Short Communication: Satellite tracking of a solitary sperm whale in Greek waters: conservation implications

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ABSTRACT

The Hellenic Trench hosts the highest density of endangered sperm whales in the Eastern Mediterranean Sea and is recognised as an Important Marine Mammal Area (IMMA). This population is exposed to substantial anthropogenic pressures, including vessel strikes, hydrocarbon activities and military exercises. In July 2024, a solitary adult male was equipped with a minimally invasive ARGOS satellite-linked transmitter southwest of Kefalonia, Greece. Over 57 days, the whale ranged from the Ionian Sea through the Hellenic Trench into the southern and northeastern Aegean Sea. Movement analyses revealed extended periods of localised movements southwest of Kefalonia-Zakynthos and later in the northeastern Aegean, indicative of potential feeding behaviour, interspersed with phases of directed travel along the Hellenic Trench and across the Cyclades toward the Dodecanese. This is the first satellite track of a male sperm whale in Greece, providing novel insights into habitat use, movement strategies, and previously undocumented transit and residency areas. These findings highlight new key areas for place-based conservation and demonstrate the value of satellite telemetry for informing targeted management in the Eastern Mediterranean.

KEYWORDS: SPERM WHALE (PHYSETER MACROCEPHALUS); SATELLITE TAGGING; TELEMETRY; MEDITERRANEAN SEA; HELLENIC TRENCH; CONSERVATION; HABITAT USE; IMPORTANT MARINE MAMMAL AREAS

The Hellenic Trench in Greek waters is a crucial habitat for the Eastern Mediterranean sperm whale (*Physeter macrocephalus*) sub-population, which is classified as Endangered (Pirotta *et al*., 2021) and estimated to comprise fewer than 200 individuals (Boisseau *et al*., 2024). Both recent large-scale surveys (Lerebourg *et al*., 2023; Boisseau *et al*., 2024) and local historical research efforts (Frantzis *et al*., 2014, 2019; Lewis *et al*., 2018; Thompson *et al*., 2023) show that sperm whales tend to congregate between south-west Kefalonia Island and central-south Crete, possibly reaching as far east as the Turkish coast at Antalya Bay (Frantzis *et al*., 1999; Öztürk *et al*., 2013; Tonay *et al*., 2021). Little is known about sperm whales in the Aegean Sea, with few recorded sightings and strandings, most of which come from anecdotal sources or grey literature. Apart from the Cretan Sea, sperm whales are considered rare visitors to the deep waters of the Aegean, including the North Aegean Trough, the Myrtoon Sea and the Icarian Sea (Frantzis *et al*., 2003; Ryan *et al*., 2013; Foskolos *et al*., 2020; Hostetter *et al*., 2020). Recent acoustic monitoring in the North Aegean Trough did not detect sperm whales, nor did the

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Basin-wide ACCOBAMS Survey Initiative (ASI) (Panigada *et al*., 2024a), which used both aerial and vessel-based visual and acoustic surveys, find evidence of them in the Aegean.

The role of the Hellenic Trench as a core area supporting the entire Eastern Mediterranean sperm whale sub-population led to the zone being designated as an Important Marine Mammal Area (IMMA) in 2016 (Tetley *et al*., 2022). Part of the region has also been proposed to be included in the newly designated Ionian marine park.[6]

At the same time, the sub-population's core habitats face substantial anthropogenic pressures, in particular from an elevated risk of lethal vessel strikes and exposure to related underwater noise from proximity to major shipping routes (Frantzis *et al*., 2019) and seismic testing (Boisseau *et al*., in review), threatening its survival. The overall small size of the Hellenic Trench sperm whale sub-population, in addition to the reported high mortality due to vessel strikes, has prompted policy discussions and international recommendations, including proposals for vessel routing modifications and speed restrictions. Moreover, it has led to voluntary commitments by Greek and international shipping companies and unions to reduce collision risks in this critical area (IMO MEPC.1/Circ.674; IWC Strategic Plan 2022–2032; ACCOBAMS-MOP8/Res8.18). In parallel, and in cooperation with the Hellenic Chamber of Shipping and the Ministry of Maritime Affairs and Insular Policy, the Hellenic Hydrographic Office issued notices to mariners updating official navigation manuals, highlighting whale presence in the Hellenic Trench and instructing vessels to intensify lookout efforts (Notice No. 24/2021 PILOT A; Notice No. 27/2021 PILOT B). In 2022, these notices were incorporated into the British Admiralty Sailing Directions (NP47, NP48, NP49), expanding their reach internationally. In addition, the World Shipping Council included the Hellenic Trench in the areas of the 'Whale Chart', where coastal states have issued advisory measures for shipping operators.

Nevertheless, there is an urgent need for targeted management actions to reduce vessel strike risk, maintain population viability, and meet international conservation commitments for marine megafauna within this ecologically sensitive region, where limited knowledge of the species' movement ecology constrains the development of fully informed management strategies (Frantzis *et al*., 2011; Hays *et al*., 2019).

Mediterranean-wide photo-identification (photo-ID) studies have documented long-distance inter-basin movements of sperm whales, indicating connectivity between the Hellenic Trench and other Mediterranean regions (Frantzis *et al*., 2011; Carpinelli *et al.,* 2014; Thompson *et al.,* 2024). This limited understanding of connectivity is supported by genetic studies that show no clear east-west basin fragmentation (Drouot *et al*., 2004; Engelhaupt *et al*., 2009), although recent preliminary findings suggest possible heterogeneity within the western basin (Violi *et al.,* 2023).

In July 2024, a research cruise led by WWF Greece, onboard WWF France's 25 m sailing boat *Blue Panda*, was conducted to collect data on presence, behaviour, habitat preferences and movements of sperm whales and other cetacean species, focusing on the less-studied northern part of the Hellenic Trench IMMA. Between 15 and 31 July 2024 (15 days), 965 nautical miles were monitored through visual and acoustic surveys. Cetaceans were located visually at the surface and, for echolocating odontocetes, acoustically, using a towed horizontal hydrophone array, following the same protocols used during the ACCOBAMS Survey Initiative (ASI) (Boisseau *et al*., 2024).

On 27 July 2024, one solitary adult male sperm whale was equipped with a satellite transmitter (Wildlife Computers Spot-365 LIMPET) south-west of Kefalonia, Greece. Tagging followed the International Whaling Commission's (IWC) guidelines (Andrews *et al*., 2019), with animals approached only after assessing their behaviour and health. Adult males were only selected for tagging if deemed healthy and solitary based on visual observation from the boat and drone.

A single transmitter was deployed on the whale's dorsal fin using a 150 lb draw weight crossbow (Vixen Excalibur II). Tagging operations were recorded with a GoPro Hero 8 mounted on the RIB to qualitatively assess transmitter placement and the animal's reaction. The sperm whale responded with a shallow dive and tail slap, with half of the fluke out of the water. To maximise the number of uplinks, the tag was programmed to relay an unlimited number of transmissions per day over two daily temporal windows (hours: 3–11, 15–22), totaling

[6] EcoSustain LLC and Nerco – N. Chlykas & Associates SA. 2025. Special Environmental Study for the Ionian Marine Park. Phase B Deliverable. Athens. May 2025. *https://ypen.gov.gr/diavouleusi/wp-content/uploads/2025/07/%CE%95%CE%A0%CE%9C_%CE%95%CE%98%CE%A0%CE%99_%CE%9C%CE%B5%CE%BB%CE%AD%CF%84%CE%B7.pdf*

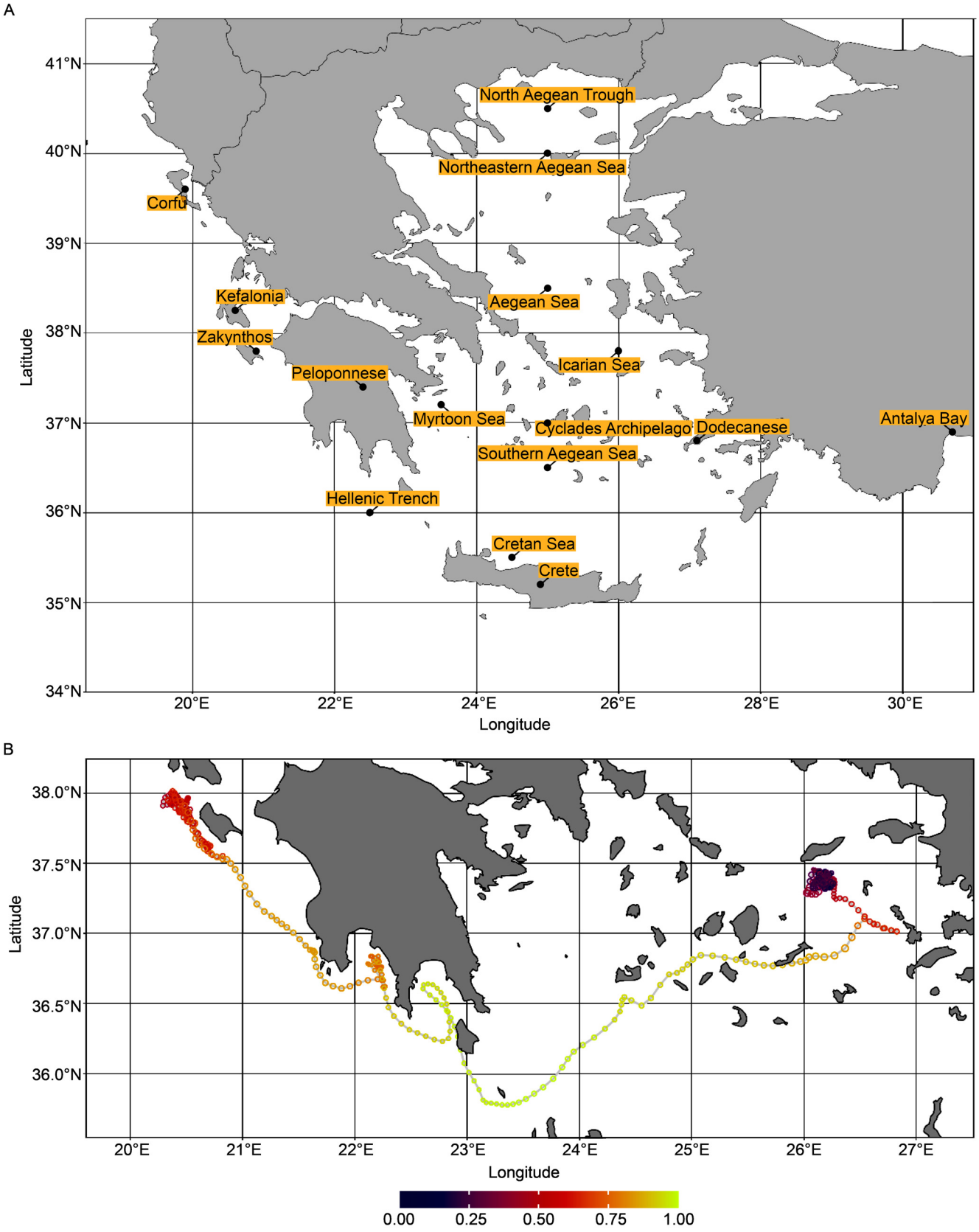

Figure 1. A: Geographical context of the study area, showing major seas, basins, islands, and submarine features used to describe the movement of the satellite-tracked sperm whale. B: Zoom-in on the SSM-filtered tracks of the tagged sperm whale south-east of Zakynthos. Each location is coloured according to its estimated move persistence (γ) from the move persistence model (MPM). Dark colours indicate foraging or feeding behaviour ($\gamma < 0.8$); light colours indicate travelling behaviour ($\gamma > 0.8$).

Table 1

Summary statistics describing the movement of the satellite-tracked sperm whale, including track-level metrics and daily summaries

Overall track summary	
Metric	
Track duration (days)	55.75
Total distance moved (km)	1,798.77
Maximum distance from tagging location (km)	535.16
Net displacement (km)	476
Tortuosity (path length/net displacement)	3.78
Daily summary	
Metric	
Mean daily distance (km/day)	31.56
Median daily distance (km/day)	24.65
Sd daily distance (km/day)	17.91
Min daily distance (km/day)	4.55
Max daily distance (km/day)	70.11

17 h per day. No data were collected outside these intervals. It was also duty-cycled to transmit every day for the first 60 days, and then every other day from 61 days after deployment.

A total of 1,725 location messages were received, providing 57 days of movement data (Fig. 1). After filtering (Aschettino *et al*., 2020) and regularisation (Jonsen *et al*., 2023) of raw Argos locations, move persistence models were applied to quantify the whale's tendency to maintain directional movement (i.e., travelling), versus making abrupt changes (e.g., feeding or socialising) (Jonsen *et al*., 2018). Table 1 summarises the overall track data and daily movement metrics of the sperm whale. The tagged sperm whale spent 15 days southwest of Kefalonia and Zakynthos, exhibiting short, localised movements indicative of reduced movement persistence, particularly in the northern Hellenic Trench during the initial tracking period. It then travelled south along the Hellenic Trench, briefly paused along the Peloponnese, and proceeded into the southern Aegean Sea, north of Crete, crossing the Cyclades Archipelago before reaching the Dodecanese and the Northeastern Aegean islands region after 18 days (Fig. 1). Elevated movement persistence characterised this transit phase, consistent with directed travel behaviour. Upon arrival in the northeast Aegean Sea, the whale remained in the area for a further 23 days, until the device stopped transmitting, again exhibiting reduced movement persistence, compatible with potential feeding behaviour. The overall tortuosity of the track (3.78; Table 1) indicates that the whale travelled nearly four times the straight-line distance between its tagging and final locations, reflecting a combination of directed movements and prolonged localised use of specific areas.

While low movement persistence is typically associated with feeding, it is important to note that the tagged sperm whale was observed in an area used by family units with females. Given that the Hellenic Trench is a known feeding habitat and critical breeding area, we cannot exclude that the recorded movements were driven by factors other than feeding.

The tagged sperm whale moved across an area encompassing 6° longitude and 3° latitude. Most of its realised habitat (i.e., areas with the highest probability of occurrence; *sensu* Anderson [1982]; Worton [1989]; Panigada *et al*. [2024b]) was located in the waters south and south-west of the island of Kefalonia, South of the Peloponnese, in the Dodecanese, and the Northeastern Aegean islands region. The tagged whale showed high residency south-west of Kefalonia, south of the Peloponnese, and in the Dodecanese and the Northeastern Aegean islands region. This area partially overlaps with the Hellenic Trench IMMA only south-west of Kefalonia and does not include a corridor across the southern Aegean Sea and critical residency areas in the Dodecanese and the Northeastern Aegean islands region.

Collision risk across the area visited by the whale was quantified through spatial analysis integrating maritime traffic intensity[7] and the realised habitat. Overall collision risk was calculated as the product of traffic intensity and whale-realised habitat maps (e.g., Redfern *et al*., 2020) in a 10 km by 10 km grid (Fig. 2A). Collision risk was also assessed at a higher resolution using a 1 km by 1 km grid to evaluate the risk of collision at smaller spatial

[7] Global Fishing Watch; *https://globalfishingwatch.org/*

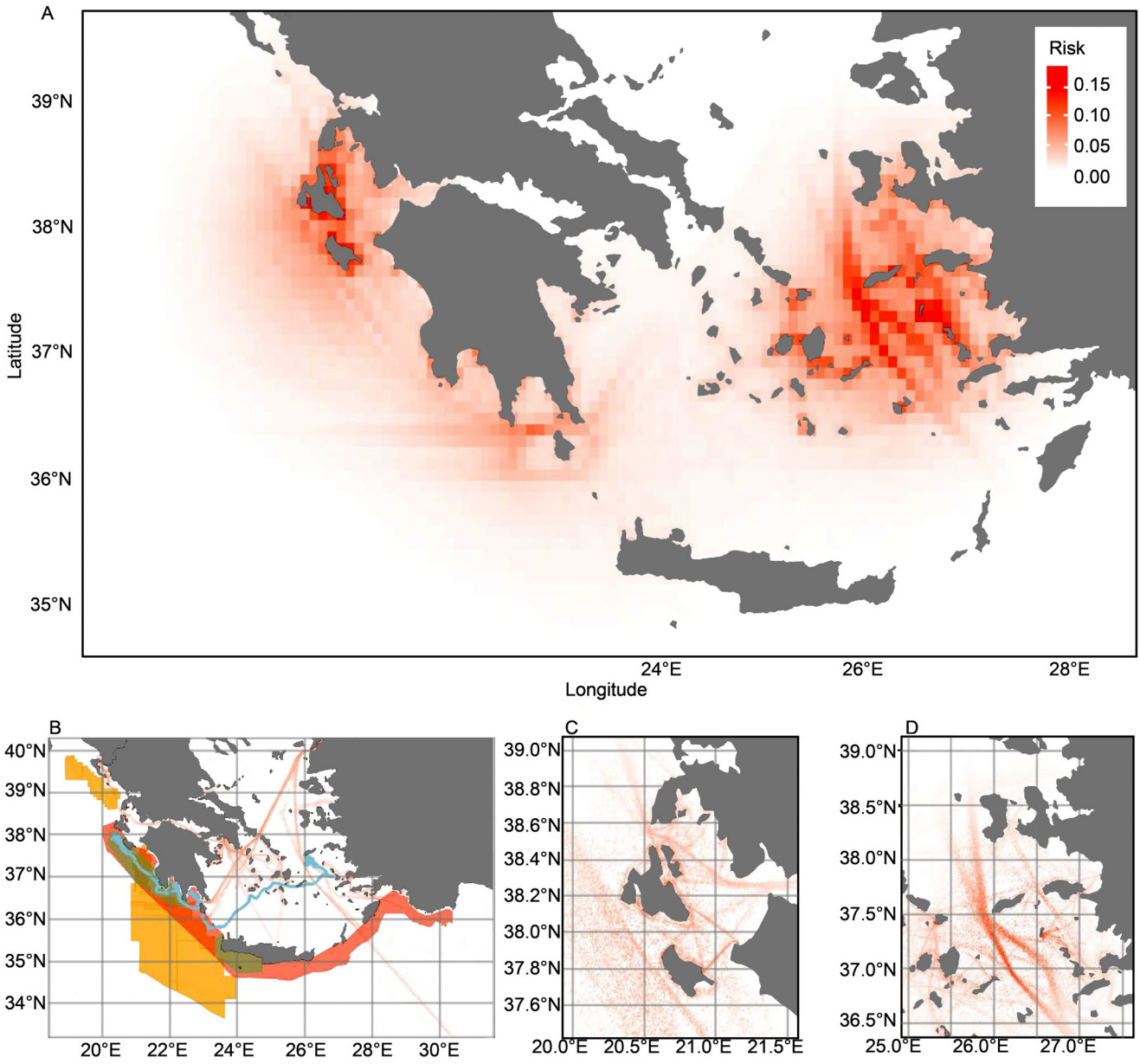

Figure 2. A: Normalised collision risk for the tagged whale, calculated on a 10 × 10 km grid, highlighting areas of significant spatial overlap between whale locations and vessel traffic that indicate elevated risk of fatal ship strikes. B: Spatial overlap between the proposed Hellenic Trench IMMA (red) and areas recommended for avoidance by commercial shipping (green; after Frantzis *et al.*, 2019). Areas of ongoing or planned seismic prospections in Greek waters are shown in orange. The track of the tagged whale (light blue) is overlaid on the density of maritime traffic during the tag deployment period. C–D: Collision risk on a 1 × 1 km grid for the Ionian Islands, Dodecanese, and north-eastern Aegean Islands regions, respectively.

scales (Fig. 2C, D). All vessels travelling above 15 knots were included, reflecting the region's mixed maritime traffic, from dense commercial routes to seasonal recreational boating. While commercial shipping is known to contribute to collision risk, high-speed recreational vessels likely pose a disproportionate threat in coastal and high-use leisure zones. Our results show high susceptibility along the central and northern Hellenic Trench, with elevated risk in the northeastern Aegean. Coastal waters near Kefalonia, Zakynthos, the Inner Ionian, Cyclades, Dodecanese and northeastern Aegean islands were particularly high-risk due to seasonal recreational and passenger vessel activity. In contrast, the greatest risk in the Hellenic Trench was concentrated in deeper offshore areas dominated by commercial shipping, particularly around the 1,000 m depth contour, where sperm whale density peaks (Frantzis *et al.*, 2014).

While based on a single individual, limiting the ability to assess inter-individual variability, this satellite telemetry study offers valuable insights into the spatial ecology of sperm whales in the Greek seas. The data

suggest greater complexity in movement patterns than previously recognised, revealing prolonged occupancy of core habitats in the Hellenic Trench and extended excursions into regions with limited prior documentation and survey effort. Despite the limited sample size, these findings highlight the need for further research to determine whether this movement pattern extends beyond this single tagged individual.

Additional satellite telemetry data could help to reevaluate our understanding of habitat use by Eastern Mediterranean sperm whales, and to expand the geographical scope of research and monitoring efforts. Integrating techniques such as photo-ID, genetics, acoustics and satellite telemetry will be crucial to inform conservation and policy. Even outside the Hellenic Trench, sperm whales still face significant anthropogenic threats, including collisions with high-speed vessels and underwater noise pollution. If confirmed, these findings may highlight gaps in conservation focused solely on the Hellenic Trench, advocating for a broader approach that considers sperm whale distribution, risk exposure and ecological connectivity to inform marine spatial planning and conservation (Johnson *et al*., 2022; Reisinger *et al*., 2022). While the small sample size precludes population-wide generalisation, this single deployment challenges existing assumptions and raises questions about previously unrecognised critical habitats and IMMAs within Greek waters. It highlights the value of telemetry to uncover significant behavioural and ecological patterns, underscoring the need for continued, expanded bio-logging efforts to better understand sperm whale movement ecology across the Mediterranean, while always prioritising animal welfare. However, this effort should not stand alone: its value is maximised when integrated with traditional survey approaches that provide complementary insights into distribution, abundance and individual life histories.

Addressing these knowledge gaps requires a collaborative, multi-method approach that spans national and disciplinary boundaries. Sharing data, coordinating fieldwork and aligning analytical frameworks will support robust, data-driven management measures. Integrating movement ecology and genetic connectivity into place-based conservation planning will ensure that Marine Protected Areas (MPAs) and mitigation measures are designed to protect sperm whales where they occur and travel. If multiple whales show similar movement patterns towards the Aegean or other under-studied areas, it will support the case for revising existing IMMAs and proposing new ones where needed. In this context, long-term tracking data can help refine spatial planning initiatives and regulate activities within existing and newly designated MPAs and marine parks, such as adjusting maritime traffic routes or establishing seasonal protection zones. Expanding our current knowledge of medium-scale movements in regions with high anthropogenic pressure is essential for securing the long-term survival of sperm whales in a rapidly changing Mediterranean Sea.

SUPPLEMENTARY INTERACTIVE MATERIAL

An interactive visualisation of the satellite tracking data, including behavioural states and associated environmental and anthropogenic spatial layers, is publicly available via GitHub here.

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REFERENCES

Anderson, D.J. (1982). The home range: a new nonparametric estimation technique. *Ecology* 63(1): 103–112. [Available at: *https://doi.org/10.2307/1937036*]

Andrews, R.D., Baird, R.W., Calambokidis, J., Goertz, C.E., Gulland, F.M., Heide-Jørgensen, M.P. Hooker, S.K., Johnson, M., Mate, B., Mitani, Y., Nowacek, D.P., Owen, K., Quakebush, L.T., Raverty, S., Robbins, J., Schorr, G.S., Shpak, O.V., Townsend Jr., F.I., Uhart, M., Wells, R.S., & Zerbini, A.N. (2019). Best practice guidelines for cetacean tagging. *J. Cetacean Res. Manage.* 20: 27–66. [Available at: *https://doi.org/10.47536/jcrm.v20i1.237*]

Aschettino, J.M., Engelhaupt, D.T., Engelhaupt, A.G., DiMatteo, A., Pusser, T., Richlen, M.F., & Bell, J.T. (2020). Satellite telemetry reveals spatial overlap between vessel high-traffic areas and humpback whales (*Megaptera novaeangliae*) near the mouth of the Chesapeake Bay. *Front. Mar. Sci.* 7: 121. [Available at: *https://doi.org/10.3389/fmars.2020.00121*]

Boisseau, O., Reid, J., Ryan, C., Moscrop, A., McLanaghan, R., & Panigada, S. (2024). Acoustic estimates of sperm whale abundance in the Mediterranean Sea as part of the ACCOBAMS Survey Initiative. *Front. Mar. Sci.* 11: 1164026. [Available at: *https://doi.org/10.3389/fmars.2024.1164026*]

Carpinelli, E., Gauffier, P., Verborgh, P., Airoldi, S., David, L., Di-Méglio, N., Cañadas, A., Frantzis, A., Rendell, L., Lewis, T., Mussi, B., Pace, D.S., & De Stephanis, R. (2014). Assessing sperm whale (Physeter macrocephalus) movements within the western Mediterranean Sea through photo-identification. *Aquat. Conserv.: Mar. Freshw. Ecosyst.* 24(S1): 23–30. [Available at: *https://doi.org/10.1002/aqc.2446*]

Drouot, V., Berube, M., Gannier, A., Goold, J.C., Reid, R.J., & Palsboll, P.J. (2004). A note on genetic isolation of Mediterranean sperm whales (*Physeter macrocephalus*) suggested by mitochondrial DNA. *J. Cetacean Res. Manage.* 6(1): 29–32. [Available at: *https://doi.org/10.47536/jcrm.v6i1.787*]

Engelhaupt, D., Hoelzel, A.R., Nicholson, C., Frantzis, A., Mesnick, S., Gero, S., Whitehead, H., Rendell, L., Miller, P., de Stefanis, R., Canadas, A., Airoldi, S., & Mignucci-Giannoni, A. (2009). Female philopatry in coastal basins and male dispersion across the North Atlantic in a highly mobile marine species, the sperm whale (*Physeter macrocephalus*). *Mol. Ecol.* 18: 4193–4205. [Available at: *https://doi.org/10.1111/j.1365-294x.2009.04355.x*]

Foskolos, I., Koutouzi, N., Polychronidis, L., Alexiadou, P., & Frantzis, A. (2020). A taste for squid: the diet of sperm whales stranded in Greece, eastern Mediterranean. *Deep-Sea Res. Part I: Oceanogr. Res. Pap.* 155: 103164. [Available at: *https://doi.org/10.1016/j.dsr.2019.103164*]

Frantzis, A., Swift, R., Gillespie, D., Menhennett, C., Gordon, J., & Gialinakis, S. (1999). Sperm whale presence off southwest Crete, Greece, eastern Mediterranean. *Eur. Res. Cet.* 13: 214–217.

Frantzis, A., Alexiadou, P., Paximadis, G., Politi, E., Gannier, A., & Corsini-Foka, M. (2003). Current knowledge of the cetacean fauna of the Greek Seas. *J. Cetacean Res. Manage.* 5(3): 219–232. [Available at: *https://doi.org/10.47536/jcrm.v5i3.801*]

Frantzis, A., Airoldi, S., Notarbartolo di Sciara, G., Johnson, C., & Mazzariol, S. (2011). Inter-basin movements of Mediterranean sperm whales provide insight into their population structure and conservation. *Deep-Sea Res. Part I: Oceanogr. Res. Pap.* 58(4): 454–459. [Available at: *https://doi.org/10.1016/j.dsr.2011.02.005*]

Frantzis, A., Alexiadou, P., & Gkikopoulou, K.C. (2014). Sperm whale occurrence, site fidelity and population structure along the Hellenic Trench (Greece, Mediterranean Sea). *Aquat. Conserv.: Mar. Freshw. Ecosyst.* 24(S1): 83–102. [Available at: *https://doi.org/10.1002/aqc.2435*]

Frantzis, A., Leaper, R., Alexiadou, P., Prospathopoulos, A., & Lekkas, D. (2019). Shipping routes through core habitat of endangered sperm whales along the Hellenic Trench, Greece: can we reduce collision risks? *PLoS ONE* 14(2): e0212016. [Available at: *https://doi.org/10.1371/journal.pone.0212016*]

Hays, G.C., Bailey, H., Bograd, S.J., Bowen, W.D., Campagna, C., Carmichael, R.H., Casale, P., Chiaradia, A., Costa, D.P., Cuevas, E., de Bruyn, P.J.N., Dias, M.P., Duarte, C.M., Dunn, D. C., Dutton, P.H., Esteban, N., Friedlaender, A., Goetz, K.T., Godley, B.J., Halpin, P.N., et al. (2019). Translating marine animal tracking data into conservation policy and management. Trends in Ecology & Evolution, 34(5), 459–473. [Available at: https://doi.org/10.1016/j.tree.2019.01.009]

Hostetter, P., Koroza, A., Tsimpidis, T., Pietroluongo, G., & Cipriano, G. (2020). Occurrence of *Physeter macrocephalus* and *Ziphius cavirostris* in the North Ikaria Basin, Aegean Sea. *IMEKO TC.*

Johnson, C.M., Reisinger, R.R., Palacios, D.M., Friedlaender, A.S., Zerbini, A.N., & Willson, A. (2022). Protecting blue corridors – challenges and solutions for migratory whales navigating national and international seas. WWF International, Gland, Switzerland. [Available at: *https://doi.org/10.5281/ZENODO.6196131*]

Jonsen, I.D., McMahon, C.R., Patterson, T.A., Auger-Méthé, M., Harcourt, R., Hindell, M.A., & Bestley, S. (2018). Movement responses to environment: fast inference of variation among southern elephant seals with a mixed-effects model. *Ecology* 100(1): e02566. [Available at: *https://doi.org/10.1002/ecy.2566*]

Jonsen, I.D., Grecian, W.J., Phillips, L., Carroll, G., McMahon, C., Harcourt, R.G., Hindell, M.A., & Patterson, T.A. (2023). aniMotum, an R package for animal movement data: rapid quality control, behavioural estimation and simulation. *Methods Ecol. Evol.* 14(3): 806–816. [Available at: *https://doi.org/10.1111/2041-210X.14060*]

Lerebourg, C., Boisseau, O., Ridoux, V., & Virgili, A. (2023). Summer distribution of the Mediterranean sperm whale: insights from the acoustic ACCOBAMS Survey Initiative. *Front. Mar. Sci.* 10: 1229682. [Available at: *https://doi.org/10.3389/fmars.2023.1229682*]

Lewis, T., Boisseau, O., Danbolt, M., Lacey, C., Leaper, R., Matthews, J., McLanaghan, R., & Moscrop, A. (2018). Abundance estimates for sperm whales in the Mediterranean Sea from acoustic line-transect surveys. *J. Cetacean Res. Manage.* 18: 103–117. [Available at: *https://doi.org/10.47536/jcrm.v18i1.437*]

Mannocci, L., Roberts, J.J., Halpin, P.N., Authier, M., Boisseau, O., & Bradai, M.N. (2018). Assessing cetacean surveys throughout the Mediterranean Sea: a gap analysis in environmental space. *Sci. Rep.* 8: 3126. [Available at: *https://doi.org/10.1038/s41598-018-19842-9*]

Öztürk, A.A., Tonay, A.M., & Dede, A. (2013). Sperm whale (*Physeter macrocephalus*) sightings in the Aegean and Mediterranean part of Turkish waters. *J. Black Sea/Medit. Environ.* 19(2): 168–176.

Panigada, S., Pierantonio, N., Araújo, H., David, L., Di-Méglio, N., & Dorémus, G. (2024a). The ACCOBAMS Survey Initiative: the first synoptic assessment of cetacean abundance in the Mediterranean Sea through aerial surveys. *Front. Mar. Sci.* 10: 1270513. [Available at: *https://doi.org/10.3389/fmars.2023.1270513*]

Panigada, V., Bodey, T.W., Friedlaender, A., Druon, J.-N., Huckstädt, L.A., Pierantonio, N., Degollada, E., Tort, B., & Panigada, S. (2024b). Targeting fin whale conservation in the north-western Mediterranean Sea: insights on movements and behaviour from biologging and habitat modelling. *R. Soc. Open Sci.* 11(3): 231783. [Available at: *https://doi.org/10.1098/rsos.231783*]

Pirotta, E., Carpinelli, E., Frantzis, A., Gauffier, P., Lanfredi, C., Pace, D.S., & Rendell, L.E. (2021). *Physeter macrocephalus* (Mediterranean subpopulation). IUCN Red List Threat. Species 2021: e.T16370739A50285671.

Redfern, J.V., Becker, E.A., & Moore, T.J. (2020). Effects of variability in ship traffic and whale distributions on the risk of ships striking whales. *Front. Mar. Sci.* 6: 793. [Available at: *https://doi.org/10.3389/fmars.2019.00793*]

Reisinger, R.R., Johnson, C., & Friedlaender, A.S. (2022). Marine mammal movement ecology in a conservation and management context. In: G. Notarbartolo di Sciara & B. Würsig (eds.). *Marine Mammals: The Evolving Human Factor* (pp.149–192). Springer International Publishing, Switzerland 2. [Available at: *https://doi.org/10.1007/978-3-030-98100-6_5*]

Ryan, C., Romagosa, M., Boisseau, O., Cucknell, A.C., Frantzis, A., Moscrop, A., & McLanaghan, R. (2013). Cruise report for a visual and acoustic survey for marine mammals of the Aegean Sea and Levantine Sea, eastern Mediterranean conducted from R/V *Song of the Whale*, July to September 2013. *Mar. Conserv. Res. Int. UK*.

Tetley, M.J., Braulik, G.T., Lanfredi, C., Minton, G., Panigada, S., Politi, E., Zanardelli, M., Notarbartolo di Sciara, G., & Hoyt, E. (2022). The important marine mammal area network: a tool for systematic spatial planning in response to the marine mammal habitat conservation crisis. *Front. Mar. Sci.* 9: 841789. [Available at: *https://doi.org/10.3389/fmars.2022.841789*]

Thompson, K., Webber, T., Karantzas, L., Gordon, J., & Frantzis, A. (2023). Summer and winter surveys of deep waters of the Hellenic Trench, Greece, provide insights into the spatial and temporal distribution of odontocetes. *Endanger. Species Res.* 52: 163–176. [Available at: *https://doi.org/10.3354/esr01265*]

Thompson, K.F., Gordon, J., Webber, T., Zuriel, Y., Kobo, K., & Tchernov, D. (2024). Threatened cetaceans off the coast of Israel and long-range movement of a sperm whale. *Aquat. Conserv.: Mar. Freshw. Ecosyst.* 34(5): e4155. [Available at: *https://doi.org/10.1002/aqc.4155*]

Tonay, A.M., Öztürk, A.A., Salman, A., Dede, A., Danyer, I.A., Danyer, E., & Öztürk, B. (2021). Stranding records of sperm whale (*Physeter macrocephalus*) on the Turkish coast in 2019–2020 with a note on the opportunistic sampling of stomach content. *J. Black Sea/Medit. Environ.* 27(3): 281–293.

Worton, B.J. (1989). Kernel methods for estimating the utilization distribution in home-range studies. *Ecology* 70(1): 164–168. [Available at: *https://doi.org/10.2307/1938423*]