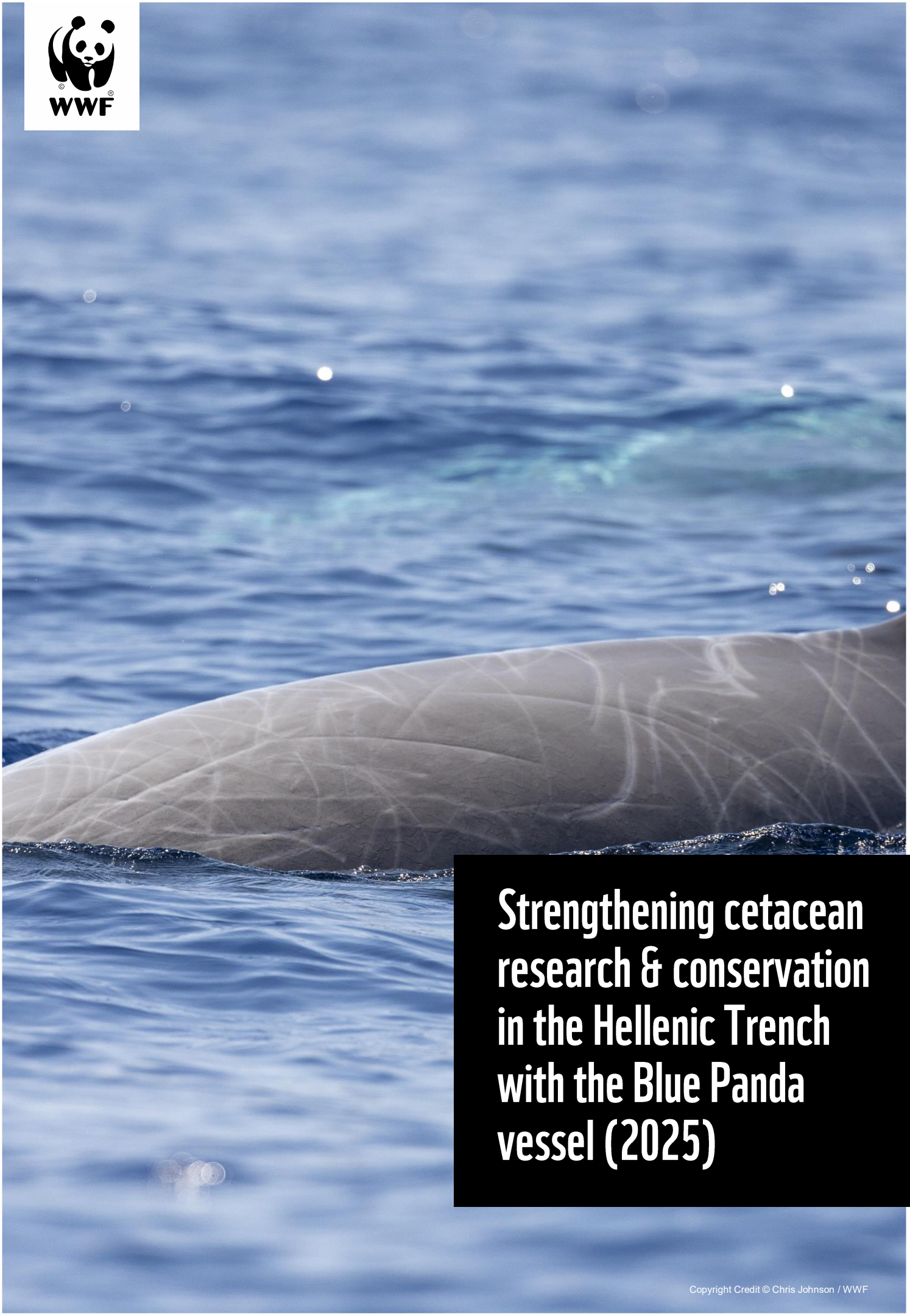
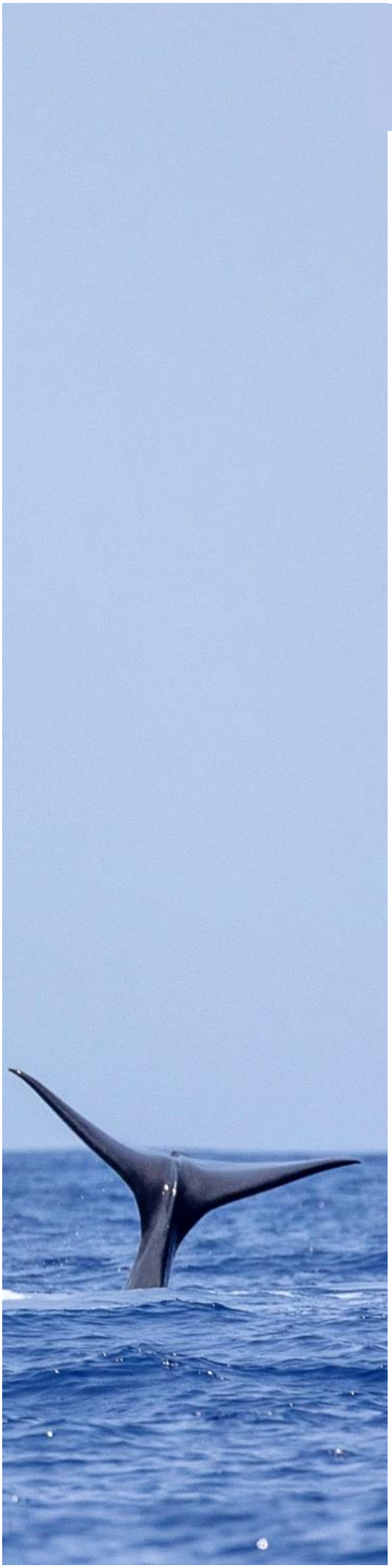


Strengthening cetacean research & conservation in the Hellenic Trench with the Blue Panda vessel (2025)



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Licensing:

All research activities were conducted under permits obtained from the Marine Research Licensing Committee (MRLC), the Ministry of Environment and Energy, and with the assent of the Natural Environment & Climate Change Agency (NECCA).

This project was implemented in coordination with the LIFE MareNatura consortium and has facilitated the exchange of information and knowledge towards the protection of cetaceans in the Eastern Mediterranean Sea, recognising the importance and the benefit of multilateral cooperation on

With the support of the: Greek Wildlife Alliance

THE WWF BLUE PANDA CETACEAN SURVEY IN GREECE IN 2025

For a second consecutive year, a research survey was conducted on the WWF Blue Panda vessel during the summer of 2025 to study deep-diving, noise-sensitive cetacean species in one of the most ecologically important marine areas in the Mediterranean, and a critical habitat for vulnerable marine species, the Hellenic Trench.

The **Blue Panda**, the WWF Mediterranean Marine Initiative is a 26-meter sailboat built in 1987 by a famous French naval architect, André Mauric, initially used as a private pleasure boat. Since 2018, when it was leased to the WWF Mediterranean Network, it serves as a **powerful medium and an attractive tool that interacts with the world and inspires the public to connect with the sea** and marine life, while also supporting the implementation of research work.

Between 5 and 23 July 2025, the Blue Panda sailed approximately 870 nautical miles across the onshore and offshore waters of the central and southern part of the Hellenic Trench in the Ionian. Starting from Zakynthos island and concluding in the port of Kalamata, Tethys Research Institute, with the support of WWF Greece through the Greek Wildlife Alliance Initiative and WWF Whales and Dolphins Initiative, implemented research activities focused on endangered cetacean species. The mission aimed to investigate the presence, behaviour, and migration patterns of cetaceans, as well as the threats they face in the region[1].

Despite challenging weather conditions and geopolitical constraints, the team implemented research activities targeting endangered cetacean species (including sperm whales, Cuvier's beaked whales, and other cetaceans), using different scientific methods such as visual and acoustic observations. As detailed in the Tethys Technical Report attached to this document, a total of 13 cetacean sightings were recorded, with Cuvier's beaked whales consistently observed throughout the survey area. In contrast, sperm whales were not visually detected this year, with only a single acoustic encounter documented.

The regular presence of Cuvier's beaked whales within high-traffic shipping lanes and areas licensed for hydrocarbon exploration and extraction underscores significant risks from ship strikes and acoustic disturbance, highlighting the urgent need to further investigate and assess their exposure to anthropogenic pressures. Meanwhile, the near-absence of sperm whales, combined with unexpected movement patterns observed in 2024, may indicate shifts in habitat use linked to environmental or human-driven changes, highlighting the need to expand connectivity research efforts that will help identify additional areas requiring protection.

[1] The main threats in the area are increased maritime traffic, habitat degradation due to pollution (plastic and chemical), fishing (reduced fish supply due to overfishing, and bycatch) and underwater noise caused by seismic tests for hydrocarbon extraction, shipping and naval exercises.

The **Hellenic Trench** is among the most ecologically significant deep-sea regions in the Eastern Mediterranean, stretching from the western Peloponnese to the southern Aegean and Dodecanese.

Despite its status as a critical habitat for endangered marine mammals, the area is facing severe and growing human pressures, including intense shipping traffic responsible for ship strikes, hydrocarbon exploration and emerging offshore development.

Among the region's flagship species is the endangered Mediterranean **sperm whale,** feeding and breeding in the area, and **Cuvier's beaked whales** occupying the deep parts where meso- and bathy-pelagic prey resources concentrate

Other smaller cetaceans, such as **striped dolphins**, are also present in the area, often found in large groups

Overall, the 2025 survey reaffirms the Hellenic Trench as a critical habitat for cetaceans, including in parts significantly affected by shipping traffic and hydrocarbon exploration and extraction activities, and stresses the importance of multi-year monitoring for better understanding newly identified patterns and guiding adaptive conservation measures. This need is further amplified by the growing pressures and impacts from human activities in the region, which pose both direct and indirect threats to cetacean populations.

Taking into consideration that targeted research activities are increasing our understanding of these sentinel species and their threats and can support advocacy and conservation efforts, ongoing and future management strategies must integrate robust science, multi-year monitoring, and precautionary spatial planning to ensure effective protection of cetaceans as well as compliance with national and international commitments.

Building on the scientific information collected, a third survey will be conducted in the summer of 2026 in collaboration with the LIFE MareNatura project and the ACCOBAMS Aerial Survey Initiative (ASI) II, and to further advance our knowledge of the endangered cetacean species in the region.

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Strengthening cetacean research and conservation in the Hellenic Trench with the Blue Panda Vessel (2025)

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Final report

Tethys Research Institute, January 2026

1. Executive summary

The present report builds directly on the outcomes of the first 2024 field season, documented in the report *Strengthening Cetacean Research and Conservation in the Hellenic Trench with the Blue Panda Vessel (2024)*. The 2024 survey demonstrated the value of integrating visual, acoustic, photogrammetric, and satellite-tagging methodologies in the northern Hellenic Trench, generating the first medium-scale movement data for an adult sperm whale in this region, which followed an unpredicted path. These initial results formed the scientific and operational basis for the 2025 research season, aimed at refining our understanding of sperm whale connectivity across Greek waters and, potentially, the broader Mediterranean Sea.

Telemetry effort from 2024 revealed that the tagged sperm whale used areas well beyond the currently recognised core habitat, including extended residency southwest of Kefalonia and Zakynthos and an unexpected, prolonged presence in the southeastern Aegean Sea. These findings challenge longstanding assumptions about habitat use and highlight the need for a sustained, multi-individual tagging strategy to clarify movement corridors, population connectivity, and inter-annual variability in movement patterns and distribution. In recognition of their scientific and management significance, the 2024 tagging-analysis results, although based on a limited sample size, have been submitted to the *Journal of Cetacean Research and Management* and are currently *in print* within the Special Issue "Cetacean Tagging: Advances and Insights" (https://doi.org/10.47536/jcrm.v5i1). The observed mismatch between the whale's realised habitat and existing Important Marine Mammal Area (IMMA) boundaries further underscores the need to revisit and strengthen spatial planning approaches to ensure they adequately reflect emerging ecological evidence.

The 2025 field survey took place between 5 and 23 July 2025 and focused on the northern and central sectors of the Hellenic Trench. The field effort was also closely coordinated with the EU LIFE MareNatura project, reinforcing a shared, cross-programme commitment to strengthening the conservation status of priority marine species in the Greek seas. Over the course of the mission, the Blue Panda covered approximately 870 nautical miles, with 13 cetacean sightings recorded, while Cuvier's beaked whales were consistently encountered. Survey effort was concentrated primarily in waters southwest of Zakynthos and along the western coast of the Peloponnese Peninsula, with additional effort in the Messenian Gulf, the Laconian Gulf, and the area between the Peloponnese and the island of Kithira.

Although the 2025 fieldwork was constrained by sub-optimal weather sea conditions and geopolitical constraints in the waters surrounding the island of Crete, that limited full coverage of the study area, and although the low number of sperm whale encounters prevented the deployment of additional satellite tags, these challenges yielded important insights into the complexity of the status, behaviour, and habitat use of cetaceans in the region. The paucity of sperm whale sightings –particularly in locations historically associated with higher encounter rates– may reflect temporary environmental shifts or may signal broader changes in distributional patterns. These uncertainties reinforce the importance of a dedicated 2026 research season. In fact, a multi-year approach is essential to determine whether recent observations reflect episodic fluctuations or a more persistent redistribution of cetaceans in the Hellenic Trench and adjacent seas. Understanding the drivers of inter-annual variability – whether ecological, oceanographic, or anthropogenic – is fundamental to informing adaptive conservation measures and ensuring that management and conservation responses remain aligned with the best available science.

Preparations for the 2026 season are already in progress. Building on the collaborative foundations established in previous years, the upcoming fieldwork will integrate more closely with the EU LIFE MareNatura project, ensuring harmonisation of methodologies, coordinated field implementation, and shared protocols and data that can support both national and regional conservation objectives. In parallel, we are building a new collaboration with the CIMA Foundation in Italy, which will significantly enhance research capacity through the expanded use of satellite tags on Cuvier's beaked whales; a species of high conservation concern, whose availability of movement and dive data is limited, which has been observed with higher frequencies over the last few years. This partnership will contribute essential information to guide protection efforts for one of the Mediterranean's most vulnerable deep-diving cetaceans. In addition, the 2026 survey is expected to operate in support of, or in parallel with, the newly-planned ACCOBAMS Survey Initiative (ASI II) effort. Such alignment will not only strengthen basin-wide data continuity but also directly contribute to the developing ACCOBAMS Long Term Monitoring Programme (LTMP), ensuring that national-level research efforts feed into a coherent regional framework for cetacean conservation. This provides a unique opportunity to harmonise scientific practice, enhance comparability across years and regions, and ultimately support evidence-based decision-making at multiple governance levels.

Collectively, these initiatives seek to reinforce the scientific foundation upon which effective conservation policies and spatial management tools can be built. Through coordinated, multi-year, and multi-partner collaboration, the research programme aims to deliver the robust empirical evidence necessary to safeguard cetaceans across the Hellenic Trench and the wider eastern Mediterranean.

2. Introduction

The Hellenic Trench is one of the most ecologically significant deep-sea regions in the Eastern Mediterranean, extending from the western Peloponnese to the south of Crete and the Dodecanese. Reaching depths of over 5,000 metres, the trench supports a distinct oceanographic environment marked by steep depth gradients, strong stratification, and the confluence of different water masses. These conditions generate a highly complex pelagic and deep-pelagic habitat that sustains a diversity of large marine vertebrates, especially deep-diving cetaceans. Among these, the endangered Mediterranean subpopulation of sperm whales (*Physeter macrocephalus*) relies heavily on the trench as a core feeding and breeding area. Similarly, Cuvier's beaked whales (*Ziphius cavirostris*), which are particularly susceptible to acoustic disturbance, occur here in unusually high densities, exploiting the deep, stable layers that concentrate their preferred prey, mainly meso- and bathy-pelagic cephalopods. The area also serves as an important habitat for fin whales (*Balaenoptera physalus*), most frequently observed in the northern Ionian sector, and the critically endangered Mediterranean monk seal (*Monachus monachus*), which favours nearby coastal areas and caves. The abrupt transition from deep waters to narrow shelves allows these species to exploit a range of habitats in close proximity to the coast, increasing their vulnerability to human activities. The Hellenic Trench is situated along a major east-west shipping corridor and is subject to different anthropogenic pressures, including intense maritime traffic, underwater noise from seismic exploration and military exercises, and potential impacts from future offshore developments. These disturbances pose cumulative risks to marine megafauna through habitat degradation, acoustic masking, behavioural disruption, and, in extreme cases, mortality.

The ecological and biological importance of the Hellenic Trench has been formally recognised by several regional and international conservation frameworks, including ACCOBAMS and the IUCN. In a recent development, the Greek government announced in July 2025 the creation of a new National Marine Park encompassing large sections of the Hellenic Trench, as part of its commitment to meeting the 30×30 global ocean protection target. These designations underscore the urgent need for coordinated conservation efforts to mitigate cumulative threats from anthropogenic pressures, which threaten the future persistence of this biodiversity hotspot. As pressures continue to mount across Mediterranean waters, the safeguarding of the Hellenic Trench represents a keystone action in the broader strategy to conserve marine megafauna and maintain the ecological integrity of this region.

This report presents a summary of the activities carried out during the second phase of the project, which started in 2024 and was further carried out in 2025. All fieldwork activities (including data and visual material collection) were implemented under the necessary research permits acquired by the relevant state authorities.

3. Methods

3.1 Study area

Fieldwork was conducted from the sailing vessel Blue Panda (MMSI 227245000). Daily visual and acoustic surveys were originally planned across the entire extent of the Hellenic Trench, covering both coastal and offshore waters from north of Kerkyra to the southern coast of Crete (Figure 1). The selected region extends for about 47,000 km^2 and was subdivided into six operational blocks to facilitate survey logistics, ensure effective spatial coverage and communicate with the relevant authorities.

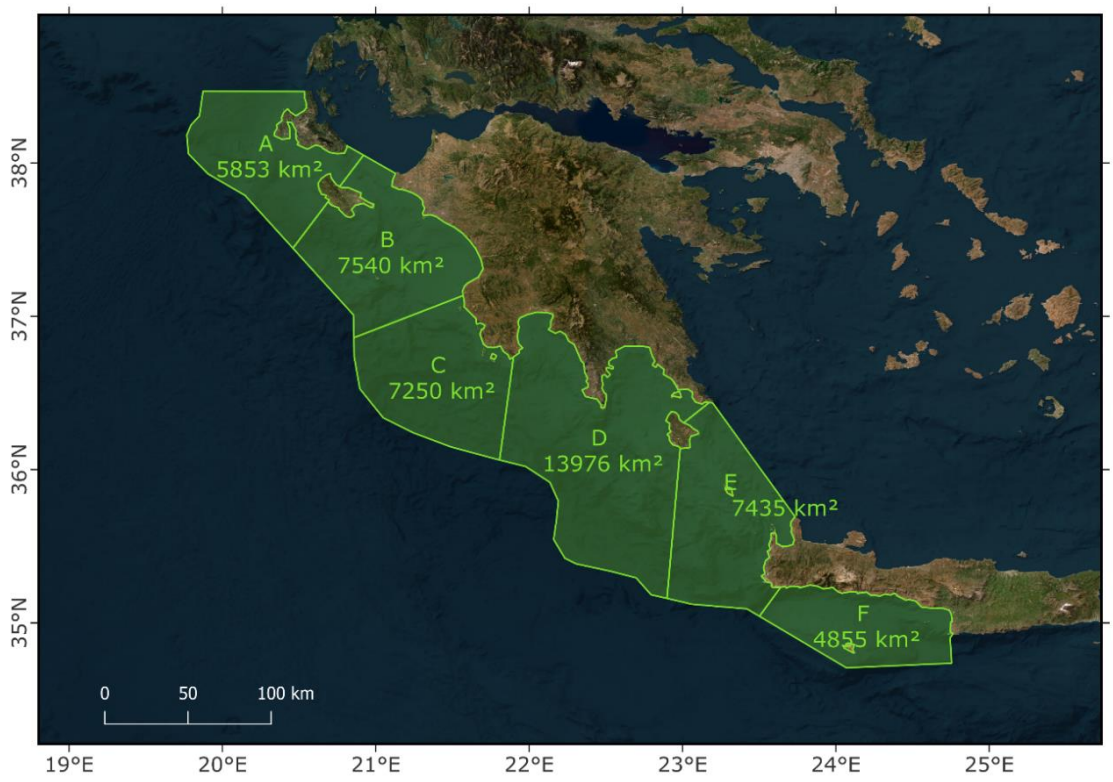

Figure 1. The study area and blocks.

This region, characterised by steep bathymetric gradients and abyssal depths of 2,000-4,000 m, is one of the most dynamic marine ecosystems in the Mediterranean that supports the presence of several species of high conservation and economic importance and is therefore subject to multiple layers of national and international protection, including an extensive network of Marine Protected Areas and other spatially explicit conservation measures (Figure 2). In addition to being encompassed by the Ionian Archipelago and Hellenic Trench Important Marine Mammal Areas (IMMA), the region is also covered by the newly declared and to be established Ionian marine park, stretching from northern Kerkyra to Antikythera (Figure 2).

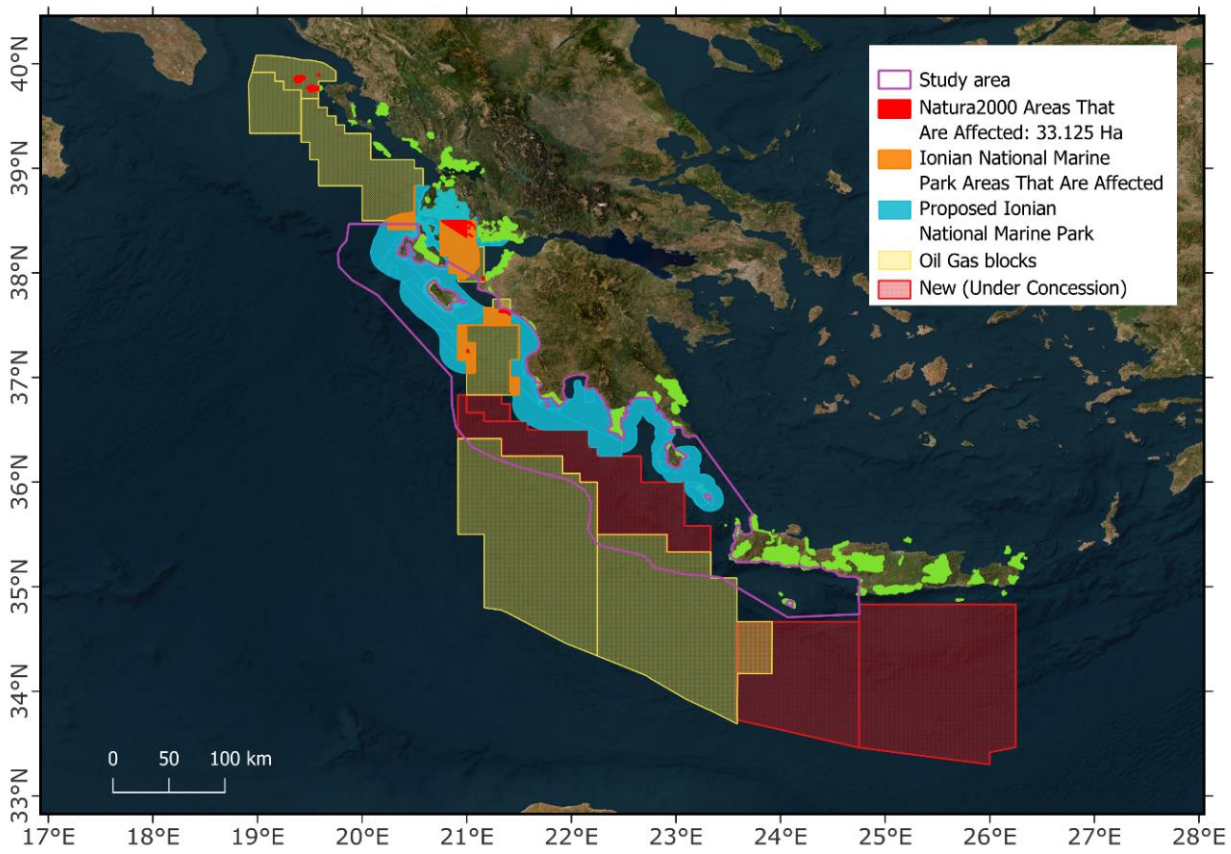

Figure 2. In red, the new blocks under concession for oil and gas exploration, alongside the ones already leased in yellow. In blue, the newly declared and to be established Ionian National Marine Park, with areas in the park affected by oil and gas blocks highlighted in orange. In light red, also the Natura 2000 site areas that are overlaid with oil and gas blocks.

3.2 Data collection

All survey activities followed the same protocols and procedures used in 2024 to ensure full comparability of methods, results, and outputs across years. Briefly:

- Visual sightings were complemented by acoustic detection for echolocating odontocetes using a towed horizontal hydrophone array compliant with ACCOBAMS Survey Initiative (ASI) standards.
- A 150-m streamer equipped with four ceramic sensors, amplifiers, and a pressure sensor was deployed. The system was connected to a topside rack hosting the required processing hardware, and recordings were made in stereo at a 500 kHz sampling rate.
- Visual and acoustic data were logged using Logger2010 (Marine Conservation Research, UK) and Pamguard, respectively.
- Following an initial behavioural assessment, the onboard RIB was deployed when conditions allowed to collect photo-identification (photo-ID) images, document behaviour, acquire drone footage and photogrammetric data.
- Opportunistic audio recordings of vocalisations were collected from the main vessel depending on weather, distance, and survey priorities.
- A DJI Mavic 3 drone equipped with an OSU Lidar Box was used to obtain precise altitude-calibrated imagery.
- When feasible, and after confirming suitable behaviour and health, Low Impact Minimally Percutaneous Electronic Transmitters (LIMPET; Wildlife Computers) were prepared for deployment on adult sperm whales. A GoPro Hero 8 camera was ready to document deployment quality and immediate reactions. When possible, tagged animals would be briefly followed to assess short-term behaviour and gather additional positional information using a CLS RXG-234 Goniometer.
- Additionally, environmental DNA (eDNA) sampling was implemented during the 2025 field season, in collaboration with the EU Biodiversa+ project “eWHALE” and Politecnico di Milano. eDNA was opportunistically collected by filtering 60 litres of seawater in proximity to sperm whales, using high-performance Sylphium or Waterra filters.
- Last, two additional research vessels were operating in different parts of the Hellenic Trench, the research vessel of the Pelagos Cetacean Research Institute and the vessel Artina of NCC, allowing for parallel efforts and strengthening the overall research and data collection effort.

3.3 Analytical framework

All analyses were designed to follow the methodological framework established in 2024, ensuring consistency and comparability across research seasons, allowing for seamless integration of new data into an existing multi-year context and strengthening the reliability of temporal comparisons. This analytical approach was intended to extract information on movement, behaviour, habitat use, spatial exposure to maritime traffic, and morphological characteristics from any telemetry and photogrammetric data collected during the fieldwork. In particular:

- The analytical workflow for telemetry data was developed to provide insight into potential foraging zones, displacement dynamics, movement strategies and routes, and behavioural states. This framework relies on a sequence of data-cleaning and regularisation steps followed by the application of continuous-time state-space models to reconstruct the most likely movement paths while accounting for location error. Regularised tracks would then be examined using a move-persistence modelling approach, capable of distinguishing between Area-Restricted Search (ARS; i.e., feeding) and Transiting behaviours, thus allowing spatial behaviour to be inferred across the movement paths.
- Kernel Utilisation Distributions analyses were implemented to assess spatial use and habitat preferences, estimate core and home ranges, identify areas of concentrated use, and delineate habitats likely to hold ecological or conservation relevance for the animals within the study region. These outputs form a critical basis for evaluating how movement intersects with environmental features and potential pressures.
- Realised habitat maps integration with vessel-density layers to investigate the interaction between cetacean distribution and maritime activity: this spatially explicit approach is intended to highlight areas where the co-occurrence of animals and maritime traffic may be greatest, and collision risk the highest, supporting management-relevant assessments of potential high-risk zones.
- Morphometric analyses: drone-based photogrammetry, calibrated using Lidar-derived altitude data, would allow for precise estimation of body length and, when possible, the derivation of body-volume proxies. Complementary acoustic measurements based on Inter-Pulse Interval (IPI) extraction from click trains were also planned to provide independent estimates of sperm whale body size.
- Photo-identification formed an integral component of the survey, providing essential information on re-sightings, social composition, residency patterns and population structure.

- eDNA: sampling sperm whale eDNA would produce genomic data, to be used for population genetic analyses and sex identification of individual animals, using a non-invasive collection method.

4. Results

Between the 5th and 23rd of July 2025, the Blue Panda sailed along the northern and central sections of the Hellenic Trench. Overall, 870 nautical miles were sailed (Table 1) with a total of 13 sightings recorded (Figure 3a and Table 2). Sperm whales were only acoustically detected and tracked once, southwest of the coast of Zakynthos during night navigation, but were lost and never located at the surface the next morning.

Figure 3b illustrates the spatial overlap between recorded sightings of Cuvier's beaked whales and the intensity of maritime traffic during the survey window. Vessel traffic density is derived from Global Fishing Watch data, represented at a spatial resolution of 0.1 degrees, providing a synoptic view of shipping activity across the study area. A minimum bounding oriented geometry encompassing the area of overlap, subsequently buffered to identify a zone where cumulative exposure to underwater noise and the likelihood of vessel collision may be elevated for Cuvier's beaked whales, was also identified. This spatial co-occurrence highlights a potentially deleterious area within the study region, underscoring the relevance of integrating species distribution data with maritime traffic information to inform risk assessment and support evidence-based management and mitigation measures.

Prevailing strong northerly winds and rough sea conditions significantly constrained the 2025 survey effort. Adverse weather prevented full coverage of the study area and limited access to offshore waters, thereby hindering the planned extension of the survey towards Chania on the island of Crete (Figure 4). In addition, a significantly high number of migrants reported in the waters around the southern part of Crete provided additional geopolitical constraints. Research effort was limited to the waters southwest of the Island of Zakynthos and along the western coast of the Peloponnese Peninsula. Considerable time and searching effort were spent in the Messenian Gulf and the Laconian Gulf, in the southern Peloponnese region and lastly between the Peloponnese and the Island of Kithira, between mainland Greece and Crete (Figure 5).

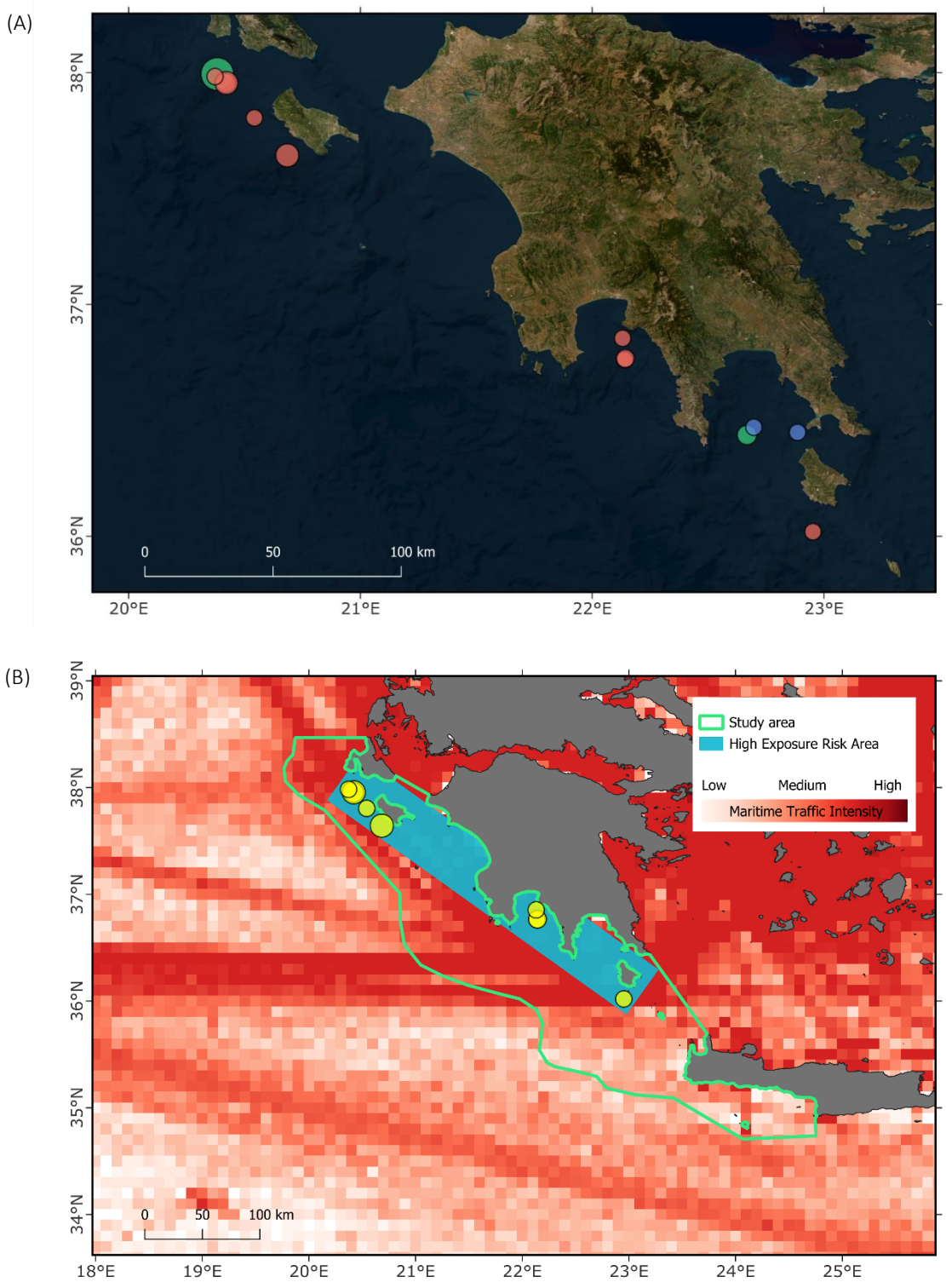

Figure 3. (A) Cetacean sightings recorded between the 5th and 23rd of July 2025. In red, Cuvier's beaked whales; in green, striped dolphins; in blue, unidentified cetacean sightings. The size of the mark is proportional to the group size. (B) Cuvier's beaked whale sightings overlapped to the intensity of maritime traffic during the survey window.

Highlighted in light blue a buffered minimum bounding oriented geometry delineating a region within the study area where the risk of exposure to underwater noise and the risk of collision for Cuvier's beaked whales could be increased.

Table 1. Daily survey effort summary (2025).

Date	Start Time	End Time	Effort Duration (hh:mm:ss)	Total Distance (km)	Total Distance (nm)
06/07/2025	04:31:26	17:06:01	12:34:35	100.54	54.29
07/07/2025	03:33:53	01:59:58	22:26:05	211.08	113.97
08/07/2025	02:00:08	17:00:55	15:00:47	146.48	79.09
12/07/2025	03:24:29	15:54:45	12:30:16	134.54	72.65
13/07/2025	03:27:04	15:42:01	12:14:57	107.56	58.08
14/07/2025	05:15:10	15:42:54	10:27:44	104.94	56.66
15/07/2025	03:30:13	14:51:13	11:21:00	110.64	59.74
17/07/2025	03:37:32	15:19:17	11:41:45	122.05	65.90
19/07/2025	03:35:52	15:41:20	12:05:28	128.76	69.52
20/07/2025	03:28:30	15:46:25	12:17:55	136.36	73.63
21/07/2025	03:24:46	16:19:28	12:54:42	160.22	86.51
22/07/2025	03:23:44	15:20:38	11:56:54	147.29	79.53
Grand Total			157:32:08	1610.45	869.57

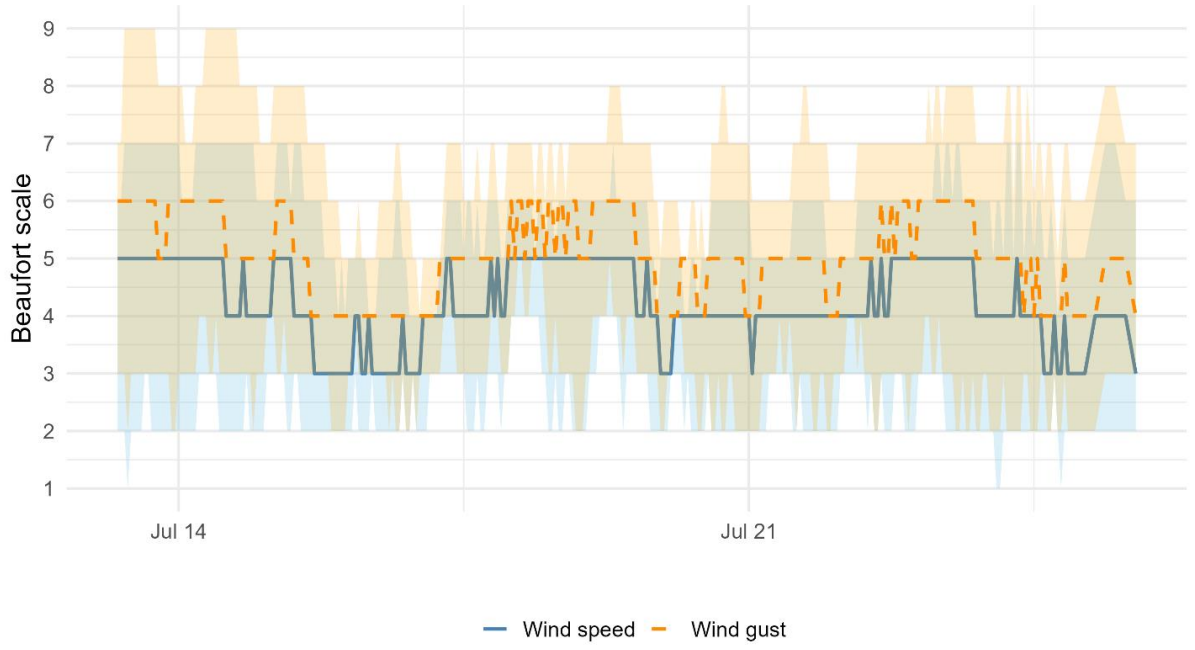

Figure 4. Temporal variation in mean wind speed and gust intensity expressed on the Beaufort scale for the last week of the study period. Shaded areas indicate the range (minimum-maximum) of values across all observation points, while solid and dashed lines represent the mean wind speed and gusts, respectively. Data correspond to forecast

outputs extracted from ICON-EU model GRIB files for selected points along the Hellenic Trench region and averaged across 15 locations selected on a regular grid within the study area.

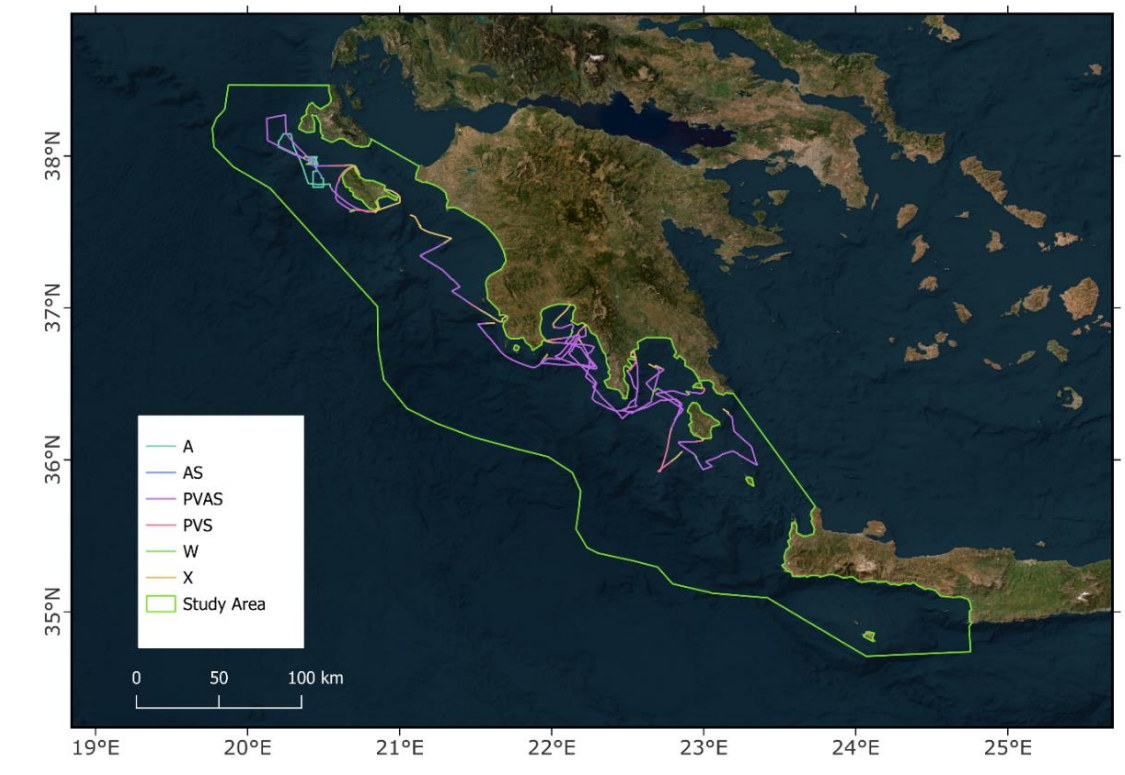

Figure 5. Survey effort by different effort categories (A = Acoustic detection, AS = Acoustic Searching, PVAS = Positive Visual and Acoustic Searching, W = time spent with cetaceans, PVA = positive Visual Searching, X = Off Effort). Survey effort was normally stopped with persistent Beaufort sea state of 4, with long waves and fairly frequent white horses.

Table 2. Summary of recorded cetacean sightings. Zc = Cuvier's beaked whale; Sc = striped dolphin; Un = unidentified cetacean.

Date	Sighting Number	Species	Latitude	Longitude	Start Time	End Time	Gr. Size	A	J	C	NB	Point Sighting
06/07/2025	001	Zc	37.6437	20.68435	10:01:57	12:35:35	5	5	0	0	0	N
07/07/2025	002	Zc	37.956	20.41926	06:30:31	07:15:28	3	3	0	0	0	N
07/07/2025	003	Zc	37.9561	20.42163	06:17:10	07:27:40	5	3	2	0	0	N
07/07/2025	004	Zc	37.9837	20.37276	08:04:42	08:08:30	1	1	0	0	0	Y
08/07/2025	005	Sc	37.9947	20.3826	03:56:01	04:15:52	10	10	0	0	0	N
08/07/2025	006	Zc	37.8054	20.54265	13:11:52	13:21:36	1	1	0	0	0	N
13/07/2025	007	Zc	36.7617	22.13975	11:36:32	12:48:27	1	1	0	0	0	N
13/07/2025	008	Zc	36.7673	22.1432	10:30:33	11:24:01	2	2	0	0	0	N
15/07/2025	009	Zc	36.8543	22.1317	10:41:17	11:43:34	1	1	0	0	0	N
19/07/2025	010	Un	36.4706	22.69775	06:06:07	06:22:44	-	-	-	-	-	Y
19/07/2025	011	Un	36.4484	22.88639	13:48:44	14:06:57	-	-	-	-	-	Y
20/07/2025	012	Zc	36.0197	22.95291	12:59:57	13:11:00	1	1	0	0		N
22/07/2025	013	Sc	36.4371	22.6679	05:27:34	05:36:42	3	3	0	0	0	N

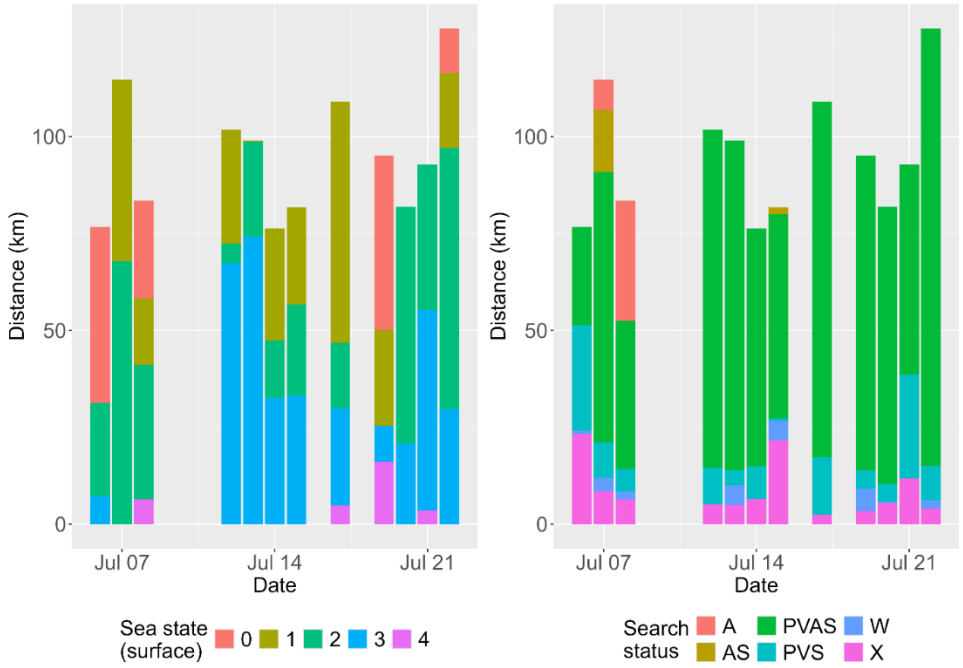

Figure 6. Total distance travelled daily in the different Beaufort sea states (left) and effort types (right – A = Acoustic Detection, AS = Acoustic Searching, PVAS = Positive Visual and Acoustic Searching, W = time spent with cetaceans, PVA = positive Visual Searching, X = Off Effort). Survey effort was normally stopped with a persistent Beaufort sea state of 4, with long waves and frequent white horses.

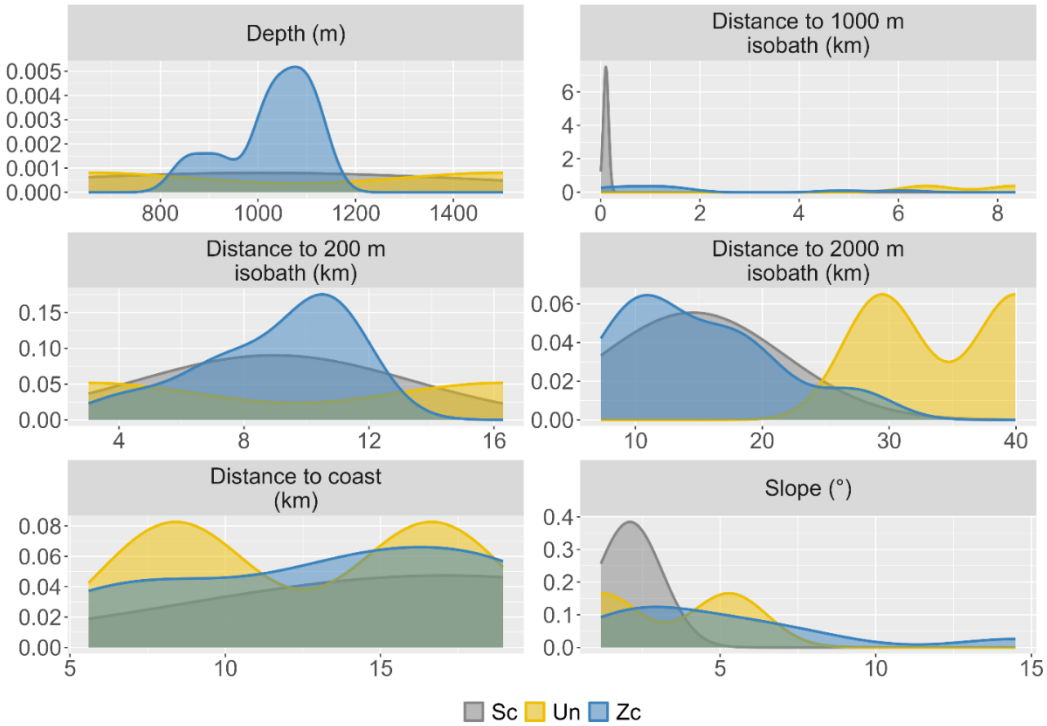

Figure 7. Density distributions of physiographic variables related to cetacean sightings: depth (m), distance to the 200, 1,000 and 2,000 m isobaths (km), distance to the coast (km), and seabed slope (°).

Cuvier's beaked whales were the most observed cetacean species, with 9 sightings and a total of 20 observed individuals, followed by striped dolphins (2 recorded observations) and 2 instances of unidentified delphinid (Figure 3 and Table 2). Cuvier's beaked whales were primarily observed at depths ranging between 800 and 1,200 meters in offshore pelagic waters (Figure 7).

4.1 Cuvier's beaked whales

A particularly important outcome of the 2025 survey was the relatively high number of Cuvier's beaked whale sightings, with nine encounters recorded and groups of up to five individuals observed on two occasions. Pictures of the sighted individuals were taken from the research vessel; closer approaches from the RIB were not possible, as the animals dove shortly after visually sighting them. Photo-identification was attempted, but a combination of distance from the research vessel, glare, and a lack of distinctive identifying features on the dorsal fins limited the effectiveness of the photographs. Cuvier's beaked whales are typically identified by notches, scars, rakes, and patches. Most of these features, aside from marks on the dorsal fin, rely on coloration and are hard to identify from a distance, especially when the animal is against the sun or in the glare. With the fieldwork being based in Greece in the summer months, the photos have a significant amount of 'noise' caused by the sun. Nevertheless, field observations allowed the distinction of at least 17 different individuals, including a group of three whales sighted on consecutive days and seen associated with additional animals during the latter sighting. Drone footage and photographs were collected whenever conditions allowed, helping to document behaviour at the surface, group composition, spatial use, and social interactions. Most observed individuals were adults, with only two juveniles or sub-adults recorded in one sighting. Drone imagery showed no unusual behaviour, with whales mostly travelling calmly at the surface (Figure 8).

Figure 8. Cuvier's beaked whales surfacing at the water surface during non-invasive drone-based observations, with no evident signs of atypical behaviour nor apparent behavioural response to the drone. Images extracted from drone footage.

4.2 Sperm whales

The Hellenic Trench is recognised as the most important habitat for endangered Mediterranean sperm whales, supporting the core of the population in the region. These deep-diving whales are not only a keystone species, but also a key indicator of ecosystem health. In this light, the absence of visual encounters during the 2025 field season is highly significant. Despite extensive survey effort under suitable conditions, sperm whales were only acoustically detected once, during a single night-time acoustic tracking, indicating an unusually low presence in areas where they are typically encountered. Informal exchanges with the other research teams operating in the area at the same time, or shortly before and after our survey, confirmed this pattern: two groups reported no sightings, while one recorded only three encounters. This consistency across projects supports the robustness of our observations and demonstrates that the

absence of sightings cannot be attributed to methodological limitations, but likely reflects a genuine deviation from typical summer distribution patterns.

It should also be noted that persistent windy conditions and additional geopolitical constraints prevented the survey from reaching key areas known to host high numbers of sperm whales, particularly the waters southwest of Crete, meaning that we could not assess whether the apparent shift in occurrence and habitat use observed in 2025 extended across the entire known habitat for sperm whales.

5. Discussion

Prevailing strong northerly winds and rough sea conditions significantly constrained the 2025 survey effort. Adverse weather prevented full coverage of the study area and limited access to offshore waters, thereby hindering the planned extension of the survey towards Chania on the island of Crete (Figure 4). In addition, a significantly high number of migrants reported in the waters around the southern part of Crete provided additional geopolitical constraints. The combination of these factors made it impossible to reach the southwestern coast of Crete, an area known for consistently high densities of sperm whales, hindering the survey's primary objective of deploying satellite transmitters on the species.

Five of the nine Cuvier's beaked whale sightings occurred west of Zakynthos and southwest of Kefalonia, in a sector of the Hellenic Trench known to support some of the highest densities of the species in the entire Mediterranean. These observations are consistent with previous findings confirming the importance of this area as a key habitat for these beaked whales, but also highlight how much remains to be learned. The Cuvier's beaked whale is listed as Vulnerable in the Mediterranean, threatened by intense underwater noise, seismic exploration, and shipping activity. Despite years of systematic and robust research efforts in this region, dedicated conservation measures are still lacking. This is especially evident in the newly declared Hellenic Trench National Marine Park, which notably excludes areas licensed for oil and gas exploration that overlap with critical habitat for both Cuvier's beaked whales and sperm whales. The 2025 results therefore emphasise the need to increase research and monitoring in the area, using both traditional and advanced technologies, to better understand population dynamics and mitigate the growing pressures from human activities that threaten the persistence of this species in Greek waters.

For sperm whales, the near absence of both visual and acoustic detections during the 2025 field season is particularly noteworthy when viewed considering the results of the 2024 survey. In 2024, telemetry data

revealed extensive movements beyond historically surveyed core habitats, whereas 2025 was characterised by a near-total lack of sightings. These contrasting outcomes suggest that the species' spatial use of the region may be shifting. Such changes could be driven by climate change, leading to variations in prey availability and oceanographic dynamics, and growing anthropogenic pressures, including underwater noise and vessel disturbance.

Given the species' small, genetically distinct, and endangered Mediterranean population – estimated at only a few hundred individuals – even short-term displacements from key habitats such as the Hellenic Trench could have serious conservation implications. These recent findings underscore the urgent need to continue systematic and joint monitoring efforts in 2026 and beyond, combining satellite telemetry, acoustic, and visual methods to clarify the drivers of variability and better understand sperm whale movement ecology. Only through sustained, multi-year research, can we determine whether these recent observations reflect temporary fluctuations or a long-term redistribution of the population, and ensure that conservation strategies remain aligned with the species' evolving spatial dynamics across the Hellenic Trench, Greek seas, and the wider Mediterranean.

6. Conclusions

The 2025 Blue Panda research survey, combined with the other efforts in the area, has provided some valuable insights into the presence of cetaceans in the Hellenic Trench. The high number of Cuvier's beaked whale sightings recorded this season confirms the importance of this area as a critical habitat for the species, including in regions significantly affected by shipping traffic and potential hydrocarbon exploration and extraction. These findings underscore the need to further study the population to contribute to enforcing the protection of the species in the area.

In contrast, the complete absence of visual encounters with sperm whales, coupled with only one acoustic detection, marks a significant and worrying deviation from historical patterns. This unexpected contrast reinforces the need to continue systematic, multi-year research efforts to better understand what may be driving these apparent changes in occurrence and distribution. It also highlights the importance of long-term datasets to distinguish natural fluctuations and variability from potential signs of environmental (e.g., climate changes) or anthropogenic disturbance.

Future research must build upon the foundations laid over recent seasons, combining traditional visual and acoustic survey techniques with modern tools such as satellite telemetry and eDNA analyses. The addition of eDNA sampling offers a powerful, non-invasive way to collect genetic material from seawater, enabling assessments of cetacean population genetics and ecology. Beyond species detection, analyses of eDNA can reveal population-level genetic information such as measures of genetic diversity, population connectivity levels and individual sex identification. Additionally, the method can also characterize marine biodiversity and explore predator-prey relationships. Together, these complementary approaches will help fill critical knowledge gaps regarding habitat use, movement ecology, and population connectivity.

Strengthening collaboration among national and international research groups working in Greek and wider Mediterranean waters, such as the EU Life MareNatura project, is also essential to ensure comprehensive and comparable shared methodologies, consistent data collection, and open exchange of information. This will allow a more comprehensive and comparable understanding of cetacean ecology and trends, ensuring that future management decisions are based on robust, high-quality evidence.

Such efforts are crucial not only for advancing scientific understanding but also for supporting policy and conservation actions. Continued and coordinated monitoring of the Hellenic Trench and surrounding areas will help identify the ecological and environmental factors behind the observed anomalies and guide the development of targeted mitigation measures against potential threats, including underwater noise, marine traffic, and oil and gas exploration. These research and management activities are directly relevant to ongoing national, regional, and international conservation frameworks, including ACCOBAMS, the IUCN Red List processes, the Ecosystem Approach of the Barcelona Convention, the Important Marine Mammal Areas (IMMA) initiative, and the International Maritime Organization (IMO). In particular, the results of the 2025 Blue Panda survey provide timely baseline information that can directly support the planning and implementation of the ACCOBAMS Survey Initiative II (ASI II), planned for summer 2026. In this context, the 2025 Blue Panda survey provides timely baseline information that can help refine survey design, spatial stratification, and sampling effort within the Hellenic Trench and beyond, ensuring that ASI II effectively captures current species distributions and potential emerging trends. Strengthening the scientific basis for these mechanisms will be key to evaluating whether existing measures are effective, and to adapting or reinforcing them where they fall short. Ensuring that conservation efforts remain informed by the best available evidence will be fundamental to protecting the exceptional cetacean biodiversity of the Hellenic Trench and the wider Mediterranean Sea.

The establishment of the Ionian National Marine Park represents a significant step towards meeting national and international biodiversity conservation targets. The Park encompasses a substantial portion of the Ionian Sea, including 24 Natura 2000 sites and a significant part of the Hellenic Trench, forming an extensive area of recognised ecological importance. Ensuring that this ecological value is effectively safeguarded will require robust and well-implemented protection and management measures.

However, the continued licensing of hydrocarbon exploration in waters adjacent to the Park raises important concerns regarding the adequacy of existing spatial protections, particularly where such activities overlap with habitats used by vulnerable cetacean species. The proximity of exploration and extraction blocks to key habitats highlights the need for ongoing evaluation of whether current zoning and management frameworks sufficiently reflect emerging scientific evidence on species distribution and habitat use. Integrating robust scientific data, sustained multi-year monitoring, and precautionary spatial planning will be essential to ensure that conservation measures effectively protect cetaceans and maintain the ecological integrity of the Hellenic Trench and the wider Mediterranean Sea.

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