Preliminary findings of visual-acoustic survey for cetaceans of the Hellenic Trench during the autumn of 2021 and winter 2022.

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Suggested citation: Thompson, KF, Webber, T, Karantzas, L, Frantzis, A. (2022). Preliminary findings of visual-acoustic survey for cetaceans of the Hellenic Trench during the autumn of 2021 and winter 2022. Greenpeace Research Laboratories Analytical Results Report 2022-03. 6pp.

Summary:
The Hellenic Trench provides critical habitat for several cetacean species, including two Mediterranean populations that are threatened according to the International Union for Conservation of Nature, the sperm whale (*Physeter macrocephalus*) and Cuvier's beaked whale (*Ziphius cavirostris*). Research effort in the deeper waters of the Trench outside the summer season is lacking and this has potentially allowed speculation as to the presence of these species during this period. Greenpeace conducted two visual-acoustic surveys in the Hellenic Trench during autumn 2021 and winter 2022 with the aim of investigating cetacean distributions in the deeper waters outside the summer season.

The visual-acoustic surveys used a towed hydrophone array and covered a total track line distance of 18,366 km over 51 days during the two seasons – approximately 22 days in autumn (21st August to 11th September 2021) and 27 days in winter (9th February 2022 to 29th March 2022). Results confirm the presence of at least five toothed cetaceans (odontocetes) across the two survey periods within the deeper waters of the Hellenic Trench: sperm whale (49 detections), Cuvier's beaked whale (four detections), Risso's dolphins (*Grampus griseus*)(five detections), striped dolphins (*Stenella coeruleoalba*) (two detections) and rough-toothed dolphins (*Steno bradenensis*) (one detection). The surveys also detected 224 unidentified delphinids, including a potential blackfish[1] (one detection) that could not be identified to species level. The visual survey helped to confirm the identity of several of these detections and confirmed the presence of striped dolphin calves during the winter survey.

The Greenpeace surveys provide clear evidence that sperm and Cuvier's beaked whales are present in the wider Hellenic Trench area throughout the year, including in the deeper regions that are the subject of seismic survey testing and hydrocarbon exploration. Vessel strikes are

[1] A species of toothed whale from the group including but not limited to false killer whale (*Pseudorca crassidens*), killer whale (*Orcinus orca*) and pilot whale (*Globicephala* spp.).

a serious cause of mortality for sperm whales in the Hellenic Trench[2] and Cuvier's beaked whales are known to be particularly sensitive to anthropogenic noise[3]. The Mediterranean subpopulation of Cuvier's are facing an increasing number of threats[4,5,6]. Vulnerability to noise from military sonar, naval traffic and geological and seismic surveying is known to be serious issue for beaked whales[7,8,9]. Given the diversity and threat status of cetaceans present in the region throughout the year and the globally Important Marine Mammal Area (IMMA) status of the Hellenic Trench we strongly advise against issuing any new permits for activities such as seismic surveys and hydrocarbon extraction throughout the wider Hellenic Trench area.

Background:

The Hellenic Trench is one of the first global IMMAs to be designated due to its regional importance for sperm and Cuvier's beaked whales and for the diversity of other cetaceans that rely on the area[10]. The Mediterranean populations of both these two deep diving species are classed as globally threatened by the International Union for Conservation of Nature[11,12], with sperm whales identified as endangered and Cuvier's beaked whales as vulnerable. Both populations are thought to be declining in abundance.

Extensive research, particularly around the 1,000 m bathymetric contour has provided important data on the distribution and ecology of on these two species. Surveys are consistent in estimating that there may be 200–300 sperm whales within the Hellenic Trench area,

[2] 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: e0212016

[3] 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

[4] 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. pp 103–140.

[5] 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

[6] Hooker SK, et al. (2019) Future directions in research on beaked whales. Front Mar Sci 5: 514 doi: 10.3389/fmars.2018.00514

[7] Cox et al. (2006) Understanding the impacts of anthropogenic sound on beaked whales. J Cetacean Res Manag 7: 117

[8] Hooker SK, et al. (2019) Future directions in research on beaked whales. Front Mar Sci 5: 514 doi:10.3389/fmars.2018.00514

[9] Li S, Rosso M (2021) Lack of knowledge threatens beaked whales. Science 371: 791. doi:10.1126/science.abg8922

[10] IUCN-MMPATF. (2017). Hellenic Trench IMMA. Full Accounts of Mediterranean IMMA Factsheet. IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force, 2017. PDF made available for download at www.marinemammalhabitat.org/portfolioitem/hellenic-trench/

[11] Pirotta et al. (2021) *Physeter macrocephalus* (Mediterranean subpopulation). *The IUCN Red List of Threatened Species 2021*: e.T16370739A50285671 https://dx.doi.org/10.2305/IUCN.UK.20213.RLTS.T16370739A50285671.en

[12] 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.

although more recent studies suggest that the population may have declined at an alarming rate during the last 12–15 years[13,14,15]. Current estimates for Cuvier's beaked whales along the Hellenic Trench are 361–704 individuals, suggesting small population despite the high sighting rates in particular areas[16]. Cetacean presence beyond the 2,000 m contour, particularly outside the summer season, is less well known. This study aimed to address this key knowledge gap given the continued interest in oil and gas exploration in the deeper waters of the Hellenic Trench, for example the bocks south and southwest of Crete.

Methods:

Passive acoustic and opportunistic visual surveys were conducted across the survey area following predetermined track lines as generated by the software Distance[17]. Standard principles for line-transect survey design were used to help ensure coverage of the wider area, including the south and southwest survey blocks. Surveys were completed by the M/Y *Arctic Sunrise* in summer-autumn (autumn survey) and the S/Y *Rainbow Warrior* during winter-spring (winter survey). Acoustic data were collected on-board the using a towed hydrophone array (Vanishing Point Ltd, Plymouth, United Kingdom). Continuous recordings were collected and stored onboard and subsequent analyses of all data followed protocols outlined in Webber et al. (2022)[18]. Sighting data were collected as means of providing additional information to verify acoustic detections and protocols for the visual survey are provided in a previous summary cruise report[19].

Results:

The acoustic surveys were conducted over 51 days during the two seasons – approximately 22 days in autumn (21st August to 11th September 2021) and 27 days in winter (9th February 2022 to 29th March 2022), covering a total track line distance of 18,366 km. The study confirmed the presence of at least five toothed cetaceans (odontocetes) across the two survey periods within the deeper waters of the Hellenic Trench: sperm whale (49 detections, mean water depths ($\bar{x}$) -3364 m, range (R) -1248 m to -4211 m), Cuvier's beaked whale (four detections, $\bar{x}$ -3071 m, R -1970 m to -3772 m), Risso's dolphins (*Grampus griseus*)(five detections, $\bar{x}$ -3338 m, R -2249 m to -4445m), striped dolphins (*Stenella coeruleoalba*) (two detections, $\bar{x}$ -2981 m, R -2490 m to -3472 m) and rough-toothed dolphins (*Steno bradenensis*)

[13] Frantzis A, Alexiadou P, Gkikopoulou KC (2014) Sperm whale occurrence, site fidelity and population structure along the Hellenic Trench (Greece, Mediterranean Sea). Aquat Conserv 24: 83-102

[14] Lewis et al. (2018) Abundance estimates for sperm whales in the Mediterranean Sea from acoustic line-transect surveys. J Cetacean Res Manag 18: 103-117

[15] Frantzis A, Koutouzi N, Gkikopoulou K, Alexiadou P, Moschopoulos E (2022) Results synthesis. Deliverable C3 of project: "Sampling, analysis and data synthesis for the assessment of Good Environmental Status (GES) of MSFD Descriptor 1 (biodiversity) for cetaceans", Green2Sustain-G. Tentes-A.Frantzis, Athens, 85 p. (in Greek)

[16] Ibid.

[17] Buckland et al. (2001). *Introduction to Distance Sampling: Estimating Abundance of Biological Populations*. Oxford University Press, Oxford, UK.

[18] Webber T, Gillespie, D., Gordon, J., Lewis, T, Thompson, KF (2022) Streamlining analysis methods for large acoustic surveys using automatic detectors with operator validation. Methods Ecol Evol 13: 1765-1777

[19] https://www.greenpeace.to/greenpeace/wp-content/uploads/2021/11/Visual-Acoustic-Survey-Hellenic-Trench-Cetacean-Survey-2021.pdf

(one detection, -3653 m)(Figure 1). Both surveys also detected 224 unidentified delphinids, including a potential black fish (one detection, -3024 m) that could not be identified to species level.

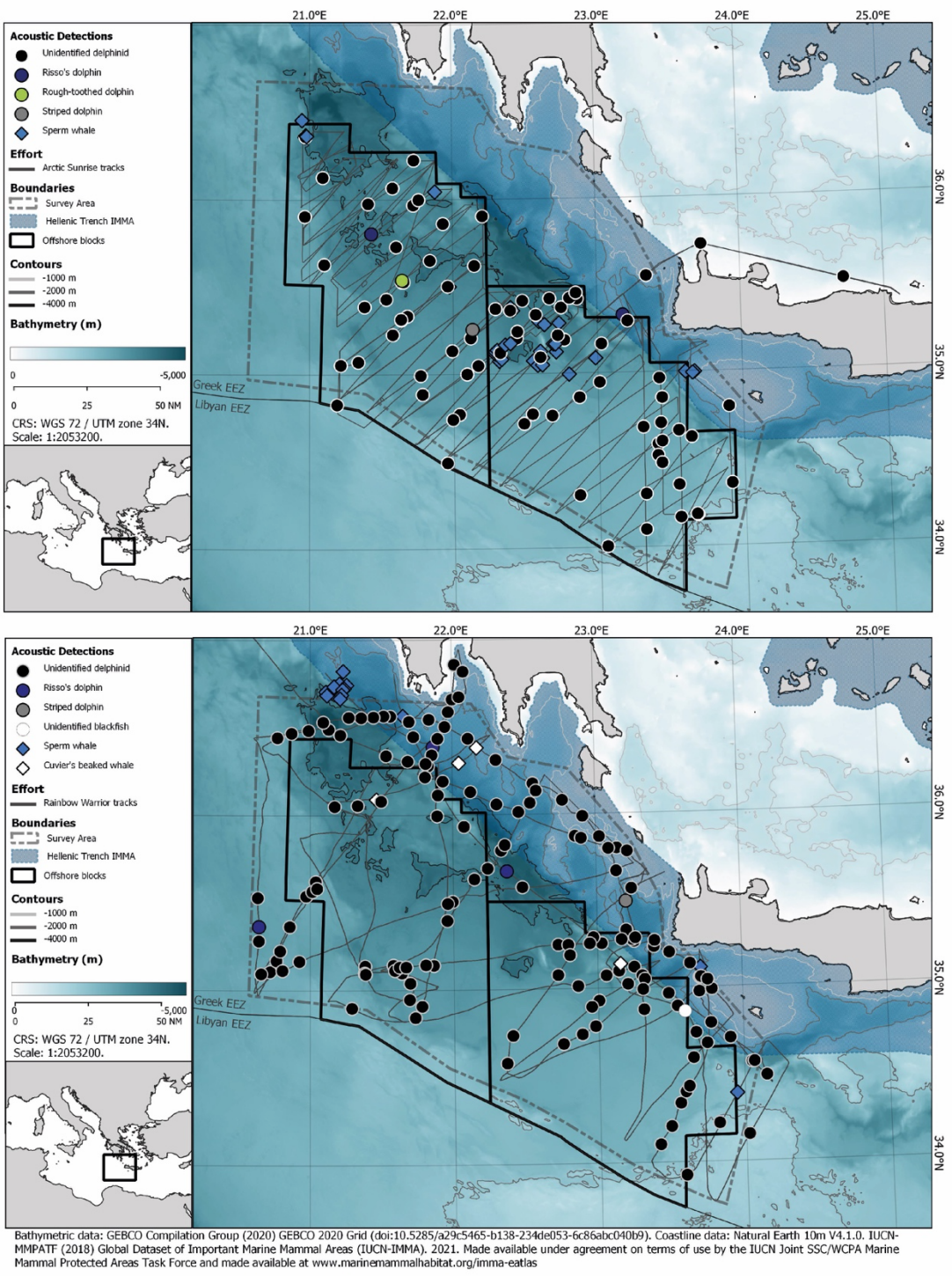

Figure 1. Acoustic detections of cetaceans during the autumn and winter survey periods. Top panel shows detections from the M/Y *Arctic Sunrise* during the autumn survey (20th August to 11th September 2021) and the bottom panel shows detections from the S/Y *Rainbow Warrior* during the winter survey (9th February 2022 to 29th March 2022).

Conclusions:

The results of the two surveys conducted in autumn and winter clearly show that both sperm and Cuvier's beaked whales are present in this region of the Hellenic Trench throughout the year. In addition, three species of dolphin were detected in deeper waters during the colder months – Risso's, striped and rough-toothed dolphins. All five species are listed by the IUCN Red List of Threatened Species with recommendations for further research and habitat protection throughout the Mediterranean (sperm whales, endangered[20]; Cuvier's beaked whale, vulnerable[21]; striped dolphins, vulnerable[22]; rough-toothed dolphin, near threatened[23]; Risso's dolphin, endangered[24]). Numerous delphinids that could not be identified to species level from vocalisations alone were also detected during the survey.

Table 2. Cetacean species detected by the Greenpeace visual-acoustic surveys within the Hellenic Trench survey area, autumn 2021 and winter 2022, and their threat status according to the International Union for the Conservation of Nature.

Common name	Scientific name	Number of detections	IUCN threat status in the Mediterranean
sperm whale	*Physeter macrocephalus*	49	Endangered[19]
Cuvier's beaked whale	*Ziphius cavirostris*	4	Vulnerable[20]
striped dolphin	*Stenella coeruleoalba*	2	Vulnerable[21]
Rough-toothed dolphin	*Steno bradenensis*	1	Near threatened[22]
Risso's dolphin	*Grampus griseus*	5	Endangered[23]

All the cetacean species detected in the survey are known to be negatively impacted by human activities in the Mediterranean, including noise and other pollution, vessel strikes, poor fisheries management and microplastic ingestion. Such stressors are likely to interact synergistically with broad scale alterations to the marine environment due to climate changes, leading to population-level impacts on species that are already known to be in decline. Further industrial-scale human activities in the wider Hellenic Trench region, including seismic surveys, hydrocarbon extraction and uncontrolled shipping, could have potentially negative

[20] Pirotta et al. (2021) *Physeter macrocephalus* (Mediterranean subpopulation). *The IUCN Red List of Threatened Species* 2021: e.T16370739A50285671 https://dx.doi.org/10.2305/IUCN.UK.20213.RLTS.T16370739A50285671.en Accessed on 12 October 2021

[21] 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. Accessed on 05 July 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. Accessed on 12 October 2021.

[23] Kerem D, Frantzis A, Scheinin A, Goffman O (2021) *Steno bredanensis (Mediterranean subpopulation). The IUCN Red List of Threatened Species* 2021: e.T160158217A160158353. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T160158217A160158353.en. Accessed on 06 October 2022

[24] Lanfredi C, Arcangeli A, David L, Holcer D, Rosso M, Natoli A. (2022) *Grampus griseus (Mediterranean subpopulation)* (errata version published in 2022). *The IUCN Red List of Threatened Species* 2022: e.T16378423A210404051. Accessed on 06 October 2022

effects on cetaceans that rely on the area as key habitat. Vessel strikes are a serious cause of mortality for sperm whales in the Hellenic Trench[25] and Cuvier's beaked whales are known to be particularly sensitive to anthropogenic noise[26]. The Mediterranean subpopulation of Cuvier's are facing an increasing number of threats[27,28,29]. Vulnerability to noise from military sonar, naval traffic and geological and seismic surveying is known to be serious issue for beaked whales[30,31,32]. The impacts related to the extensive use of airguns for seismic surveys and noise from military activity could have a cumulative impact on the whales that rely on the Hellenic Trench habitat. Given the diversity and threat status of cetaceans present in the region throughout the year and the IMMA (globally Important Marine Mammal Area) status of the Hellenic Trench, we strongly advise against issuing new permits for activities such as seismic surveys and hydrocarbon extraction throughout the wider Hellenic Trench area.

Acknowledgements: Many thanks to the crews of the *Arctic Sunrise* and *Rainbow Warrior*, Olly Boisseau, 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.

[25] 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: e0212016

[26] 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. Accessed on 05 July 2021

[27] 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. pp 103–140.

[28] 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. Accessed on 05 July 2021

[29] Hooker SK, et al. (2019) Future directions in research on beaked whales. Front Mar Sci 5: 514

[30] Cox et al. (2006) Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res Manag 7: 117

[31] Hooker SK, et al. (2019) Future directions in research on beaked whales. Front Mar Sci 5: 514

[32] Li S, Rosso M (2021) Lack of knowledge threatens beaked whales. Science 371: 791