offshore region of the Hellenic Trench, west and southwest blocks. Predetermined track lines generated by the software Distance were surveyed to ensure coverage of the entire area. Tracklines were surveyed using both passive acoustic monitoring (towed array acquiring continuous recordings) and non-systematic visual survey effort with two observers on a rotation of watches from the bridge wings of the ship where conditions allowed. The survey was conducted over approximately three weeks, covering a total track line distance of 5971 km.

Four species of cetacean were detected during the acoustic survey (120 detections within the two blocks), with sperm whales providing the greatest number of confirmed species detections (35 detections, at 1250–4210 m deep), followed by Risso's dolphins (two detections, 2250–3830 m deep), and single occurrences of striped dolphins and rough toothed dolphins (*Steno bredanensis*). An additional 80 detections of unidentified dolphins within the family Delphinidae whose vocalisations could not be assigned to species level. Visual data was also consistent with these findings. Sightings provided positive identification of Risso's dolphins (two sightings, one confirmed by acoustics and images with group size ~40 individuals, the other at lower confidence with no images or acoustics), and eight

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unidentified dolphins too far from the survey track line to be identified. The results clearly demonstrate that at least four cetacean species use the offshore habitat of the Hellenic Trench at depths between approximately 440 m to 4,210 m. All four species are known to be impacted by multiple stressors in the Mediterranean, including from the impact of human activities, such as noise, ship strikes, macroplastic ingestion etc. Three of the four species (sperm whales, endangered; striped dolphins, vulnerable; rough-toothed dolphin, near threatened) are listed in the IUCN Red List of Threatened Species with recommendations for further research and habitat protection throughout the Mediterranean, while the fourth is classed as vulnerable in the national Red Book of Animals of Greece.

Background

The Hellenic Trench region is known to be a core habitat for sperm whales (*Physeter macrocephalus*) and Cuvier's beaked whales (*Ziphius cavirostris*). For Eastern Mediterranean sperm whales, surveys by Frantzis et al. (2014)¹ and Lewis et al. (2017)² are consistent in estimating a population size of between 200–300 whales, with highest densities located along the 1,000 m bathymetric contour. There is no current abundance estimate for Cuvier's beaked whales in this region, but sighting rates appear high in the Hellenic Trench area³⁴. Following a long period of scarcity of Cuvier's beaked whale sightings in this area related to multiple large mass strandings due to military sonar use⁵, higher sighting frequencies have been observed, presumably indicating recovery of the local population unit (Pelagos Cetacean Research Institute, unpublished data). Both these species are classed as threatened in the Mediterranean Sea. Sperm whales are listed as globally vulnerable, but the Mediterranean subpopulation is classed as endangered⁶ by the International Union for

¹ Frantzis A, Alexiadou P, Gkikopoulou KC. (2014). Sperm whale occurrence, site fidelity and population structure along the Hellenic Trench (Greece, Mediterranean Sea). *Aquatic Conservation Marine Freshwater Ecosystems* 24(SUPPL.1): 83–102.

² Lewis T, Boisseau O, Danbolt M, Gillespie D, Lacey C, Leaper R, et al. (2018). Abundance estimates for sperm whales in the Mediterranean Sea from acoustic line-transect surveys. *Journal Cetacean Research Management* 18:103–117.

³ Alexiadou P., Paximadis G., Politi E., Gannier A., Corsini-Foka M. (2003). Current knowledge of the cetacean fauna of the Greek Seas. *The Journal of Cetacean Research Management* 5: 219–232.

⁴ Cañadas, A. & Notarbartolo di Sciara, G. (2018). *Ziphius cavirostris* (Mediterranean subpopulation) (errata version published in 2020). *The IUCN Red List of Threatened Species* 2018: e.T16381144A184717719. <https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T16381144A184717719.en>. Downloaded on 05 July 2021.

⁵ Podesta et al. (2016). Cuvier's beaked whale, *Ziphius cavirostris*, distribution and occurrence in the Mediterranean Sea: High-use areas and conservation threats. In: Notarbartolo Di Sciara, Podestà and Curry. *Advances in Marine Biology: Volume 75. Mediterranean Marine Mammal Ecology and Conservation*. Chapter 4. pp 103–140.

⁶ Notarbartolo di Sciara, G., Frantzis, A., Bearzi, G. & Reeves, R. (2012). *Physeter macrocephalus* (Mediterranean subpopulation). *The IUCN Red List of Threatened Species* 2012:

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the Conservation of Nature (IUCN) and estimates suggest numbers are decreasing. Whilst globally classed as least concern, the Mediterranean subpopulation of Cuvier's beaked whale are listed by the IUCN as vulnerable⁷, with a decreasing trend in abundance. Much of the research on these two species has focused on nearshore areas and there is little information on distributions in offshore regions of the Hellenic Trench. Other species that have been recorded within the eastern Mediterranean basin are: fin whale (*Balaenoptera physalus*), northern minke whale (*Balaenoptera acutorostrata*), humpback whale (*Megaptera novaeanglia*), striped dolphin (*Stenella coeruleoalba*), Risso's dolphin (*Grampus griseus*), common dolphin (*Delphinus delphis*), bottlenose dolphin (*Tursiops truncatus*), harbour porpoise (*Phocoena phocoena*), long-finned pilot whale (*Globicephala melas*), killer whale (*Orcinus orca*) and rough-toothed dolphin (*Steno bredanensis*)⁸.

The primary aim of this research was to document the presence of cetaceans within the region west and southwest of Crete. This region comprises two survey blocks -southwest and west of Crete that are potentially to be the focus of seismic testing by Total to evaluate hydrocarbon deposits for the oil and gas industry. The blocks are contiguous to the Hellenic Trench Important Marine Mammal Area (Fig. 1) and represent an area of ~40,000 km² of the Eastern Mediterranean with less research effort than nearer shore habitats of the Hellenic Trench. In the current study, data on the presence of all cetaceans was recorded using a visual and passive acoustic survey of the area, during late August to September, with the aim of addressing this knowledge gap and improving research effort.

Methods:

Passive acoustic and opportunistic visual surveys were conducted across the survey area following predetermined track lines as generated by the software Distance⁹ following the standard principles for line-transect survey design to ensure coverage of the entire area (Figure 1). These tracks were generated given the specific survey parameters of the system

e.T16370739A16370477. <https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T16370739A16370477.en>. Downloaded on 05 July 2021.

⁷ Cañadas, A. & Notarbartolo di Sciara, G. (2018). *Ziphius cavirostris* (Mediterranean subpopulation) (errata version published in 2020). *The IUCN Red List of Threatened Species* 2018:

e.T16381144A184717719. <https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T16381144A184717719.en>. Downloaded on 05 July 2021.

⁸ Hellenic Trench Important Marine Mammal Area. Available at: <https://www.marinemammalhabitat.org/portfolio-item/hellenic-trench/>

⁹ Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. (2001). [Introduction to Distance Sampling: Estimating Abundance of Biological Populations](#). Oxford University Press, Oxford, UK.

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onboard the vessel *M/V Arctic Sunrise* (survey width of ~6 km)¹⁰. Two transects of approximately 2,999 km and 2,972 km in length were designed to provide sufficient coverage of the study area, with some overlap of the Hellenic Trench IMMA. The survey was conducted over approximately three weeks, covering a total trackline distance of 5971 km.

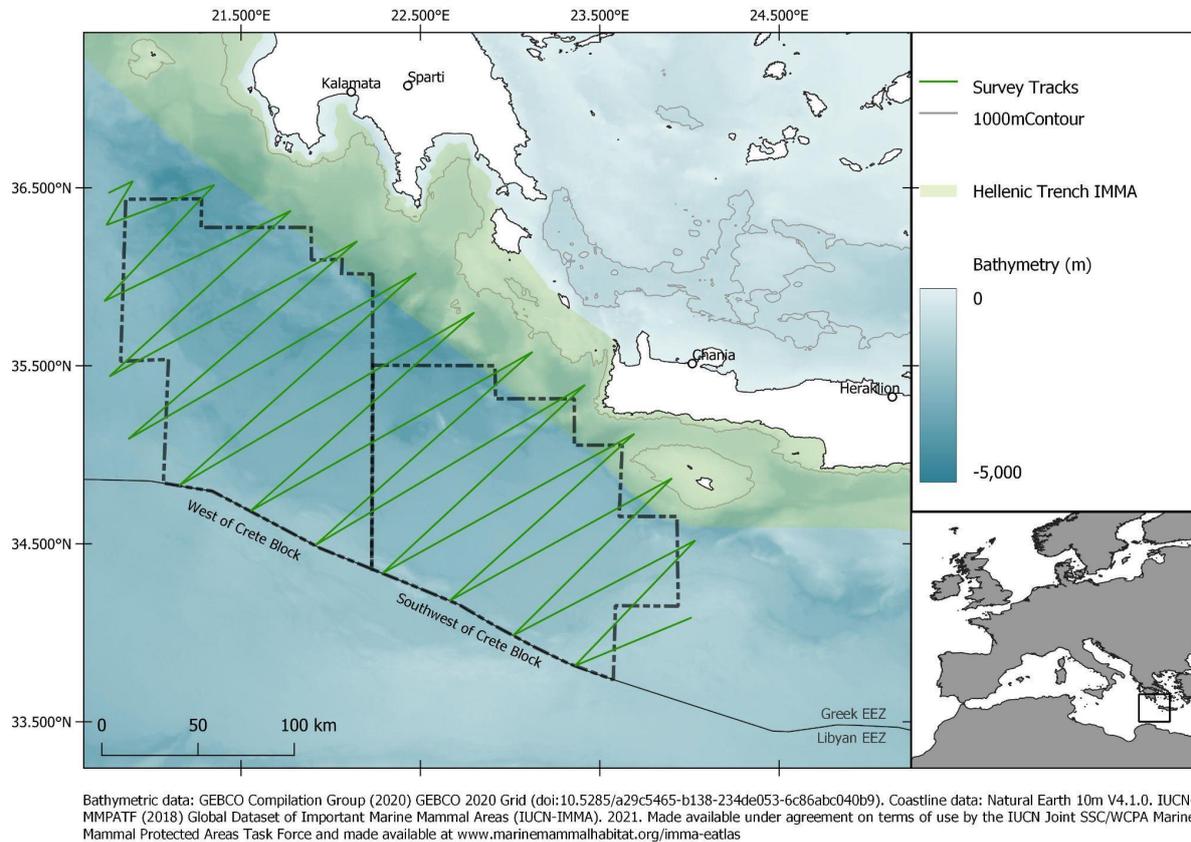


Figure 1. Survey area and predetermined track lines showing west and southwest blocks, and the location of the Hellenic Trench Important Marine Mammal Area (in green shading).

Passive acoustic survey

Acoustic data were collected on-board *M/V Arctic Sunrise* using a towed hydrophone array (Vanishing Point Ltd, Plymouth, United Kingdom). The array's streamer section comprised four hydrophone elements mounted within an oil (Isopar M) filled 5m long, flexible, 35mm diameter polyurethane tube. This was towed using a 350m Kevlar-strengthened tow cable. Two hydrophones, the 'medium frequency' pair (Benthos AQ4 elements and Magrec HP02 preamplifiers, nominal frequency range 50Hz to 40kHz) were spaced 3m apart while the 'high

¹⁰ Webber et al. In prep. Streamlining analysis methods for large acoustic surveys using automatic detectors with operator validation.

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frequency' pair (Magrec HP03 hydrophone and preamplifiers units, nominal frequency range 1 kHz to 200 kHz) were spaced 50cm apart. Each array element was connected to one channel of a four-channel SAIL data acquisition card (St Andrews Instrumentation Ltd, Tayport, United Kingdom) where analogue filtering and gain were applied before each channel was sampled at 500kHz. A high pass filter of 10 Hz and gain of 6 dB were applied to the 'medium frequency' channels 0 and 1, while a high pass filter of 2kHz and gain of 12 dB applied to the 'high frequency' channels 2 and 3. Data from the SAIL acquisition card were written as four channel .wav files using PAMGuard¹¹ (available at www.pamguard.org), which also carried out real time acoustic processing, displayed results and logged the ship location from GPS. The raw .wav data files were reprocessed onshore in conjunction with GPS data collected at the time using PAMGuard (version 2.01.05).

Acoustic .wav files were processed in PAMGuard offline using a click detection threshold of 16dB with a 20-degree angle veto to minimise the amount of noise being detected. Various thresholds were tested in 3dB steps from 10dB to 19dB to ensure maximum noise removal whilst keeping clicks from marine mammals. The click train detector module¹² within PAMGuard was used to group clicks into trains. Settings were determined through trial and error using a small subset of data in order to maximise the number of true click trains and minimise false trains occurring from noises from the towing vessel. Three spectral template classifiers which take the average spectrum of a click train and assign it a species once a correlation threshold is reached. The sperm whale, delphinid and beaked whale spectral classifiers used default settings from within the module. Two narrow band click classifiers with a frequency sweep were also added to search for beaked whale clicks. The first using the PAMGuard defaults for beaked whales with a test band between 24 kHz and 48 kHz, and the second higher frequency test band (40 kHz to 80 kHz) to search for higher frequency beaked whale clicks. The presence of a frequency sweep, assessed by eye, would be used in identifying the presence of beaked whales. A third narrow band classifier was also used to detect narrow band high frequency (NBHF) clicks, with a test band between 100 kHz and 150 kHz, providing a classifier for any NBHF species. These were then rolled out across the entire dataset. The whistle and moan detector within PAMGuard was also implemented between 1

¹¹ Gillespie, D, Mellinger, D., Gordon, J., McLaren, D., Redmond, P., McHugh, R., Trinder, P. ., Deng, X. ., & Thode, A. (2008). PAMGuard: semiautomated, open source software for real- time acoustic detection and localisation of Cetaceans. *Proceedings of the Institute of Acoustics*, 30(5).

¹² MacAulay, J. (2020). Chapter 2: Open Source Click Train Detector For Toothed Whales. University of St Andrews.

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and 24kHz¹³. Whistles are assigned a likelihood score for each species included in the classifier which will add up to one when all the species are summed. Species in the classifier were: bottlenose and common dolphin, false killer whale (*Pseudorca crassidens*), killer whale (*Orcinus orca*), pilot whale (*Globicephala* spp.), Risso's dolphin and striped dolphin. Species included in the classifier were recorded in other regions, not the Hellenic Trench.

Manual verification of recordings was then conducted on sections identified by the detectors as containing potential odontocete presence. Click trains and whistles were manually marked up in PAMGuard. Delphinid encounters were defined as periods of whistles and/or echolocation clicks separated by at least 20 minutes of silence before and after, while individual sperm whale and beaked whale click trains were treated as separate events. If any overlap between clicks and whistles occurred, they were included in the same event, except if the clicks originated from sperm whales. The location of encounters was estimated using target motion analysis within PAMGuard.

Visual survey

A non-systematic visual survey was conducted during daylight hours (0700 to 1800 local time) to provide additional evidence of cetacean presence in the survey area, and where possible data on: species identity, location, numbers of animals and behaviour.

Observers were located on the Arctic Sunrise bridge wings and performed one-hour watches throughout the survey period, scanning using both binoculars and the naked eye throughout the watch. At the beginning and end of every watch, or if any change was noted, the following environment and effort variables were recorded: effort status, observer identity, position, speed of vessel over ground, Beaufort Sea State, depth, water temperature, swell height and direction, visibility, glare and rain. Five of the 19 observers had previous cetacean visual survey experience and therefore the survey was deemed to be opportunistic. However, in addition to the continual effort from two dedicated observers in any one hour, additional watches were also completed opportunistically by the bridge officer on watch.

If cetaceans or turtles were observed, the following data were recorded: date, time (local), initial observer identity, effort status, ship's heading, position, depth, sighting method (naked eye or binoculars), initial sighting cue (blow, surface activity, body or submerged), bearing to

¹³ Gillespie, Douglas, Caillat, M., Gordon, J., & White, P. (2013). Automatic detection and classification of odontocete whistles. *The Journal of the Acoustical Society of America*, 134: 2427–2437.

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the animal, closest distance (estimated), group size (minimum / maximum / best guess), presence of calves, species (highest taxonomic group possible), and confidence of species identity (definite / probable / possible). Species identity was confirmed using Carwardine (2020)¹⁴. Where possible photographs were taken of the groups for the means of species identification.

Results:

Passive acoustic survey detections

Of 120 detections recorded in the passive acoustic survey throughout the west and southwest Crete Blocks, the presence of four species was confirmed: sperm whales (*Physeter macrocephalus*), Risso's dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*), and rough-toothed dolphins (*Steno bredanensis*). The majority of detections (almost two thirds) were of dolphins (Delphinidae) that could not be identified to species level (Table 1).

Dolphins detected using the whistle classifier had at least a 0.80 likelihood score providing good confidence of their species identity: Risso's (0.85 likelihood), striped dolphin (0.99 likelihood). One detection, initially identified as false killer whales (0.77 likelihood), required expert corroboration and so a recording was sent to experts at the United States National Oceanic and Atmospheric Administration for identification. The species recorded showed a characteristic 'stairstep' whistle that is consistent only with rough-toothed dolphins (*Steno bredanensis*) (Jennifer McCullough, Simone Baumann-Pickering, *pers. comm.*)¹⁵. With the exception of unidentified dolphins, sperm whales were by far the most frequently detected, with 35 detections throughout the study period in both west and southwest survey blocks, between 1250 m and 4210 m deep (Figure 2).

¹⁴ Carwardine, M. (2020). Handbook of whales, dolphins and porpoises. London: Bloomsbury Wildlife. p. 528.

¹⁵ Rankin, S, Oswald, J, Simonis, E, Barlow, J. (2015). Vocalisations of the rough-toothed dolphin, *Steno bredanensis*, in the Pacific Ocean. Marine Mammal Science 31: 1538-1548.

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Table 1. Acoustic detections of cetaceans using passive acoustic monitoring from the Arctic Sunrise during 20th August to 11th September 2021 survey of the west and southwest blocks of the offshore area of the Hellenic Trench. Depth ranges are derived from GEBCO bathymetric data¹⁶ and are rounded to the nearest 10 m.

Common name	Species	Number of detections	Comments
Sperm whale	<i>Physeter macrocephalus</i>	35	Depth range: 1250–4210 m
Risso's dolphin	<i>Grampus griseus</i>	2	Depth range: 2250–3830 m Detection 1: <u>Date:</u> 24th August 2021 <u>Time:</u> 02:36 UTC <u>Lat:</u> 35.8046 <u>Long:</u> 21.4320 Detection 2: <u>Date:</u> 10th September 2021 <u>Time:</u> 07:14 UTC <u>Lat:</u> 35.3284 <u>Long:</u> 23.17823
Striped dolphin	<i>Stenella coeruleoalba</i>	1	3470 m <u>Date:</u> 9th September 2021 <u>Time:</u> 08:38 UTC <u>Lat:</u> 35.2535 <u>Long:</u> 22.1337
rough-toothed dolphin	<i>Steno bredanensis</i>	1	Depth: 3650 m <u>Date:</u> 24th August 2021 <u>Time:</u> 15:43 UTC <u>Lat:</u> 35.5383 <u>Long:</u> 21.6454
Unidentified delphinid	<i>Delphinidae</i>	80	440–4390 m
	Total number of detections	120	

¹⁶General Bathymetric Chart of the Oceans. Available at: <https://www.gebco.net>

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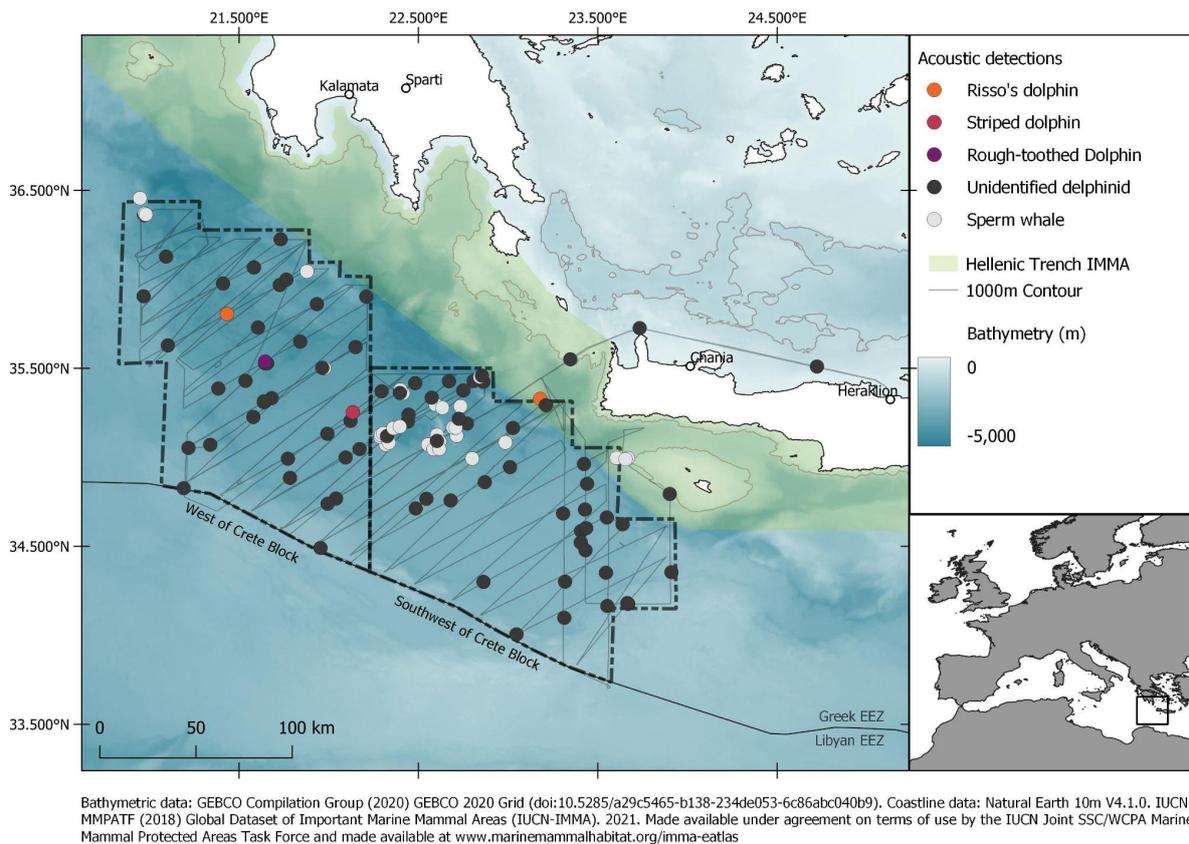


Figure 2. Acoustic detections of cetaceans from the Arctic Sunrise during the 20th August to 11th September 2021 survey period. Sperm whale detections are shown in light grey.

Visual survey observations

Visual survey effort totaled 441 observer hours, with 346 hrs of visual watches conducted in Beaufort Sea states no greater than three, ensuring ideal survey conditions. A total of 10 visual encounters with cetaceans were made and an additional 5 turtles were sighted during the survey period (Table 2). Risso's dolphins were encountered twice, with one sighting providing detailed images and observations to ensure an accurate species identity. The definitive Risso's dolphin encounter was with a group of 40 animals, who appeared to be travelling. No calves were present in the group, which proceeded to bow ride the ship. A second sighting was designated as 'possible' Risso's dolphins based on description but could not be confirmed.

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Table 2. Cetaceans and turtles observed during opportunistic visual surveys in the offshore region of the Hellenic Trench, west and southwest survey blocks, 20th August to 11th September 2021.

Common name	Scientific name	Number of encounters	Comments
Risso's dolphin	<i>Grampus griseus</i>	2	One encounter designated as 'possible' based on description. <u>Not confirmed by acoustic data.</u> <u>Second encounter confirmed with images and acoustics.</u> Group size = 40 individuals, no calves present. <u>Date:</u> 10th September 2021 <u>Time:</u> 07:14 UTC <u>Position</u> Lat: 35.3284 Long: 23.17823
Unidentified dolphin	Delphinidae	7	Not close enough to the ship to verify or have no images. Group sizes ranged from 2–12 dolphins.
Loggerhead turtle	<i>Caretta caretta</i>	5	
	Total	15	

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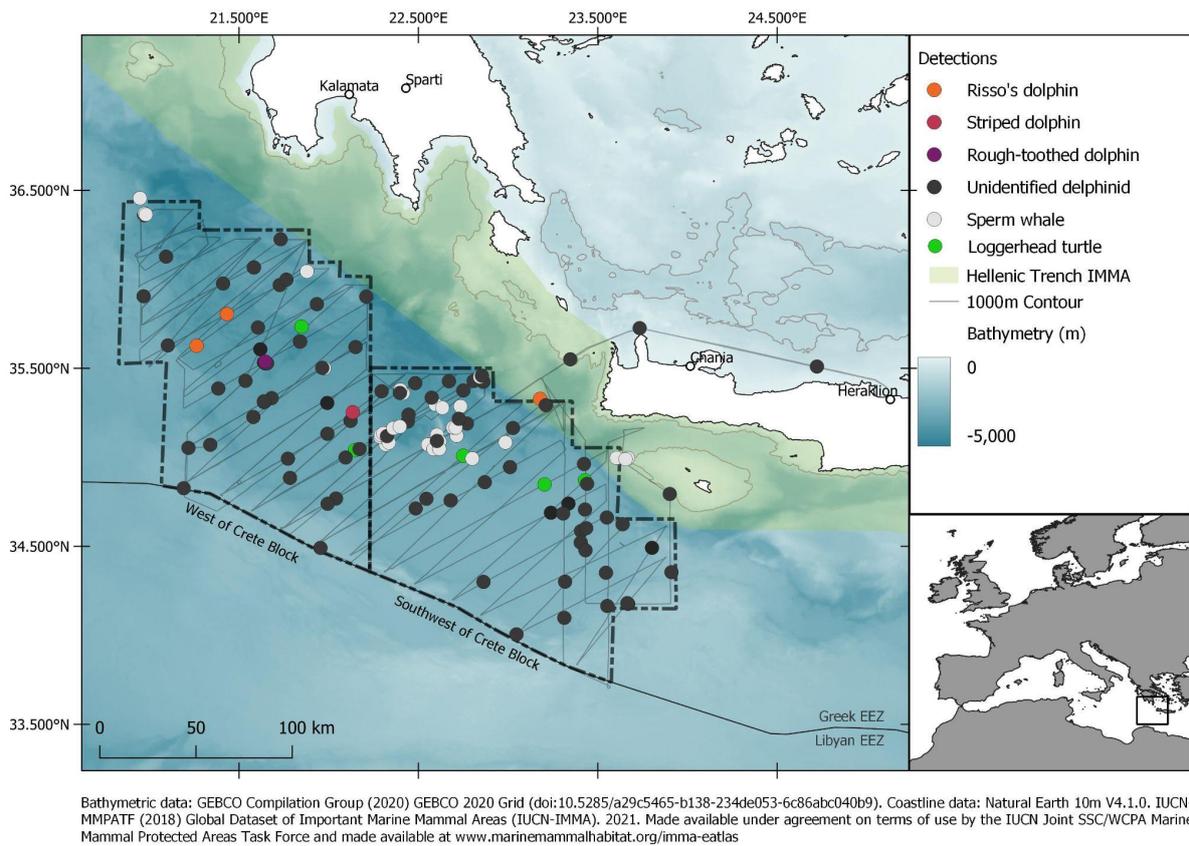


Figure 3. Cetaceans and turtles detected by the Arctic Sunrise in the offshore region of the Hellenic Trench during the approximately three-week passive acoustic and visual survey (20th August to 11th September 2021). Note: Map combines all acoustic and visual detections, including the Risso's dolphin visual detection of lower confidence.

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Conclusions:

The survey carried out by the Arctic Sunrise during 20th August to 11th September 2021, covered an approximately three-week period and a total track line length of 5971 km of the offshore area of the Hellenic Trench, west and southwest blocks. By combining passive acoustic monitoring (collecting continuous recordings 24 hrs day during the survey) and visual surveys during daylight hours, weather permitting, we show that at least four species of cetacean were present during the study period (155 detections, including transits to port, 120 detections within the study area). Additional acoustic detections and sightings of unidentified groups of dolphins suggest potentially more species, or at least greater numbers.

Taking both offshore blocks together, cetaceans detected include: sperm whales, Risso's dolphins, striped dolphins and rough-toothed dolphins. A specific threat status has been designated for Mediterranean sub-populations for these species^{17, 18}. According to the IUCN Red List of Threatened Species, one species identified is classed as endangered (sperm whales), one is vulnerable (striped dolphin), one is proposed near threatened (rough-toothed dolphin) by the specialists who recently assessed its status and one is data deficient (Risso's dolphin), requiring further research effort to better determine this species habitat use in the region (Table 3). It has to be noted that this last species (Risso's) is listed as vulnerable in the national Red Book of threatened animals of Greece¹⁹. Common threats to these species include noise pollution, ship strikes, macroplastic ingestion, chemical pollution, over fishing and harvesting of aquatic resources, disease, development and human intrusions and disturbances.

¹⁷ Boisseau et al. (2010). Encounter rates of cetaceans in the Mediterranean Sea and contiguous Atlantic area. *Journal Marine Biological Association UK* 90: 1589-1599.

¹⁸ Kerem, D., Frantzis, A., Scheinin, A., Goffman, O., In press. *Steno bredanensis* Mediterranean subpopulation - (Lesson, 1828). The IUCN Red List of Threatened Species.

¹⁹ Legakis A. & Maragkou. P. (2009). The Red Book of Threatened Animals of Greece. Hellenic Zoological Society, Athens, 528 p. (in Greek).

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Table 3. Cetacean species detected in the study area and the IUCN Red List of Threatened Species threat status for Mediterranean sub-populations where available.

Common name	Species	Number of detections	IUCN threat status in Mediterranean
Sperm whale	<i>Physeter macrocephalus</i>	35	Endangered ²⁰
Risso's dolphin	<i>Grampus griseus</i>	2	Data deficient ²¹ Vulnerable at the national level ¹⁹
Striped dolphin	<i>Stenella coeruleoalba</i>	1	Vulnerable ²²
Rough-toothed dolphin	<i>Steno bredanensis</i>	1	Near threatened ¹⁸

The most frequent species confirmed as being detected during the survey were sperm whales, in both west and southwest blocks, with three and 32 detections respectively. No sperm whales were observed during the visual survey, suggesting that these whales were detected either in poor light conditions, weather or were engaged in foraging dives, given the ease in distinguishing this species.

²⁰ Notarbartolo di Sciara, G., Frantzi, A., Bearzi, G. & Reeves, R. (2012). *Physeter macrocephalus* (Mediterranean subpopulation). The IUCN Red List of Threatened Species 2012: e.T16370739A16370477. <https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T16370739A16370477.en>. Downloaded on 12 October 2021.

²¹ Gaspari, S. & Natoli, A. 2012. *Grampus griseus*. The IUCN Red List of Threatened Species 2012: e.T9461A3151471. Downloaded on 12 October 2021.

²² Aguilar, A. & Gaspari, S. 2012. *Stenella coeruleoalba* (Mediterranean subpopulation). The IUCN Red List of Threatened Species 2012: e.T16674437A16674052. <https://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T16674437A16674052.en>. Downloaded on 12 October 2021.

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Risso's dolphins were detected acoustically twice, with one large group of at least 40 individuals, suggesting this region could be a feeding area for this species. Risso's dolphins are known to forage on cephalopods along continental slopes, preferring mesopelagic squid²³, and like other teuthivorous species, can be impacted by anthropogenic noise²⁴. The depth range for the Risso's encounters was 2250 - 3830 m deep, suggesting a potential for the deeper offshore areas of the Hellenic Trench to be important for foraging groups.

The Arctic Sunrise surveyed a large offshore area of the Hellenic Trench with effective coverage. The results clearly demonstrate that at least four cetacean species and loggerhead turtles use the offshore habitat of the Hellenic Trench at depths between approximately 1,000 m to 4,200 m. All four cetaceans detected are known to be impacted by multiple stressors in the Mediterranean, including from the impact of human activities, such as noise. Two of the four species are classed as threatened with recommendations for further research and habitat protection throughout the Mediterranean, while the third as near threatened and the fourth as threatened at the national level.

Acknowledgements:

Many thanks to the crew of the Arctic Sunrise, Jonathan Gordon and Doug Gillespie. Acoustic analysis was carried out by Thomas Webber.

Permit:

All research was conducted under the permit of the Marine Research Licensing Committee (MRLC). MRLC is a special inter-ministerial committee, the operation of which is based on provisions of the Greek Ministry of Foreign Affairs' Service Organisation.

²³ Luna et al. (2021). Cephalopods in the diet of Risso's dolphin (*Grampus griseus*) from the Mediterranean Sea: A review. *Marine Mammal Science* (online early). <https://doi.org/10.1111/mms.12869>

²⁴ Bearzi et al. (2011). Risso's dolphin *Grampus griseus* in the Mediterranean Sea. *Mammalian Biology* 76: 386-400.