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

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EXECUTIVE SUMMARY

A research project was conducted during the summer of 2013 by the *Song of the Whale* team and collaborators to undertake the first systematic survey for sperm whales and harbour porpoises of the Aegean Sea, and to survey previously little studied areas of the eastern Mediterranean Sea. The project was conducted between 18 July and 2 September 2013. The Aegean Sea was surveyed both visually and acoustically for marine mammals at different spatial scales including a broad scale survey for sperm and beaked whales, and a fine scale survey of the northern Aegean Sea (Thracian Sea) for harbour porpoises. Following the Aegean Sea survey, the team undertook a broad-scale survey of the northern Levantine Sea between Rhodes, southern Turkey and Cyprus, including waters over the Eratosthenes Seamount to the south of Cyprus. The International Fund for Animal Welfare funded the research project, with additional funding for the harbour porpoise survey in the Thracian Sea provided by Pelagos Cetacean Research Institute. The project had several aims: to fill the significant remaining systematic survey 'gaps' for sperm whales in the Mediterranean; investigate the waters of the northern Aegean Sea for the presence of harbour porpoises and, to provide data to help identify risks posed by shipping to cetaceans such as noise pollution and ship-strikes. As such, background noise measurements were routinely collected using a calibrated hydrophone, and continuously recorded using a towed hydrophone array. Furthermore, AIS data were recorded to enable shipping traffic density estimations to be derived. This report briefly summarises the survey effort, geographical coverage and preliminary results; however post-processing of acoustic data is underway so that a more detailed spatial analysis can be presented. Notable findings include confirmation of the presence of free-swimming harbour porpoises in the northern Aegean Sea, and encounters with both rough-toothed dolphins, and a single monk seal sighting offshore in the Levantine Sea.

1. INTRODUCTION

A recent review of the threats and status of species in the Mediterranean Sea identified ship strikes (namely direct impact with the hull, propeller or associated sub-sea structures of a vessel) and entanglements in drift nets as primary threats to large whales (Notarbartolo di Sciara and Birkun Jr., 2010). Anthropogenic sound is also of major concern for certain species in the region (*e.g.* Cuvier's beaked whales; Aguilar Soto *et al*., 2006; Pirotta *et al*., 2012). Given the intensity of shipping between the Mediterranean and Black Seas *via* the Aegean Sea, both ship strike and noise have been identified as posing potential threats to individuals and populations of whales (Notarbartolo di Sciara

and Birkun Jr., 2010). Chemical and debris pollution, entanglements and disturbance are also serious threats to small cetaceans (*e.g.* Bearzi *et al.,* 2010).

The European Commission and the EU member states are developing criteria and methodological standards for defining good environmental status in relation to several descriptors including underwater noise. The EU Marine Strategy Framework Directive, has identified that shipping noise should be mitigated to achieve the good environmental status of European waters. One of the criteria under development requires member states to monitor shipping noise levels and ensure they will not increase. The measurements of ship noise in the region will demonstrate the technique for collecting data, provide some initial data on noise levels and hopefully thereby encourage and assist governments in complying with their international obligations under the International Maritime Organisation (IMO) and EU and support efforts to identify the types of vessels which will benefit most from ship quieting technology.

Harbour porpoises (*Phocoena phocoena*) are thought to be largely absent from the Mediterranean Sea. However, over the last two decades, 12 published records of strandings of this species have occurred in Greek and Turkish waters in the Aegean Sea (Tonay and Dede, 2013, Frantzis *et al*., 2001). Those harbour porpoises found stranded in the Aegean Sea (and in the Black and Marmara Seas) exhibit unique haplotypes, not found in the North Atlantic Ocean (Viaud-Martínez *et al.,* 2007). As such, they are recognised as a sub-species: the Black Sea harbour porpoise (*P. phocoena relicta*), comprising an insular and threatened population listed as 'Endangered' on the IUCN Red List (Birkun and Frantzis, 2013). However, the IUCN Red List does not include a listing for the Mediterranean harbour porpoise due to a lack of data from which to estimate key biological parameters (Birkun and Frantzis, 2013). Although Mediterranean animals share the same haplotype as harbour porpoises in Ukrainian Black Sea waters, it remains possible that those in the Aegean Sea comprise an insular and threatened population representing either a relict Mediterranean Sea or an isolated Black Sea sub-population (Frantzis *et al*., 2001; Tonay and Dede, 2013; Viaud-Martínez *et al*., 2007), or a combination of both.

In principle, harbour porpoises in Mediterranean waters are protected by both national legislation and international agreements including the EU Habitats Directive and the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS). Their conservation status and distribution however have been subject to much discussion and concern by conservationists and within the Scientific Committee of the International

Whaling Commission (IWC). In some parts of Europe the total bycatch of harbour porpoises has been well above a level deemed acceptable (Hammond *et al*., 2002; Vinther and Larsen, 2004). Harbour porpoises are listed as an Annex II species under the Habitats Directive, obliging EU member states to establish and maintain their favourable conservation status. However in some areas, there are insufficient data on presence, distribution and abundance to inform conservation actions. The Black and Aegean Seas are a case in point the main aim of the survey work in the Northern Aegean presented here was to establish whether porpoises are present in the northern Aegean Sea using both acoustic and visual techniques; this was the first dedicated systematic survey of the area.

Sperm whales in the Mediterranean Sea are widely distributed from the Straits of Gibraltar to the Levantine Basin, and formerly were thought to be common in portions of the Mediterranean Sea. However, the Mediterranean subpopulation, which is genetically distinct, now contains fewer than 2,500 mature individuals and potentially as few as in the mid hundreds (Notarbartolo di Sciara *et al.* 2012). Surveys undertaken previously indicate that sperm whale numbers are higher in the western basin (Lewis *et al.,* 2007), and surveys of other parts of the basin have not revealed the existence of very high concentrations of sperm whales (Notarbartolo di Sciara *et. al.,* 2012), except along the Hellenic Trench (Frantzis *et al*. in press). In the absence of effective management to mitigate ongoing threats to sperm whales from bycatch (entanglement in fishing gear) and ship strikes, the population decline is continuing. Previous surveys by IFAW and SOTW team in 2003, 2004 and 2007 were aimed at filling significant 'gaps' in survey coverage for sperm whales in the Mediterranean basin (Lewis *et al.,* 2007). The project in 2013 aimed to provide survey coverage of the Aegean Sea, Egyptian waters and other parts of the Levantine Basin which had previously received little effort. Unfortunately, due to political unrest in Egypt during the summer 2013, it was not possible to obtain diplomatic clearance to undertake the planned survey off Egypt, and the survey in the Aegean Sea was not completed as originally planned due to permitting complications.

2. METHODOLOGY

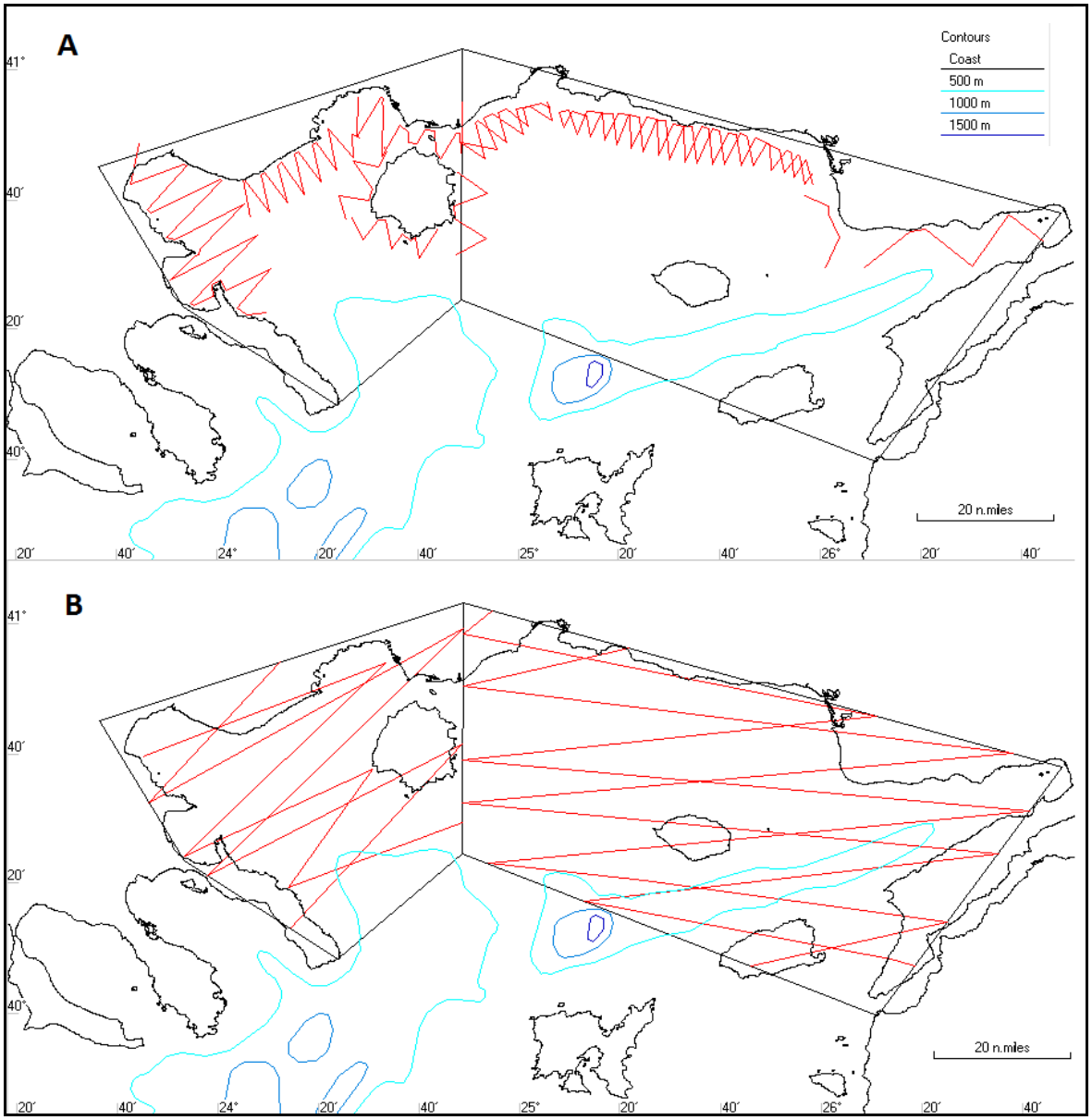
2.1 Visual and acoustic survey

Marine Conservation Research (MCR) in collaboration with Pelagos Cetacean Research Institute commenced a visual and acoustic survey of the Aegean Sea from R/V *Song of the Whale* (SOTW) on 7 July 2013 after a passage from the UK. SOTW is a 21 metre auxiliary-powered cutter-rigged sailing research vessel, owned by the International Fund for Animal Welfare and operated by MCR Ltd. The survey was conducted under permits issued by the Cypriot, Greek and Turkish authorities by an

international team including local scientists from NGOs and universities. Pre-determined track-lines were designed using Distance software (Thomas *et al.*, 2010) and the survey area was sub-divided into three survey blocks (Table 1 and Figure 1).

Table 1. The survey was sub-divided into three survey areas.

Region	Time-frame	Aims	Survey speed	Survey design
Thracian Sea	7 – 26 July	1. Harbour porpoise distribution and abundance	5 – 7 kn	Figure 1a & 1b
Aegean Sea	26 July – 8 August	1. Harbour porpoise distribution and abundance 2. Sperm whale distribution and abundance 3. Cetacean distribution in relation to shipping lanes 4. Describe background noise levels	6 – 8 kn	Figure 1c
Levantine Sea	9 August – 2 September	1. Cetacean distribution in relation to shipping lanes 2. Describe background noise levels	6 – 8 kn	Figure 1d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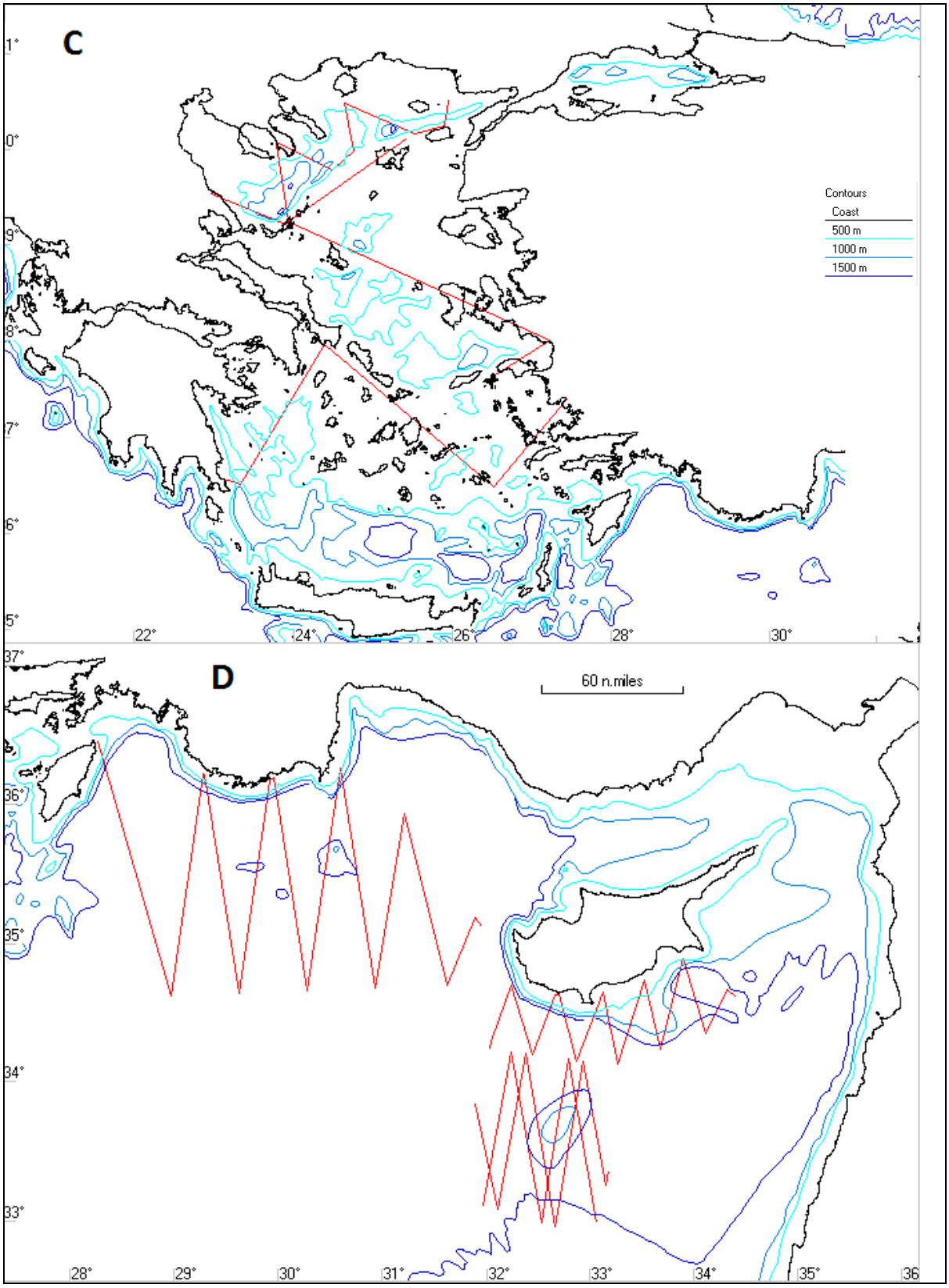

Figure 1. Survey areas showing the planned pre-determined track-lines in: a) The Thracian Sea (coastal); b) Thracian Sea (offshore); c) Aegean Sea; d) Levantine Basin.

2.1.1 Harbour porpoise double platform visual and acoustic survey of the Thracian Sea

Acoustic sampling for the harbour porpoise survey was conducted using two towed arrays each containing a pair of broadband elements with 2 kHz to 200 kHz bandwidth, towed 200 m behind the vessel. Two 16-bit two-channel .wav files were recorded continuously at a sample rate of 500 kHz using Pamguard (Gillespie *et al*., 2009) and routine checks of the software (2 minutes every 15 minutes) were conducted to monitor for cetacean vocalisations and guarantee the equipment was working optimally. Signals were passed through bespoke buffer boxes to internal NI 6251 sound cards. The buffer boxes provided variable frequency responses; however, for the bandwidths of interest for harbour porpoises (115-160 kHz), the response was approximately flat.

Visual observations were carried out during daylight hours and in suitable sea state (sea state ≤ 3 for the harbour porpoise survey and ≤ 4 for the other parts of the survey). For the Thracian Sea harbour porpoise survey, a double-platform method was employed following Hammond *et al.* (2002). Continuous visual effort was maintained by four observers on hourly rotation to reduce observation fatigue. This survey method used two observers on each of two platforms. Two "primary observers" were positioned on a foredeck platform (eye height of 3.5 m above sea level) and scanned the sea with the naked eye to a distance of 500 m in an arc from 0^{o} to 90^{o} either side of the vessel. These observers wore ear-plugs and were not prompted by other observers or acoustic information to ensure that an unbiased detection function could be derived. Upon sighting a marine mammal, the observer recorded the bearing using an angle board and the distance using a range-finding stick made for individual observers according to their eye height and arm length using the Heinemann (1981) formula.

From the A-frame observation platform situated on the aft deck (eye height of 5.5 m above sea level), two "trackers" scanned the sea ahead of the vessel using reticulated 7 x 50 binoculars. The binoculars were mounted on a monopod above a Panasonic HDCSD90 video camera set with a 3 second pre-record to allow Video Range Tracking (VRT) of animals. Upon sighting a marine mammal, the VRT camera was set to record, ensuring that both the target animal and the horizon were in frame. A running commentary was made by the observer stating the binocular reticular distance to the animal, direction of travel (*e.g.* right to left / left to right), relative angle of travel (in relation to the observer) and number of animals. This information was also documented using Logger (IFAW, 2010) software by a separate data collector. When a porpoise was being tracked, the second A-

frame observer covered the whole area in front of the vessel, in order not to miss any additional animals.

In order to obtain accurate distances to animals for each sighting, sequential images of each surfacing with the animal and the horizon in the image are extracted post-process. From observers' eye height on the A-frame and the distance of the horizon, an accurate distance can be calculated to the animal using an automated Visual Basic code. Four downward facing open dome CCTV cameras with 3.6 mm lenses were mounted above the A-frame to capture images of the observers as they directed their binoculars towards a porpoise encounter. From lines running perpendicular to the vessels centre line on the floor of the A-frame and a "sight line" marked on top of each pair of binoculars, accurate angles to the animal, relative to the vessel's heading, could be calculated (Figure 2).

Figure 2. Example of a CCTV image from the starboard camera 1

Environmental and GPS data were logged automatically to the Logger database every 10 s, including date, time, vessel position (latitude, longitude), true heading (Simrad HS80 GPS Compass), sea surface temperature (°C), true wind speed (knots) and direction. Manual records of other environmental variables (such as sea state, wave and swell height) and survey effort (numbers and positions of observers) were made hourly. Data on the distribution and densities of rubbish and discarded fishing gear were also collected throughout the survey.

2.1.2 Cetacean surveys of the Aegean and Levantine Seas

For the general cetacean survey, a single 400 m towed array was used for making mid-frequency recordings of sperm whales and delphinids at a sampling rate of 48 kHz (two channel recordings via *Fireface 800* sound card). In addition, higher frequency recordings were made at a sampling rate of 192 kHz to detect beaked whales (via bespoke buffer boxes with internal NI 6251 soundcards). The entire system was capable of detecting signals from 10 Hz to 200 kHz. For the bandwidths of interest for both sperm whale (2 to 24 kHz) and beaked whale clicks (25 to 50 kHz), the response of the system was approximately flat. For these surveys, visual surveys were conducted from a single platform only, *i.e.* A-frame observations as described in section 2.1.1 above.

2.1.3 Acoustic software

Pamguard software was used throughout all cetacean surveys with modules to automatically detect cetacean vocalisations including a click detector to log harbour porpoise, beaked whale, sperm whale and other odontocete click trains, and a whistle and moan detector to detect the tonal calls of both odontocetes and mysticetes. Two-minute listening stations were carried out at 15 minute intervals during which cetacean clicks or whistles were logged by an operator (to species level where possible). Noise from the research vessel, other vessels and water noise were recorded as a categorical index: 0= not heard, 1= faint, 2= becoming clear, 3= clearly audible, 4= becoming loud, 5= nothing else audible. The same subjective scale was used for cetacean vocalisations.

2.1.4 Mid-frequency recording of cetaceans

Throughout the project, mid-frequency two-channel recordings at a sampling rate of 48 kHz were also collected via a *Fireface 800* sound card for other mid-frequency odontocetes, especially sperm whales.

2.1.5 Visual observations of floating debris

In order to estimate the density of rubbish, specifically floating debris, visual observers recorded the distance and bearing to each piece observed along the track. These records were recorded during daylight only. Rubbish was classified into nine categories: fishing gear, food packaging, plastic bag, plastic bottle, miscellaneous plastic, polystyrene, wood, balloons and other. Subsequently during data analysis, the following categories were consolidated into a single ‘plastics’ category: plastic bag, plastic bottle and miscellaneous plastic.

2.2 Analysis of ambient noise and vessel density

2.2.1 Ambient noise measurements

Ambient noise recordings made with a calibrated hydrophone to allow comparison with the AIS logs of target vessels in order to calculate relative received signal levels and map areas of high traffic and ship noise density in relation to cetacean relative abundances. Relative ambient noise measurements were recorded continuously using a 200 to 400 m long (water depth dependent) towed hydrophone array recording at a sampling rate of 48 kHz via a Krohn-Hite filter box (with a low pass filter at 24 kHz) through a National Instruments NI 6251 sound card. Point samples of calibrated ambient noise recordings were also made using an omni-directional RESON TC4032 hydrophone with a frequency response of ±2.5 dB between 10 Hz and 80 kHz. During recording the hydrophone was housed in a protective weighted cage deployed from the aft davits of SOTW. These measurements were also used as reference measurements, by simultaneously recording with both the calibrated RESON hydrophone and the same towed hydrophone used for the continuous recordings. This point sampling was carried out throughout the survey area twice a day at 07:00 and 19:00 local time with simultaneous CTD casts to circumvent biases associated with strong sea surface warming during daylight hours. Recordings of three minute duration were made while SOTW was stationary, with the engine, echo-sounder and generator powered off. During these recordings, acoustic signals were made below the water surface using a hammer-strike, at known times (recorded on Logger software) to allow a comparison of sensitivity between the calibrated RESON hydrophone and the non-calibrated towed array.

2.2.2 Recording vessel density

The Automatic Identification System (AIS) was developed for vessels by the IMO (International Maritime Organisation) to complement the use of radar in order to aid navigation at sea. All commercial vessels with a gross tonnage of greater than 300 and all passenger ferries are required to transmit AIS signals which can be monitored using an AIS receiver. This presents a convenient means by which to record locations of individual vessels in order to investigate the distribution of shipping traffic and assess ship density levels and hence identify high risk zones for cetacean ship-strikes (Leaper and Danbolt, 2008). The electronic navigation system on board SOTW (*dKart Navigator,* Morintech Navigation) recorded the following data approximately once every 10 s for each vessel within AIS range: MMSI (maritime mobile service identity) number; latitude; longitude; course over ground; speed over ground and destination. The data were concatenated using an Excel macro and the minimum distance from SOTW to each unique vessel-per-day was plotted using R (R Team, 2005).

2.2.3 Conductivity, temperature, depth (CTD) cores

CTD cores were taken at each point sampling station (twice a day as in section 2.2.1) using a *SBE 19plus SeaCAT Profiler* (Sea-Bird Electronics Inc.). Casts were made to a depth of 100 m, or 20 m above the seabed in depths of <100 m, at each sampling station. The CTD instruments sampled at a rate of 4 Hz while the profile was taken at a speed of 1 ms^{-2}. Only the ascending casts were used for analysis. The instrument sensors were rinsed with deionised water between each profile. Data were downloaded to a computer directly from the instrument and were converted, filtered and aligned and plotted using *SEASOFT-Win32* software.

3. RESULTS

3.1 Survey effort and sightings

A total of 613 hours (25.5 days) of acoustic data were collected along pre-determined randomly designed track lines in the Mediterranean Sea. Some additional 226 hours (9.4 days) of acoustic recordings were made during passages in the region (Table 2). A total of 229 sightings of between 826 and 1174 individual cetaceans were made including seven species of odontocete (Table 3). Of these, 59 sightings could not be identified to species level, usually where the groups were too distant to observe diagnostic features. No baleen whales were recorded in the region. A single monk seal (*Monachus monachus*) was observed south of Cyprus. Other than marine mammals, 11 individual turtles were observed, seven of which were identified as loggerhead (*Caretta caretta*) (Table 3). Unfortunately, there were insufficient sightings to derive absolute density estimates for harbour porpoises using the double platform method.

Table 2. Summary of dedicated (transect) and opportunistic (passage) survey effort in the eastern Mediterranean and Aegean Seas.

	Thracian Sea (Coastal)		Thracian Sea (Offshore)		Aegean Sea		Levantine Basin		Total	
Survey Mode	km	hh:mm	km	hh:mm	km	hh:mm	km	hh:mm	Km	hh:mm
Passage	240	23:27	135	12:15	591	60:13	102	14:11	1069	**110:06**
Passage+acoustic	135	10:23	483	42:59	575	56:39	681	58:39	1874	**168:40**
Passage+visual	10	52:41	338	33:44	93	08:04	22	02:37	464	**97:07**
Passage+acoustic +visual	114	10:11	93	06:32	38	03:25	427	37:10	672	**57:18**
Transect	1	07:40	0	00:00	55	04:28	5	01:23	61	**13:31**
Transect+acoustic	509	46:02	973	86:54	967	85:03	1859	157:19	4308	**375:19**

Transect+visual	12	01:03	0	00:00	7	34:11	12	01:02	30	**36:16**
Transect+acoustic +visual	319	27:42	222	20:29	402	32:23	1433	120:43	2375	**201:18**
Transect+acoustic +double platform	354	31:21	494	43:03	0	00:00	0	00:00	848	**74:25**

Table 3. Summary of the cetacean sightings recorded during surveys throughout the Aegean Sea and eastern Mediterranean Sea.

Species	Number of sightings	Group size range	Total number of individuals		
			Min	Max	Mean
Bottlenose dolphin	68	1—45	234	336	283
Unidentified dolphin	59	1—35	185	288	200
Striped dolphin	46	1—35	287	378	333
Common dolphin	25	1—13	91	137	114
Harbour porpoise	9	1—5	16	17	17
Risso's dolphin	3	5—15	21	35	28
Rough-toothed dolphin	2	3—9	10	13	12
False killer whale	1	3—4	3	4	3.5
Loggerhead turtle	7	1	7	7	7
Unidentified turtle	4	1	4	4	4
Monk seal	1	1	1	1	1
Unidentified shark	1	1	1	1	1.0

The sighting data presented here are not corrected for effort, therefore they must be interpreted with caution. In the northern Aegean Sea, the most frequently encountered species was the bottlenose dolphin (*Tursiops truncatus*) which was largely confined to coastal waters. There was only a single record of bottlenose dolphin in the Levantine Sea: off southern Turkey (Figure 3Figure 4 Figure 5). Striped dolphins (*Stenella coeruleoalba*) were mostly observed in waters further from shore (Figure 3Figure 4 Figure 5), whereas common dolphins (*Delphinus delphis*) were observed in both coastal and offshore waters of the Aegean Sea (Figure 3 and Figure 4), but were absent from the Levantine Sea, albeit based on much lower survey effort (Figure 5). Sightings of harbour porpoise (*Phocoena phocoena*), were confined to a single bay in the easternmost reaches of the Thracian Sea (Figure 4). Risso's dolphins (*Grampus griseus*) were observed once in the Aegean Sea off the Athos Peninsula (Figure 3) and on two occasions in the Levantine Basin between Rhodes and Cyprus (Figure 5). Rough-toothed dolphins (*Steno bredanensis*) were seen twice: in association with Risso's dolphins

on one of these occasions. False killer whales (*Pseudorca crassidens*) were recorded once, to the south of Cyprus (Figure 5).

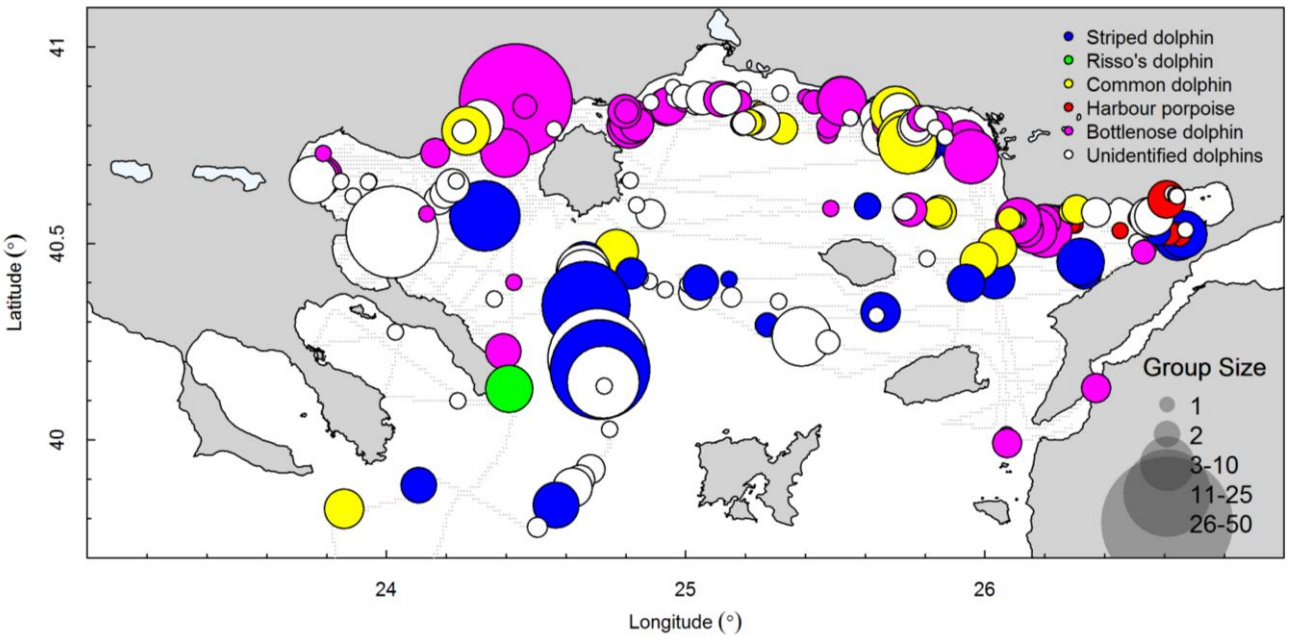

Figure 3. Sightings of cetaceans during both inshore and offshore surveys in the Thracian Sea (northern Aegean Sea). The radius of each symbol, and hence the symbol size, is proportionate to mean estimated group size. NB: Some areas were more intensively surveyed than others, and the sightings presented here are not corrected for effort. The track of SOTW is shown as a grey line.

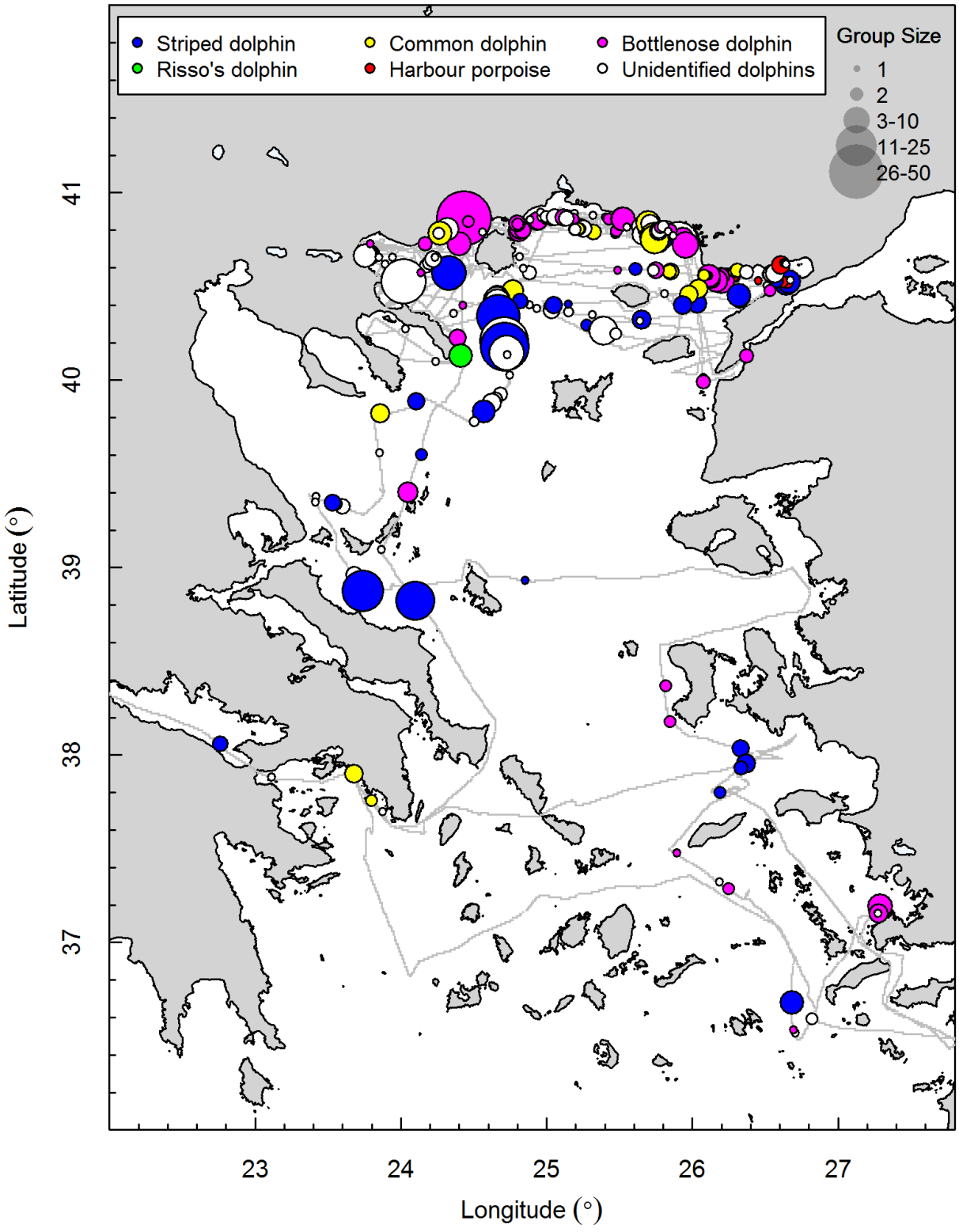

Figure 4. Sightings of cetaceans from the Aegean Sea surveys. The radius of each symbol, and hence the symbol size, is proportionate to mean estimated group size. NB: Some areas were more intensively surveyed than others, and the sightings presented here are not corrected for effort. The track of SOTW is shown as a grey line.

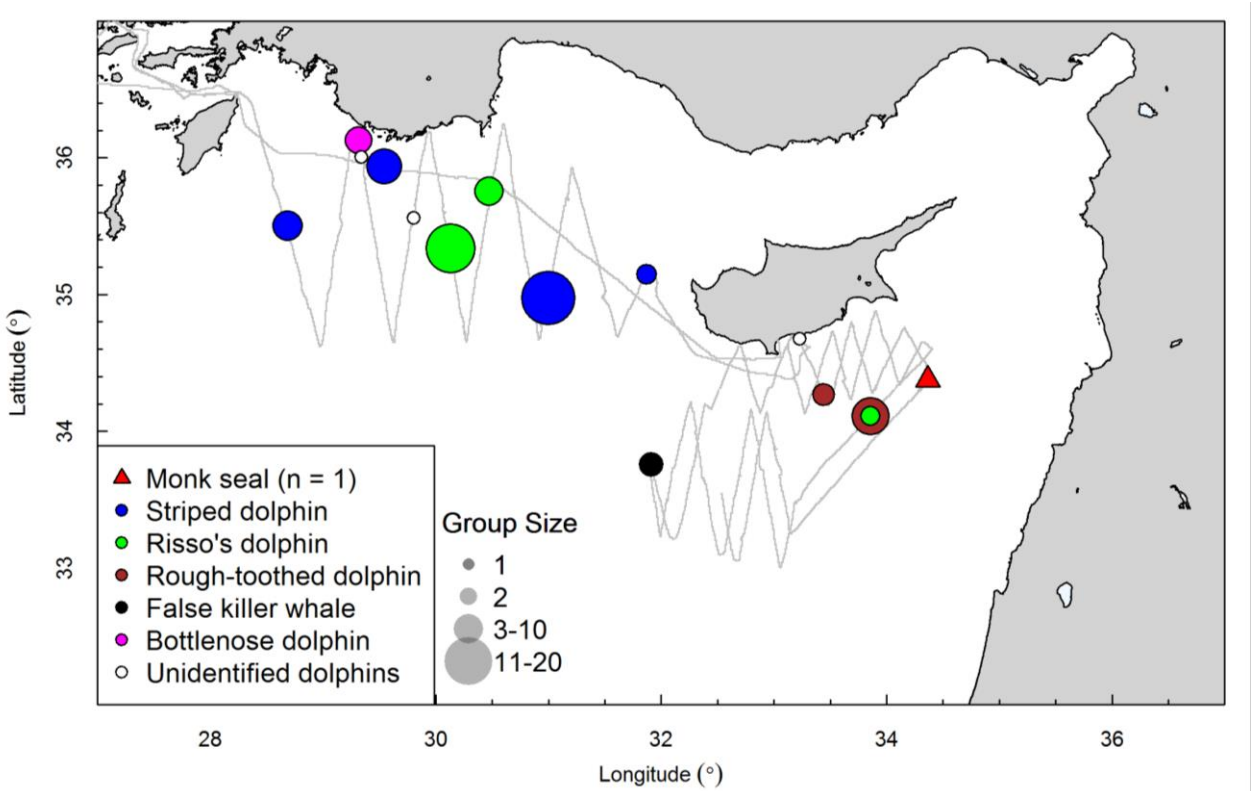

Figure 5. Sightings of marine mammals during the eastern Mediterranean survey (Levantine Basin). The radius of each symbol, and hence the symbol size, is proportionate to mean estimated group size. NB: Some areas were more intensively surveyed than others, and the sightings presented here are not corrected for effort. The track of SOTW is shown as a grey line.

3.2 Acoustic detections

The hydrophone was monitored every 15 minutes with headphones in order to log and classify the presence of cetacean vocalisations. Dolphin clicks and whistles were heard throughout the study area (Figure 6). Detections were frequent in the northern Aegean Sea (Figure 6), although it should be noted that there was substantially higher survey effort in that area (See Figure 1a & b). Sperm whale clicks were largely confined to three areas: the Ikaria Trough (Figure 7), a deep area north of Ikaria Island in western Turkey; the Rhodes Basin 40 nm south-east of Rhodes (Figure 6); and to the south of Cyprus (Figure 6). A post survey analysis will be carried out in order to select and plot harbour porpoise and beaked whale detections throughout the survey area.

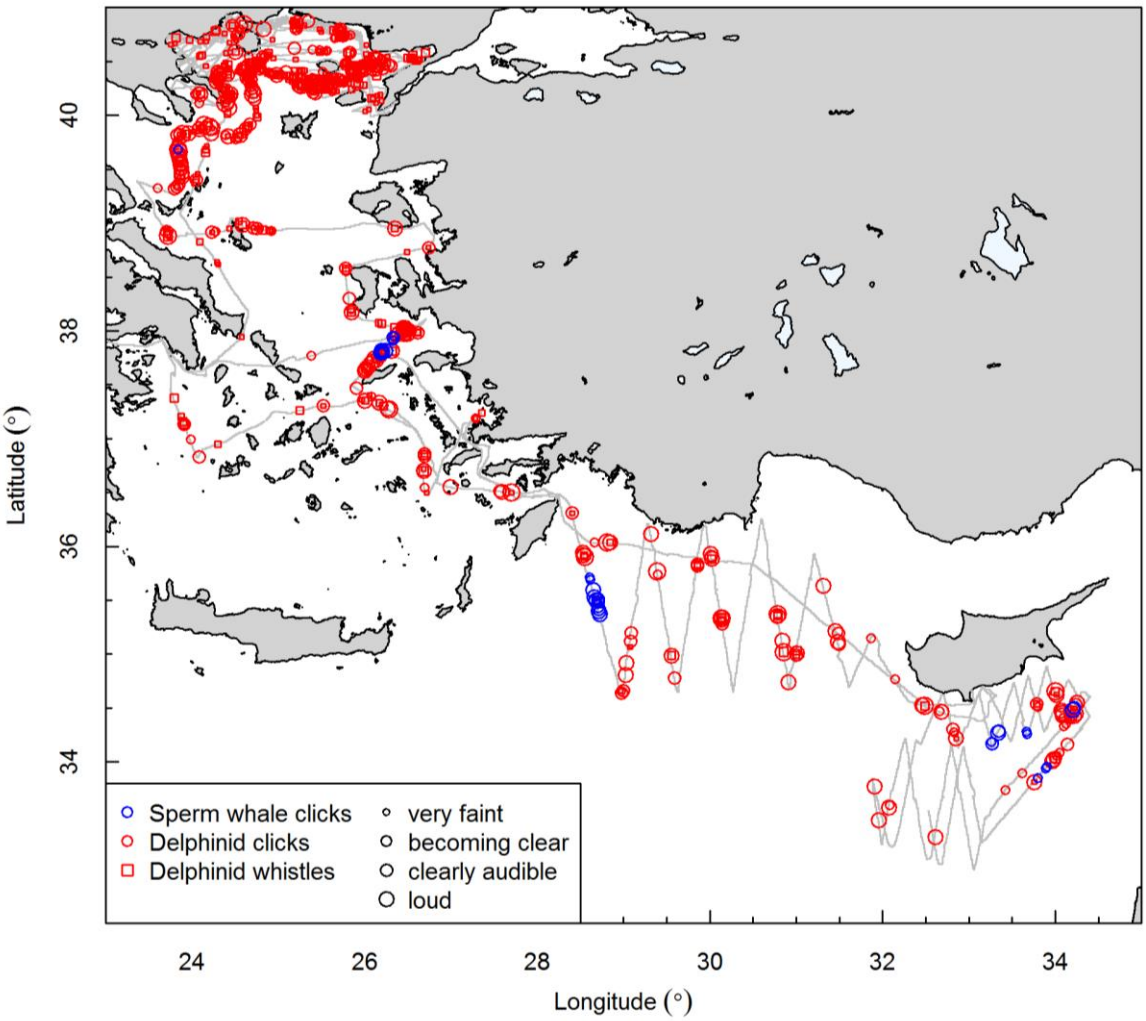

Figure 6. A summary of delphinid clicks and whistles heard during 2 min listening stations (every 15 min) from the Aegean Sea and Levantine Sea surveys. The track of SOTW is shown as a grey line.

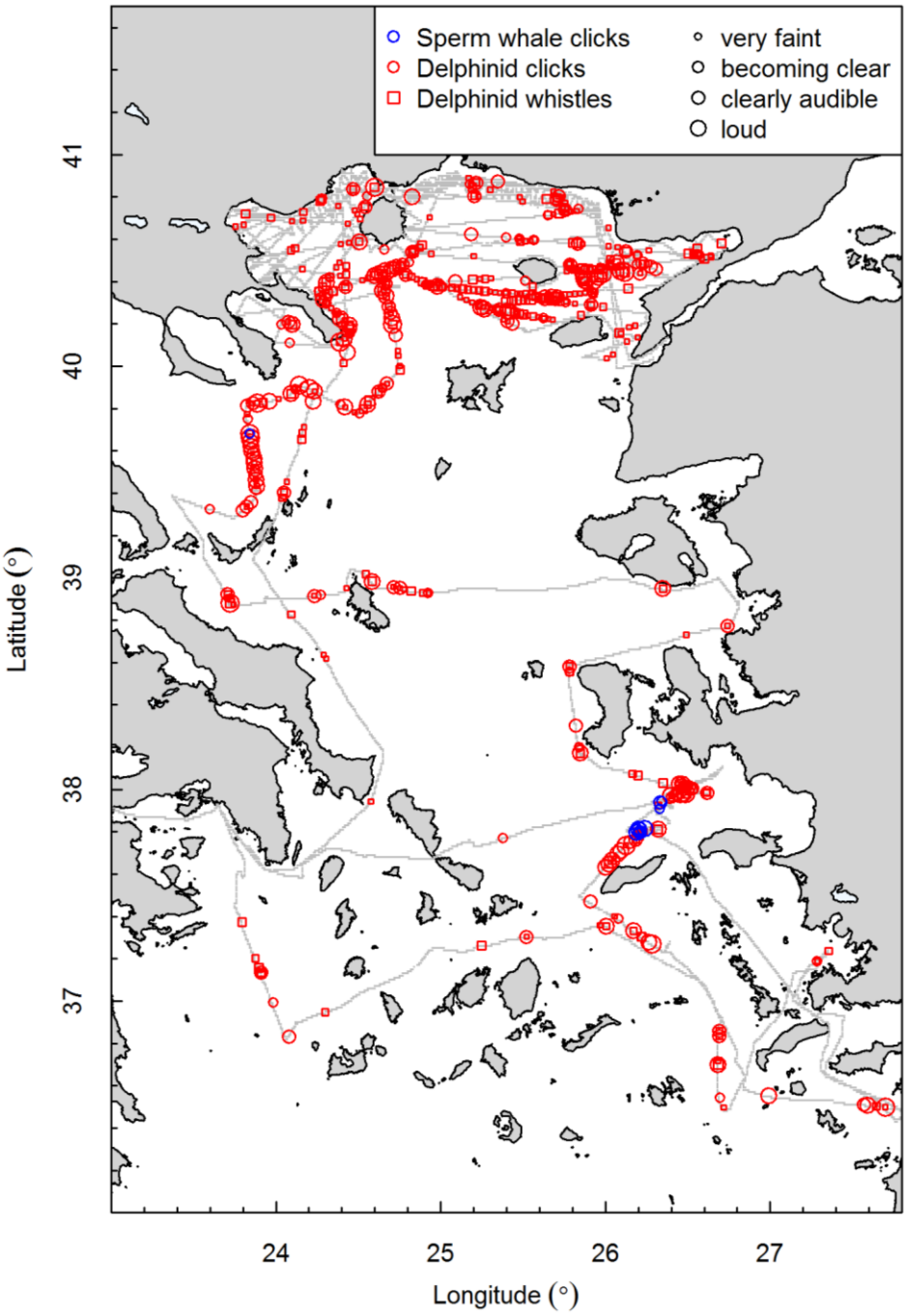

Figure 7. Sperm whale clicks heard during 2 min listening stations (every 15 min) from the Aegean Sea survey. The track of SOTW is shown as a grey line.

3.3 CTD and calibrated noise measurements

Simultaneous RESON calibrated hydrophone recordings and CTD casts were made at 44 stations throughout the survey area (Figure 8). CTD data will be used to calculate the thermocline depth at different sampling areas. A characterisation curve will be generated from the RESON recordings from which comparable background noise measurements can be derived from the towed array. This will enable us to characterise the relative background noise levels throughout the study area assuming the effects of flow noise to be equivalent throughout the survey.

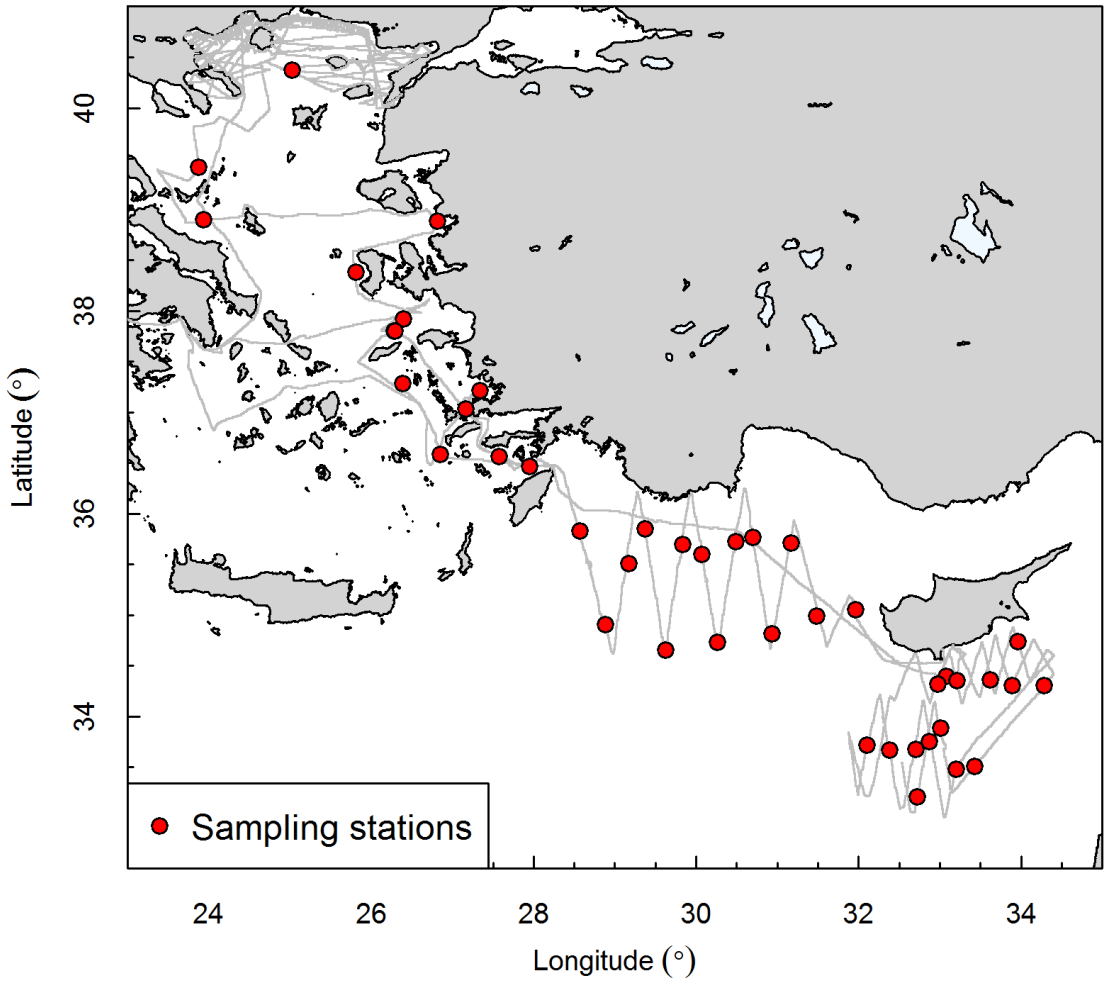

Figure 8. The location of point sampling stations: simultaneous CTD casts and calibrated background noise measurements (red circle) and the track of Song of the Whale (grey line).

3.4 Ship traffic and AIS analysis

The number of AIS transmissions received by SOTW from a given vessel is biased by both course and speed over ground. Therefore, for the analysis of AIS data, only single observations per vessel per day will be considered at an arbitrary point. This arbitrary point was chosen to be the closest point of approach to SOTW. A total of 3402 such vessel records (unique vessels per day at their closest point of approach to SOTW) were recorded throughout the project. These data are useful in identifying areas of high shipping density, *i.e.* shipping lanes (Figure 9). A concentration of high density, high-speed craft can be seen around the Greek islands, where there are regular inter-island ferry services. Busy ship traffic routes from the Suez Canal (in the south-eastern Mediterranean) and the Çanakkale Straits (north-eastern Aegean) can also be seen (Figure 9). In due course, a more detailed analysis of shipping speeds and directions will be conducted using vector fields. These results will be compared to those of a similar study by the SOTW team in 2007, in order to determine differences in ship

speeds and movement patterns. Such data are critical to inform management initiatives which aim to mitigate cetacean mortalities due to ship-strikes.

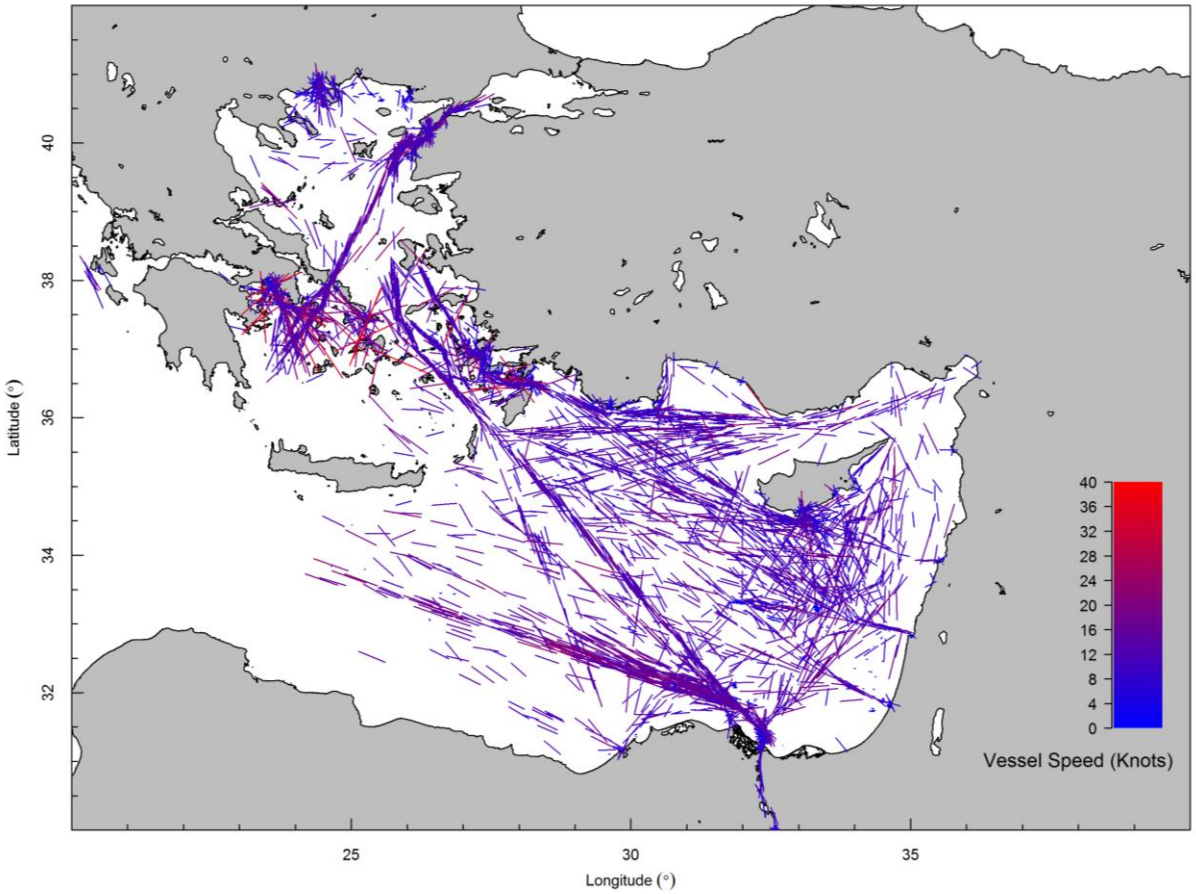

Figure 9. AIS locations and speeds of unique vessels per day at their closest point of approach to R/V Song of the Whale.

3.5 Presence and Distribution of rubbish and plastic debris

During visual observations, 1822 records of floating debris were recorded, distributed widely both inshore and offshore (Figure 10). The most commonly recorded category was miscellaneous plastic (*n* = 747) while the least commonly recorded category was balloons (*n* = 10).

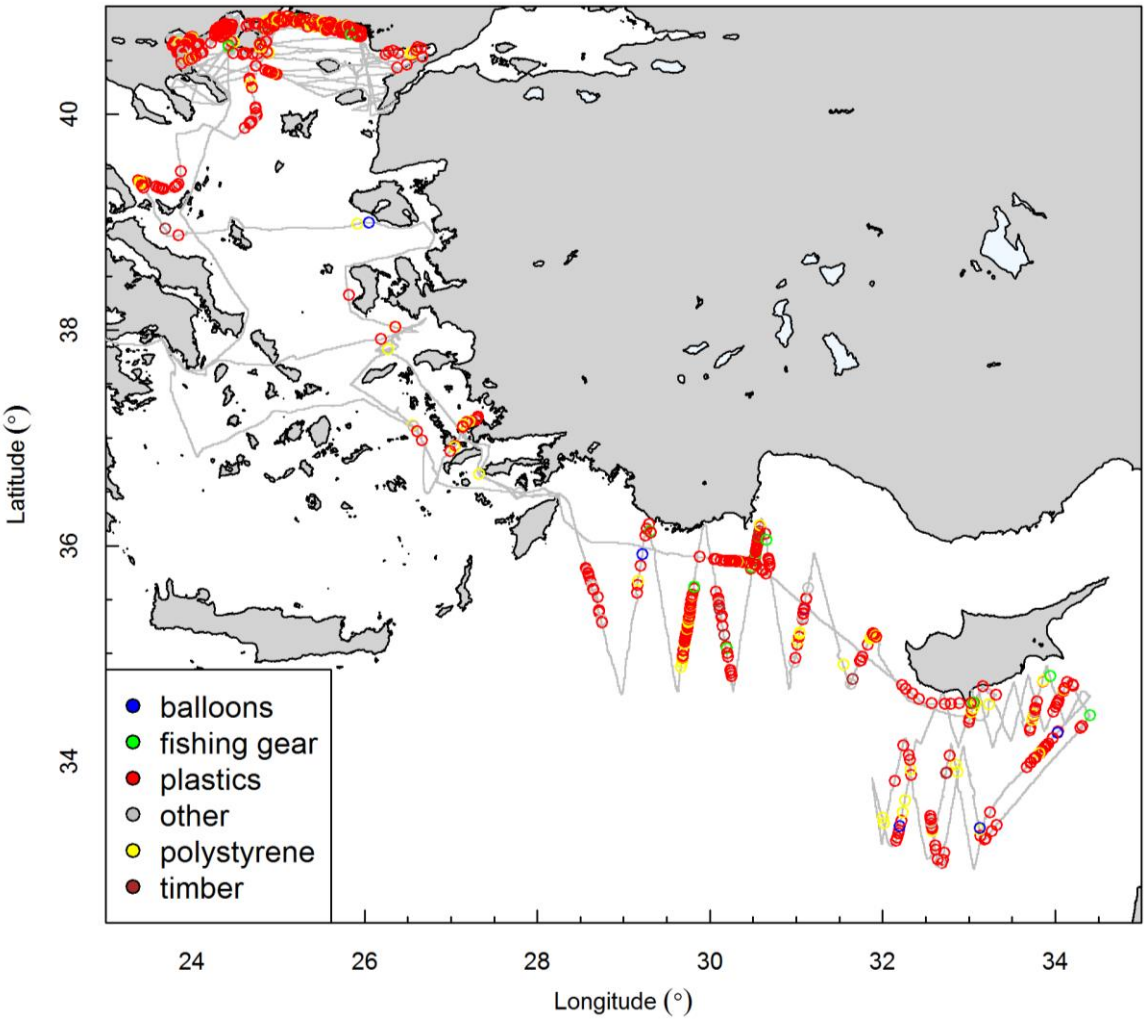

Figure 10. Sightings of floating debris observed during visual surveys (i.e. during daylight hours and when on visual effort). All plastic debris is shown in red. The track of SOTW is shown in grey. NB: Some areas were more intensively surveyed than others and the debris sightings presented here are not corrected for effort.

4. DISCUSSION

This report provides a preliminary overview of the data collected during the project; a more thorough analysis of all datasets will be carried out in due course. A detailed analysis of cetacean vocalisation data is currently underway. Ambient noise data are also being analysed in order to interpret the noise characteristics throughout the survey area with respect to cetacean densities and shipping lanes in the Aegean and eastern Mediterranean Seas. Estimates of density will be calculated for the Aegean and Levantine Seas in due course. The surveys demonstrate the feasibility of collecting important baseline data on environmental pollution (*e.g.* background noise and marine debris/rubbish) during cetacean surveys and we hope that this will encourage other researchers to

adopt this approach and collect potentially useful ancillary environmental data during future surveys.

The results presented herein include the first record of free-swimming porpoises seen in the northern Aegean Sea since 1993 and the first live porpoises ever documented in Turkish Aegean waters. Furthermore, preliminary analysis of acoustic data from the Aegean Sea surveys has confirmed several additional detections of harbour porpoises in two areas of the Greek Thracian Sea. These novel data on the presence and distribution of harbour porpoises in the Aegean Sea have important conservation and management implications. A more detailed analysis of the data from the survey is currently in preparation. Having confirmed the presence of live porpoises in the northern Aegean Sea, further dedicated systematic surveys would be very useful in order to better understand the status of harbour porpoises in the Aegean Sea (*i.e.* whether the species is resident or vagrant) and to shed light on the population affinity and seasonal presence.

A single monk seal sighting to the south of Cyprus is of significance given that very little is known about the offshore distribution of this critically endangered species in the Mediterranean Sea. It is most likely that this individual belongs to the Greece-Turkey sub-population (part of which whelps at sites along the south and north coasts of Cyprus), in which case this single record extends the current known range of this population (Coll *et al.* 2010, Gücü *et al.* 2004). The four Risso's dolphin sightings recorded during this survey are also noteworthy considering the Mediterranean sub-population of this species is categorized on the IUCN Red List as 'Data Deficient' (Taylor *et al.,* 2012). Similarly, the rough-toothed dolphin sightings presented here are of particular significance, as there is very little information available about the occurrence of this species in the Mediterranean Sea. For example, the rough-toothed dolphin is current not considered to be native of Cyprus according to the IUCN Red List (Taylor *et al.,* 2012). The status of this species in the Levantine Sea is currently being re-assessed, and the records presented here from 2013 contribute further valuable data to inform the on-going review of the range and status of rough-toothed dolphin in the Mediterranean Sea.

Further analysis of acoustic data may reveal additional detections, particularly of species such as beaked and harbour porpoise which can be difficult to identify in the field. The results from these analyses will be reported in detail in the final report.

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